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Yun Wen · Yi-ju Wu · Grace Qi · Siao-Cing Guo · J. Michael Spector · Shobhana Chelliah · Kinshuk · Yu-Ju Lan *Editors*

Expanding Global Horizons Through Technology Enhanced Language Learning

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Preface

We have known for a long time that technology is changing the way we live, work and learn, but nothing has made this understanding clearer than the global coronavirus pandemic in the past few months. We have never relied on Internet technology as much to connect one another. Despite unprecedented challenges, we are delighted that the 3rd Pan-Pacific Technology Enhance Language Learning (PPTELL 2020) & Critical Thinking Meeting can be held as scheduled online during the COVID-19 pandemic.

This year, the conference is jointly organized by the University of North Texas (UNT) and National Taiwan Normal University (NTNU). This is the first time that PPTELL is hosted outside of Asia. The conference theme is "Expanding Global Horizon through Technology Enhanced Language Learning and Critical Thinking". A total of 29 papers authored by scholars from six countries will be presented in PPTELL 2020. After a rigorous review process, 13 papers among the accepted submissions, with authors from Taiwan, the USA, Singapore, Turkey and China are selected and included in the proceeding. All the papers included were double-blind peer-reviewed by at least three reviewers from the 40 Program Committee Members from 13 countries. We want to thank all the Program Committee Members for their time and contribution to making the proceeding an important reference for future research on TELL and critical thinking.

The focus of the contributions in this proceeding is the important issues in learning/teaching language and critical thinking in the intelligent and digital era. Today's language learning and teaching is facing unprecedented opportunities and challenges; thus, mastering critical thinking skills is essential for solving real-world problems. The connection of the physical and digital worlds and the participatory culture of cross-disciplinary dialogues will lead to substantial development of technology-enhanced language learning and teaching and learning critical

thinking. We sincerely thank all the authors and speakers from diverse disciplines and backgrounds who contributed to the conference.

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Part I
Technology Enhanced Language Learning (TELL)

Chapter 1
Investigating Pupils' Cognitive Engagement in Augmented Reality-Supported Second Language Learning Classrooms

Yun Wen and Sin Yee Lau

Abstract Augmented Reality (AR) is one of the promising technologies that has been used in the educational field. It helps to increase learners' motivation, establish links with real-life experiences, and create contextual awareness. Yet current research in AR for education is still in its infancy and there are few studies regarding the integration of AR in language learning classroom. This study is part of an on-going pedagogical innovation project on AR-enhanced creating and sharing activities for pupils' Chinese character learning. The study concentrates on examining the effectiveness of the designed AR activities by focusing on students' cognitive engagement, in terms of the ICAP framework which helps to assess cognitive engagement with behavioural metric. A total of 53 grade two students from a government primary school in Singapore participated in this study. The findings of the study provide insights into designing and assessing AR-enabled activities in language classrooms.

Keywords Augmented reality · Chinese character learning · Cognitive engagement · Collaborative learning

1.1 Introduction

Chinese character learning is a major hurdle for Singapore local students whose first language is English, because Chinese, as a kind of logographic language, is distinctive from English and other alphabetic languages. In Chinese, distinguishable types of strokes combine in different ways to form components (some of them are radicals) that are the fundamental elements to construct characters. Memorizing those strokes and various components and how they make up every character is one of the major challenges of learning Chinese. School teachers and researchers in the field

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of teaching Chinese strive to find optimal ways to teach Chinese characters beyond rote memorizing.

Augmented reality (AR), as one kind of technologies that combine or supplement real-world objects with virtual objects, has been widely developed for education (Bacca, Baldiris, Fabregat, Graf, & Kinshuk, 2014; Cuendet, Bonnard, Do-Lenh, & Dillenbourg, 2013). The possibility of combining augmented information with contextual information may provide new experiences in language learning (Santos, Lübke, & Taketomi, 2016; Wen, 2018). Bacca et al. (2014) summarized in their review paper that research on AR has demonstrated its advantages for increasing students' motivation, learning gains, interaction and collaboration. Yet they also pointed out that current research in AR for education is still in its infancy, few AR systems have been developed into real classrooms, and a majority of studies examining the effectiveness of system or learning experience via users' perception data. Furthermore, the integration of the pedagogical design with AR in language learning is relatively less, compared within science or mathematics learning (Wen & Looi, 2019).

This study is part of an on-going pedagogical innovation project, augmented reality-enhanced creating and sharing, which employs AR applications ARIS and HP Reveal to investigate the effect of primary school students' radical-derived Chinese character learning in classrooms. The study concentrates on examining the effectiveness of the designed AR activities by focusing on students' cognitive engagement. Cognitive engagement refers to learners' cognitive involvement in learning activities (Fredricks, Blumenfeld, & Paris, 2004). It is usually positively correlated with students' academic performance (Wang, Wen, & Rose, 2016). Researchers in AR-supported mobile learning have been studying how these modes for learning aid students' engagement and understanding for decades (Squire & Klopfer, 2007). In this study, students' cognitive engagement is analysed in terms of the ICAP (Interactive, Constructive, Active or Passive) framework (Chi, 2009; Chi & Wylie, 2014), which helps to analyse cognitive engagement with behavioural metric. Focus group discussion of students and teacher interview data are used to triangulate observation data, unveiling the significant social interactions and contextual factors that represent students' engagement and verifying the proposed coding scheme. The study seeks to provide insights into designing and assessing AR-enabled activities in language classrooms to leverage its potential to motivate and engage students in second language learning.

1.2 Literature Review

1.2.1 AR-Enhanced Active Chinese Character Learning

Shen and Ke (2007) compared three types of encoding strategies used in character learning: rote memorization, student self-motivated elaboration, and teacher-guided elaboration. Their findings indicated that elaboration resulted in significantly better

retention for sound and meaning of characters than rote memorization. Between student self-motivated elaboration and teacher-guided elaboration, retention of sound and meaning was significantly better with teacher-guided elaboration in study intervals of 20 minutes, but this advantage disappeared at 48 hours recall interval. In a recent study, Shen and Xu (2015) further provided empirical evidence to support the effectiveness of active learning in classroom vocabulary learning for beginning-level Chinese L2 learners. In other words, student self-directed elaboration can be deemed as an effective approach to learning Chinese characters. Although we have to point out that, the subjects of their study are college students, the findings are consistent with the feedback that we obtained from Singapore local senior CL teachers.

Innovations in language education have been targeted towards ways of enhancing learners' structural understanding of the logographic system beyond rote learning and mechanical practice (Lam et al., 2001). Classroom pedagogy has gradually shifted from knowledge transmission to knowledge construction, Chinese character learning is no exception. Computers and the Internet have been put into use in assisting language learning, and their positive effect on developing vocabulary acquisition or Chinese character learning has been reported in a large number of studies (e.g. Lam et al., 2001; Spiri, 2008; Sung, 2014). In the context of Singapore, the effectiveness of collaborative Chinese character learning has also been elucidated in Wen's study (2018) on a Chinese character composition game with paper interfaces.

AR, as one kind of technologies that combine or supplement real-world objects with virtual objects, has been widely developed for education (Bacca et al., 2014; Cuendet et al., 2013). AR not only provides each individual with a new interactive approach to human and computer interaction but also integrates human–computer context interactions that may provide new experiences in language learning. Beyond content delivery, this study pays more attention to exploring how we can enhance the interactions between learners and the contextual information through pedagogical content design. The link between virtual information and authentic environments is emphasized in the design. As Klopfer and Squire (2008) pointed out in their early study, successful AR applications require learners to solve complex problems in which they have to use a combination of real collected evidence and virtual information. One mechanism for achieving this is to design context-aware applications on mobile devices. Meanwhile, the integration of pedagogical designs (such as collaborative problem solving) with AR can also help to create authentic learning contexts where participants need to solve problems or complete tasks together.

1.2.2 Cognitive Engagement

Cole and Chan (1994) defined students' engagement as "the extent of students' involvement and active participation in learning activities" (p. 259). Fredricks et al. (2004) identified three dimensions of students' engagement, namely behavioural engagement, emotional engagement, and cognitive engagement. Cognitive engagement is understood as the psychological investment in, effort to comprehend and

master challenging concepts, and the willingness to complete difficult tasks across domains, and in which self-regulated and other regulatory strategies of guiding one's cognitive efforts is emphasized (Fredricks et al., 2004; Kahu, 2013).

The ICAP framework was developed by Chi (2009) and Chi and Wylie (2014) to define cognitive engagement activities on the basis of students' overt behaviours. They proposed that learning activities and their resulting overt engagement behaviours can be differentiated into one of four modes: Interactive, Constructive, Active or Passive. In terms of the knowledge-changing process, interactive mode of engagement achieves the greatest level of learning, greater than the constructive mode, which is greater than the active mode, which in turn is greater than the passive mode. The framework has been used to analyse cognitive engagement in online environments via analysing online discourses automatically (e.g. Atapattu et al., 2019; Wang et al., 2016). Although the framework initially developed for face-to-face learning, there are few reported cases on exploring the factors on students' cognitive engagement in AR-supported learning environment based on the framework. ICAP in this study can be used to identify and examine effectiveness of a new learning environment, in which human-computer-context interactions are supposed to be integrated and augmented by AR techniques, and higher-level students' cognitive engagement may take place.

1.3 Methodology

The purpose of this study is to examine learner's cognitive engagement in the AR-supported collaborative Chinese character learning activities. The guiding research question is whether and how the AR-supported context-based language learning activities help to improve students' cognitive engagement, as well as how to assess students' cognitive engagement in the AR-supported language learning classroom.

1.3.1 Participants

This study involved a total of 53 (Grade 2, 8–9 years old) students from a government primary school in Singapore. The students were from 2 different classes taught by 2 Chinese language teachers (Teacher E for the AR experimental class and Teacher C for the non-AR control class). Both classes received an equivalent amount of invention time and participated in the similar activities, but the experimental class used AR applications ($N = 28$), and the control class did not ($N = 27$). Besides, both classes exhibited similar Chinese radical's knowledge (in terms of the pre-test before intervention) and so were Teacher E's and Teacher C's teaching experience. In each class, we randomly selected two groups (3–4 students) as target groups to capture their entire learning processes with video cameras and they were interviewed after the holistic intervention.

1.3.2 Activity Design

The school-based intervention spanned for three months, from August 2019 to October 2019. The content of the study followed the school syllabus and ran parallel with the school curriculum. In addition to the technical trainings for the teachers and students, three iterative lessons were designed and implemented in the experimental and control classes, respectively. Each lesson lasted for 60 mins. In both classes, every group was provided an iPad to carry out the group activities. The intervention procedure in the two classes is illustrated in Fig. 1.1. A total of three rounds of intervention was conducted.

Every single intervention lesson in both classes began with the instruction provided by the teachers. After that, in the activity of ***acquisition***, the students of the experimental class completed group tasks based on ARIS. ARIS (n.d.) is a mobile application builder which targets educators looking to develop AR education game (Field Day, 2020). In the ARIS system, all AR features are powered by Vuforia engine, by which developer can easily add advanced computer vision functionality of image recognition, and in this way it allows users to interact with spaces in the real world. In our study, this function was used to recognize radical cards we designed for students in terms of their curriculum. Using the AR feature in ARIS, students scanned the physical radical cards with their device's camera to trigger an animation (Fig. 1.2a). Students were then asked to answer questions regarding the Chinese radical they selected. In each lesson, the students of the experimental class completed the game in groups to master 15–18 target radicals at their own pace. In contrast, the students of the control class were led by their teacher to learn the same target radicals by using the same pictures and animations (Fig. 1.2b). Teacher C also asked the same questions about the Chinese radicals and her students answered them by rising their arm or speaking out.

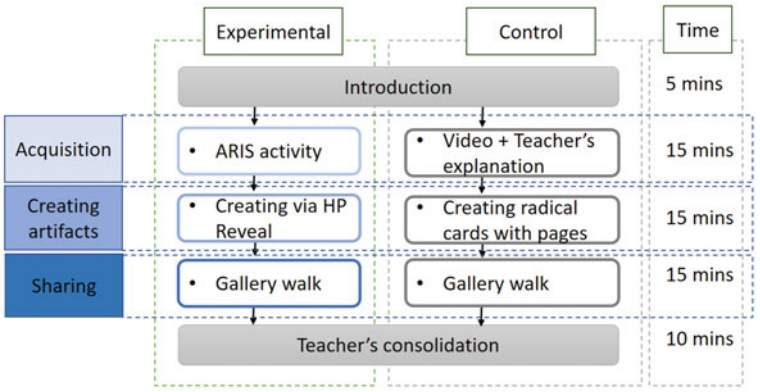

Fig. 1.1 Activity processes of the experimental and control classes

a. ARIS with AR feature to trigger a Chinese radical animation

b. Teacher C using PowerPoint slides to present Chinese radical animations

Fig. 1.2 Learning scenarios in the activity of acquisition

After completion of the first activity, students proceeded to the second activity—***creating artefacts***, in which they generated their own AR artefacts using HP Reveal. The procedure as follows: (1) completing the AR paper to illustrate the semantics of the radicals; (2) uploading AR papers to HP Reveal by taking a photo through the application; (3) filming a video of themselves reciting a sentence they constructed using the phrase they formed using the targeted Chinese radical while acting out the constructed sentence; and lastly (4) uploading the recording to superimpose it on the virtual AR paper which was uploaded earlier. Different from the experimental class, the control class was not able to superimpose their video recording to a physical paper. Students completed the same tasks using Apple Pages.

At the stage of **sharing**, students from both experimental and control classes did a gallery walk to view other groups' artefacts (Fig. 1.3). The sharing activity consisted of 2 segments, student-led and teacher-led session. During student-led segment, a student from each group stayed behind with their artefacts while the rest of the

a. Demonstrating artefacts via HP Reveal in the experimental class

b. Watching video recordings from Apple Pages in the control class

Fig. 1.3 Sharing group artefacts in the experimental and control classes

members went around the class to look at the other artefacts created by the rest of the class. The duty of the member who stayed behind with the artefacts was to introduce their artefacts to the visiting classmates and answer their enquiries. The rest of the members were to learn and comment about the artefacts made by the others.

1.3.3 Data Sources and Analyses

This study aimed at investigating whether students could be cognitively engaged better in AR-supported language learning activities, and what strategies could enhance their cognitive engagement. We focused on analysing their learning processes in the last lesson in which the teachers and students have been familiar with the learning design. The main data sources included:

1. the two target groups' learning processes in each class;
2. focus group discussion with the target group students;
3. post-interview data from the teachers.

For both the experimental and control classes, two video cameras were set up to record the two target groups, by which face-to-face interactions among peers and their interactions with the apps were recorded. Additionally, their discourse and iPad related actions were recorded by iPad's screen recording. We analysed and assessed students' cognitive engagement levels in terms of Chi's ICAP framework. For the sake of consistency, two authors watched and transcribed all the video data and identified behavioural indicators according to ICAP, as shown in Table 1.1, the coding scheme was designed to capture the cognitive engagement of the three main activities: (1) acquisition of Chinese radical's knowledge; (2) creation of students self-generated AR-artefacts and (3) sharing of students self-generated AR-artefacts. As tangible interfaces were used in the study, the coding scheme took into account of 2 different modes of overt behaviours: communicative discourse and action-based learning behaviour. Next, the transcribed data was segmented into units of "theme". In this study, one theme referred to one radical-related activity. Finally, the learning process data was coded according to the coding scheme. The coding scheme was developed through an interactive process of creating codes, coding, modifying and refining codes, and recording consistent with Miles and Huberman's (1994) recommendations for rigorous and meaningful qualitative data analysis.

The focus group discussion and teacher's post-interview were conducted to address how the participants perceived the learning and teaching experience using AR tools and without using AR tools. To make sure the reliability of the data analysis, during the entire coding process, two researchers examined the data, completed the coding independently, and then collaborated and built a consensus on their coding.

Table 1.1 Coding scheme for assessing cognitive engagement

Level	Modes	Type of activities		
		Acquisition	Marking artefacts	Sharing
I	Hands-on Discourse	Discuss the similarities or differences of the radicals. Debate with teacher or peer about their comment/statement about the semantic or form of the radical Ask and answer comprehension questions relating to Chinese language	Two or more group members having constructive discussion on what Chinese radical, character and phrases to be written and what kind of drawing to represent the writings on the AR paper or how they should film, what to do and say during the video recording to best portray the phrase (co-constructing) Both parties must make transactive contributions. Student A talks about his/her ideas and Students B/C question or build on Student A's comments to come out with better ideas	Both the owner and visitors are involved in constructive discussion on how to improve the language aspect of the artefacts Both parties made transactive contributions. Student A talks about his/her ideas and Students B/C question or build on Student A's comments to come out with better language usage or better presentation of artefacts
C	Hands-on Discourse	Read the question and interpret the question. Explain a radical to a peer who gave a substantive comment Explain concepts in the video, compare or contrast to prior knowledge or other materials	Represent an idea either from his/her teacher or peer in their own words without challenging the idea, such as coming out from a drawing based on his/her peer's explanation, or drawing something different from the radical cards on the AR paper During a dyads conservation, Students B gives substantive comments on Student A's ideas, or corrects grammar errors, either implicitly or explicitly	Compare artefact artefacts to build on how they depict the given radical During a dyads conservation, Students B gives substantive comments on Student A's ideas, or corrects grammar errors, either implicitly or explicitly
A	Hands-on	Pause, stop or repeat video; select an answer from a menu of choices Control: Raise up hands to response to teacher's question, but without explanation	Replicate a presented idea without providing new knowledge, including writing a phrase or drawing as instructed, or copying picture from textbook or radical cards	Mimic the action shown and repeat what is said in the recording
	Discourse	Repeat a statement or take verbatim notes without providing any new inferences or describing a scenario	Repeating a statement, taking verbatim notes that do not provide any new inferences, describing a scenario	Ask about the language aspect of the artefacts but did not contribute any thoughts thereafter
P	Hands-on Discourse	Take no overt actions other than attending, like touching the iPad or cards or listening to teacher	Take no overt actions other than attending, like touching the iPad or cards	Watch and laugh without comments

1.4 Findings

1.4.1 Learning Process

The learning activity of acquisition was further segmented into units of the individual Chinese radicals' acquisition. The experimental class had 6 units and the control class had 18 units. The difference in the number of units was due to the design of the learning activities. For the experimental students, they were assigned with 6 radicals to work with right at the start of the class. On the other hand, control students attended to a more traditional class where their teacher used PowerPoint slides to introduce all the radicals, total up to 18 radicals (Fig. 1.4).

In this stage of activity, both focus groups from the experimental class managed to participate actively, with 83% at the active level and 17% at the constructive level in total. In the designed AR activity, students were required to search and scan for the corresponding radical card before they were allowed to move on. This design germinated students' active participation. The actions of searching and scanning made learning more active as the students needed to be consciously seeking their knowledge to make sense between the cards in their deck and the questions. The weaker students who might not know the answer to the question would also benefit from the process. It was observed that the stronger asked the weaker to search and scan the correct cards, and as a result, the weaker would learn from the process. While the experimental groups were able to engage in active learning, the control groups had a higher percentage of higher levels of active learning experiences. They were 8% at the interactive level, 64% at the constructive level and 22% at the active level in total.

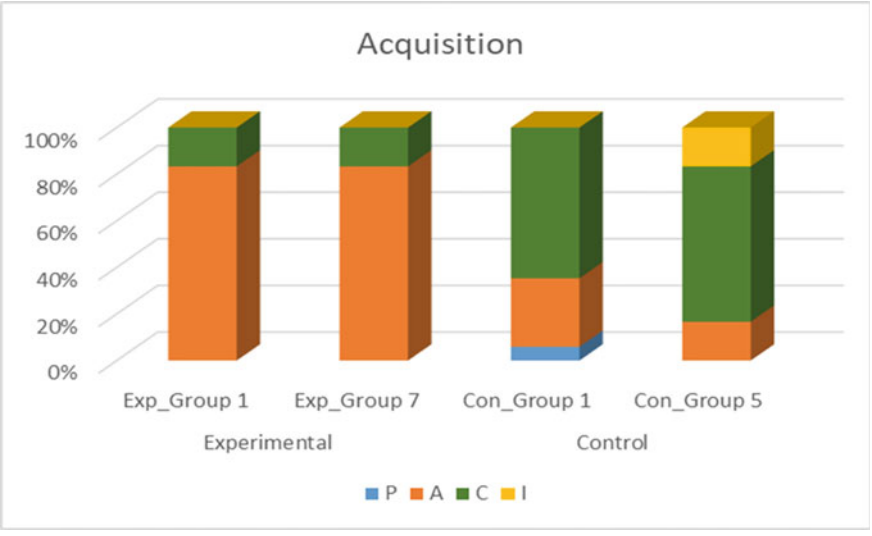

Fig. 1.4 Comparison of cognitive engagement in acquisition

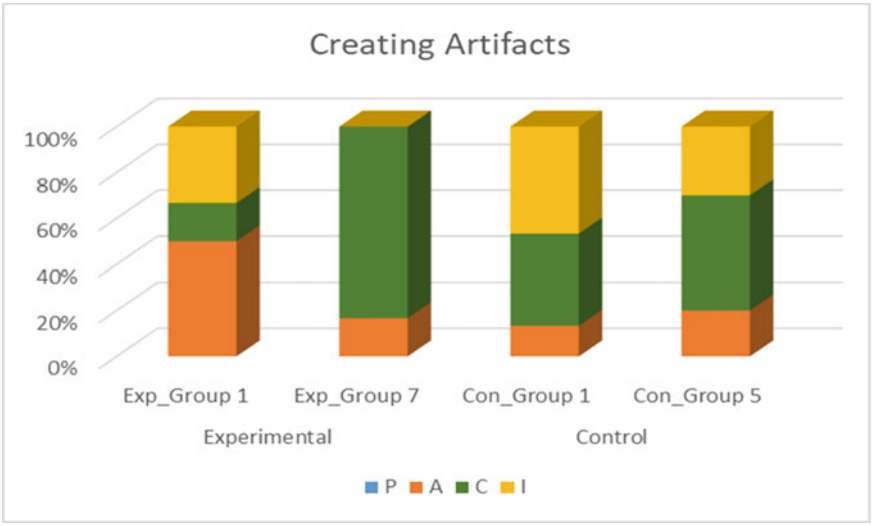

Fig. 1.5 Comparison of cognitive engagement in making artefacts

That was because Teacher C had good questioning skills. She kept asking students questions and her students were very delighted to share their thoughts (Fig. 1.5).

In the learning activity of making artefacts, the unit of analysis was the episode of making every single artefact. The experimental groups produced 6 artefacts each, but Teacher C emphasized on creating as many as artefacts as the students could, that resulted to more artefacts generated in the control groups (15 artefacts in Group 1 and 10 artefacts in Group 5). In the activity, as all the groups had created their own artefacts, passive learning did not exist. Active learning process included writing a phrase as instructed, replicating drawings from other materials such as the textbook or the radical cards, without making any new inferences and providing new knowledge. At the constructive level, students presented their ideas with their depictions; provided substantive comments and corrected language error or any other non-technical errors. At the interactive level, students co-constructed the group artefacts. They built on or corrected the other party's ideas to increase the quality of the artefacts or language use.

Both focus groups from the experimental class managed to participate more actively in this activity compared to the activity of acquisition. As students were required to illustrate their thinking into drawings, they were observed working as a group to generate their group artefacts. Nevertheless, the level of engagement varied among groups. Moreover, the control groups had a higher percentage of superior active learning experiences with 40% at the interactive level and 44% at the constructive level. This might be because making an AR-related artefact was more time-consuming, students in the experimental class were rushing to finish the assigned tasks. Though they were mind-engaged beyond hand-engaged, but not in depth. Another reason might be that the original collaborative learning culture of the

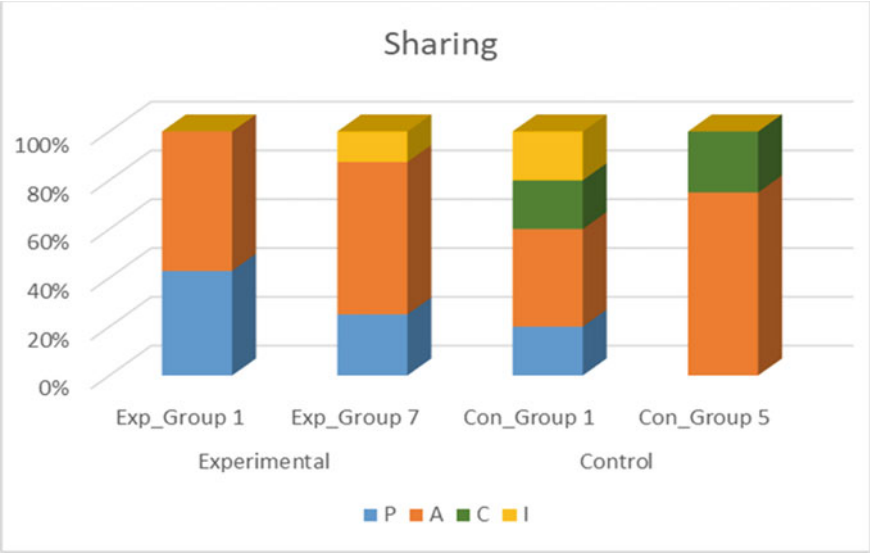

Fig. 1.6 Comparison of cognitive engagement in sharing

control class was better than that of the experimental class that was evidenced in the students' focus group discussion (Fig. 1.6).

Students in both classes were not as interactive and constructive in the activity of sharing as they were in the previous two activities. Most of the students needed reminders and scaffoldings to help them structure their thinking and views about the others' artefacts. If left alone, students from both classes would merely laugh while viewing the artefacts without commenting about it. Teacher C was observed to prompt her students constantly to make comments by suggesting some questions they could ask. While Teacher E did remind her students to engage with one and other, but she did not provide examples or any scaffoldings for her students due to the time constraint.

1.4.2 Students' and Teachers' Perceptions

In the focus group discussion, students from both classes said that they enjoyed the activities and learning Chinese language in this approach and wished to continue playing with the activities. Students from both classes mentioned they enjoyed the creating and sharing session and wished that they could spend more time on doing the activities, in which they had the freedom to select the topic they would like to work on, and they were less afraid of making mistakes. Teacher E commented that the advantage of AR was the ability for students to self-direct their learning. In her years of practices, she believed that language learning and teaching should

be flexible, students should be allowed to make mistakes and then they learn from their mistakes. This self-directed learning approach would benefit second language learners as it could prevent them from feeling dreadful from teacher's instruction and the different activities could grab their attention. Teacher E also mentioned that learning in such condition reduced the burden of learning. In the opinion of Teacher E, the addition of AR technology in her class minimized stress and spark interest to the learning activities, therefore, increasing their concentration on the activities.

Nevertheless, students from both classes mentioned that the activities were too easy, and it should be more challenging or there should be more variety of Chinese character or radicals to learn. Students from the experimental class, however, expressed that they were only able to perform up to their expectation in the last lesson as they got more familiar with the AR system. They stated that they were not sure what they were required to do and how to operate the system itself at the beginning stage. On the other hand, students from the control class did not think it was hard to get used to the Apple Pages but agreed that they performed better over time. In other words, the complexity of operating AR may have posed a challenge to the students resulting in cognitive overloading. Teacher E mentioned that the workload was slightly too heavy for students to handle, and the procedure of creating an AR artefact was too complex for students with limited relevant experience.

While being asked about their experiences about collaborative learning, all students from the experimental class expressed that they had learnt to work with their group members. A student mentioned that she could get help from her group-mates when she was clueless about how to continue the game. Although everyone agreed that they learned to work with each other, one boy from the experimental class said that he would rather complete the activities alone as he would be able to complete the activities faster and do more artefacts. Students from the control class said they often worked in groups, not just in Chinese classes, while students from the experimental class said they were less exposed to group work. Both Teacher E and Teacher C agreed that their students interacted with each other more during the intervention, especially for the quieter students. Although the less active students appeared to be more engaged during the intervention, Teacher C observed that, in her class, those students with low language proficiency had fewer opportunities to approach to screens than those with higher language proficiency. This was not the case for the experimental class, in which students not handling iPads could interact with the radical cards and used the cards to get themselves involved by talking about the cards or waving at the iPad.

There was an inconsistency in feedback regarding the need of the physical cards. One of the students in the experimental class claimed that she preferred completing the activities digitally as having to scan the cards were a hassle. Interestingly, her group's members stated otherwise. This could be explained through the video recording that the girl who claimed that the cards were a hassle was the leader of the group and was seen using the iPad most of the time while the rest of the group members were not able to use it. This demonstrated the need of having physical items to keep all members occupied and involved in the activities especially when young learners like them were still building up their awareness of collaborative learning.

Furthermore, the novelty of the animation-triggering cards kept the students curious and they named them the "magical card".

With regard to the usefulness of the radical-related animation, students from the control class enjoyed watching the Chinese radical animation while students from the experimental class admitted that they skipped the animation as they could not relate it to tasks by themselves. During the instruction, teacher C from the control class constantly drew a connection between the animations and the real life or the contents students had previously learned in class. On the other hand, students from the experimental class were given the animation without anyone elaborating on them. While we expected that self-initiated discussion would take place among group members triggered by the animations, it did not occur. In the post-interview, Teacher E suggested that the AR system should get the students to echo after watching the animation.

1.5 Discussion and Conclusion

This study proposed a learning activity design approach to improving language learners' engagement in Chinese character learning. The results indicated that not only students from the AR-supported class but also those from the non-AR-supported class were actively engaged in the designed learning activities. Although the performance of the experimental class was not superior to that of the control class, the analyses of students' cognitive engagement during the learning process can provide insights into designing and enacting AR-enabled activities in language classrooms.

It was found that asking students to generate their own artefacts could prompt students to be more engaged in the learning process. The use of augmented paper helped to engage every group member. Yet the balance between providing students opportunities to create their own artefacts and minimizing being overloaded by new technology should be considered by designers. It was also found that the level of engagement varied among groups, and teachers played an essential role in triggering higher level interactions in second language learning (Wen, 2019). In the AR system design, embedding dashboard might help teachers to provide comments or assistance for individuals and groups (Hellermann, Thorneb, & Fodorb, 2017). Teacher's explanation and elaboration on the goals of the activities and the connection between the learning content and what students have learned from the textbook or experienced in real life were important.

There were some limitations in this study. First, the study was only conducted in two classes and two teachers were facilitating the activities. Future work could expand the participants from other schools. Second, the learning process data were only collected from two target groups in each class, and from one lesson. Examining the effectiveness of learning design with long-term intervention could be considered in future studies. Third, in addition to cognitive engagement, other dimensions of students' engagement, such as behavioural engagement or emotional engagement could be considered to investigate students' engagement in AR-supported

learning environments. Despite the limitations, the findings of this study contribute to designing and enacting AR-enabled activities in language classrooms and proposing a coding scheme for assessing students' cognitive engagement.

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Chapter 2
A Glimpse of Pedagogical Impacts of Social Media: Mirror, Mirror on the Wall, Who Is the Fairest of Them All?

Hsing-Chin Lee

Abstract Etiquette Education and the use of social media for communication are key elements for learning, especially when the modern networking so prevail. The pedagogical purpose of this paper is to report on an investigation of user's behaviors on Instagram. Answers were sought to questions such as: Do users use Instagram? What genres do they browse? Are there any inappropriate posts seen on the Instagram? What solutions do users know to resolve the inappropriate posts on the Instagram? And finally, how teachers can be involved in scaffolding or facilitating etiquette development? The study demonstrates how etiquette is 'behaved' in social media such as Instrgram.com. Given the fact that it seems politeness and behavior development has been missing in a digital age, what might be the best possible way of integrating etiquette education in the college English curriculum? The study discriminates among 512 comments and remarks from various ranges of users. Issues relating to awareness of bad conduct on social media platforms and whether social media users filter what they follow, and FOMO (as The Fear Of Missing Out) are tackled. How the phenomenon of comparison is the thief of joy in social media? How leaving nasty comments while hiding behind a screen and an anonymous username appears to be the commonest practice in using social media? How body image concerns the viewers? And how social media takes a toll on society? It is suggested that Etiquette teaching needs to be extended into the standardized English curriculum at university level.

Keywords Social media · Pedagogical · FOMO · Instagram · Etiquette

2.1 Introduction

In a fast-information-processed society, social media is a medium for people to communicate with each other. It is also a daily pastime for young people. Instagram,

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Facebook, and Line are some of the most commonly used social networking platforms in Taiwan. Among them, Instagram appeals to young people the most. Not only is the page clean and tidy, it also adds many features, creates a lot of fun, and enriches types of preference and enlarges everybody's circles of friends. Due to the popularity of the smart phone, a large number of people began to find business opportunities online, especially from the social media, which connects dots of human resource. The rise of social media in recent years has changed the way people live (Darwish, 2017). People can learn, make friends, and get information through social media. One of the most popular social media among young people is Instagram. Young people share their lives with friends through social media to maintain relationships with their peers.

Social media has bridged people together with sharing of feelings and life stories instantly. People can do almost everything they wish. They send beautiful photos to achieve pleasing effects. They probe other people's lives and they access information online. For Instagram users, it is a way of life and they are looking forward to new features developed in the future and we adults are hoping that social media plays a more positive part in the modern life.

The study is conducted to explore the behavioral differences in using Instagram (hereafter IG) between college students (18–22 years old) and the middle-aged users (40–65 years old). IG, the most popular social media platform, has 1 billion users worldwide. In Taiwan, the number of IG users has reached 7.4 million monthly, which accounts for nearly one-third of Taiwan's population. This study used a questionnaire to quantify the responses related to (1) IG addiction, (2) user behavior (type of browsing Posts, use of Finsta, Story), and (3) user acceptance and thoughts of related privacy issues. Moreover, the researchers found that further study is needed to pin down more IG user behavior to better encourage positive applications of social media.

The pedagogical purpose of this paper is to report on an investigation of user's behaviors on Instagram. It is hoped that through this study, one can explore the differences between college students and the middle-aged users using Instagram, the posts they like to read, the frequency of use, and the actions they make when they see indecent posts. What constitutes the differences between the degree of attraction to Instagram among college students and the middle-aged users? Do young college students and the middle-aged users use Instagram differently? How do privacy concerns of using Instagram differ between these two groups? This study has not tackled issues such as what exactly addiction entails.

2.2 Social Media as a Way of Life

The study demonstrates how etiquette is 'behaved' in social media such as Instrgram.com. Is Instagram a Pandora's box? Could it be true that in modern times, a Pandora's box has grown from it meaning 'any source of great and unexpected troubles,' or alternatively 'a present which seems valuable but which in reality is a curse' whether we like it or not. The study discriminates among 514 comments from

various youngsters who were in response to the questionnaire. Such issues relating to awareness of bad conduct on social media platforms, whether social media users filter what they follow, and FOMO (as The Fear Of Missing Out) are tackled. Is the phenomenon of comparison the thief of joy in social media? How users often lose personal joy when using social media when they compare themselves to others? How leaving nasty comments while hiding behind a screen and an anonymous username is common practice when using social media? How body image concerns the viewers? And how social media takes a toll on society? It also advocates the need of developing students' sense of beauty in handling the social phenomenon of imperfection in daily life, such as road rage, lack of compassion, common complaints over trivial affairs and daily misconducts. The questionnaire questions might be able to explain the reasons why etiquette teaching needs to be extended into the standardized English curriculum at university level. Language, culture and etiquette are three inseparables. Through arousing a sense of globalization in social media etiquette, the study might boast its positive impact on developing students' inner score toward reflecting themselves on social media.

Discussions over the beautiful, seemingly harmless photos of Instagram models are on dinner tables and affect people's attitude toward body image. If this is not enough, it is also fair to say that friends on holiday induces FOMO on their friends who see the posts.

According to the World Digital Magazine's 2015 Digital Life Survey, among many social media, Instagram is probably the most powerful digital tool with social, documenting, and photo editing functions. Instagram is a photo sharing platform that allows users to take photos and use some special effects to modify the photos before sharing these photos with friends. On a personal conversation, the students from Zhongshan Girls' High School in 2019 pointed out that the time-limited 'Story' function of Instagram has become a favorite feature for the teens because it is not only innovative but also refreshing (Kasteler, 2010). Compared to Posts, it comes as no surprise that people prefer instant 'post and view' activities because users can quickly upload photos or videos that are taken, and they are automatically deleted 24 hours later without leaving any trace. This is useful for sharing life but not wanting the photos to be forever displayed on other people's pages, and it is a good feature not to cause more troubles than necessary for others. In addition, users can also use the built-in and punch-in function to record real-time feelings or events and the two particular functions appeal to many people.

Instagram seems to be inseparable from young people's lives (Wang, 2018). Young people use it almost every day because of its attention-grabbing and practical features. It is almost impossible for them not to take a glimpse of what is happening on Instagram every few minutes. However, Instagram users may overlook the legal issues which are involved in inappropriate use of Instagram. The study sought to analyze why so many people use Instagram, and explain why Instagram has become popular all over the world and still boomingly charmed its users. As mentioned earlier, many people are already in the habit of using Instagram, still, there are a small number of people who do not know about this image-based networking site.

Social media is attractive because it combines features that cater for the social needs. It gradually changed the degree of dependence on social networking. It has become an integral facet and it is ubiquitous in many groups (although maybe not everywhere with everyone) in this modern world. Everyone has different motivations of using different social media for different purposes such as motivations of dependency and self-disclosure. Due to the technological innovation of humanity, social networking sites are no longer just online platforms for connecting people. It is now worth conducting various studies related to the self-esteem and well-being of users. The viewing behavior and what contents people are browsing on Instagram are discussed.

In recent years, social networking sites have developed rapidly, and privacy issues on social networking sites have become increasingly tricky. Issues from information security to personal privacy have gradually attracted attention, and discussions often go viral (Whiting & Williams, 2013).

2.3 Methodology

A survey of user behavior among college students (18–22 years old) and the middle-aged users (40–65 years old) is needed to investigate their different degrees of dependence on Instagram. The methodology employed in this research incorporates 514 subjects and a questionnaire (see Appendix 1). Based on the research purpose and related literature, a questionnaire is designed for this study to determine different levels of user awareness and to investigate behavior of Instagram users. College students and the middle-aged users answered the questionnaire questions on aspects of Instagram dependence, user behavior and privacy in order to understand the impact of social media on current users. This quantitative research aims to address the above-mentioned questions.

2.3.1 Scope of the Research and the Subjects

When making the statistical analysis, the questionnaires of two middle-aged subjects were excluded, as it was found that they did not complete all the survey questions. One of them filled the questionnaire questions in random. The other remarked that she didn't understand how IG should become a new networking social norm and thought the effort of spending the time doing the questionnaire went down the drain.

The purpose of this study is to understand the use of Instagram among college students and middle-aged people. We collected the respondents from the subjects of two ranges of age groups: 18–22 and 40–65 years old. The reason for choosing middle-aged people of 40–65 is to understand how people of similar age to parents of aged 18–22 students learn about Instagram, and their Instagram viewing behavior. Instagram is very popular among college students, yet, how do parents learn about

this rather trendy social media, which might seem nothing like what they have experienced before. This study includes a pilot and an official questionnaire. The pilot version collected 308 valid questionnaires, and the later 512.

2.3.2 Questionnaire Design

The structure of the questionnaire design consists of 15 questions such as the age of the respondents including some basic information, their tentative habits of using social media. In addition, it is composed of questions in relation to user dependence on Instagram, such as the duration of time spent on Instagram. The second part includes a series of questions set to understand the behavior of Instagram users. The questions relate to some novel Instagram features, such as fake accounts (small accounts) and time-limited 'Story'. And the last part of the questionnaire concerns privacy issues related to Instagram. Two questionnaires were made. The first questionnaire was used/applied in a pilot study. However, after collecting the questionnaires from the interviewees, it is found that the information collected was not sufficient. Some questions were left unasked. It didn't employ enough data for measuring. The second questionnaire (Appendix 1) was modified accordingly with necessary questions for this study.

2.4 Results and Discussion

512 samples are valid and collected from the respondents of both college students aged 18–22 and middle-aged people of 40–65.

2.4.1 Questionnaire Results and Analysis

According to the survey, the top three most popular social media used by respondents were Instagram (98.2%), Line (97.7%), and Facebook (97.1%). Other popular social networking sites Include Twitter (64.1%), Messenger (36.5%), and Weibo (50%). Since 98.8% of the respondents using Instagram, there are only 1.2% of the respondents who do not use Instagram.

The questionnaire questions investigated the time and frequency of users using Instagram. The results indicate that college students usually spend 1–2 h per day on Instagram, while middle-aged people tend to spend much less on Instagram per day. In addition, middle-aged college students only use Instagram once a day because they are busy with work and Instagram has not been a familiar social interacting platform; on the other hand, college students use Instagram more frequently throughout the

day. To be more exact, 28.1% of respondents use Instagram every 1–2 h during the day (Figs. 2.1, 2.2).

The survey results also suggest that users are dependent on social media, and college students are more addicted to Instagram. The two main reasons for college students to use Instagram frequently are fear of missing out messages (FOMO) and

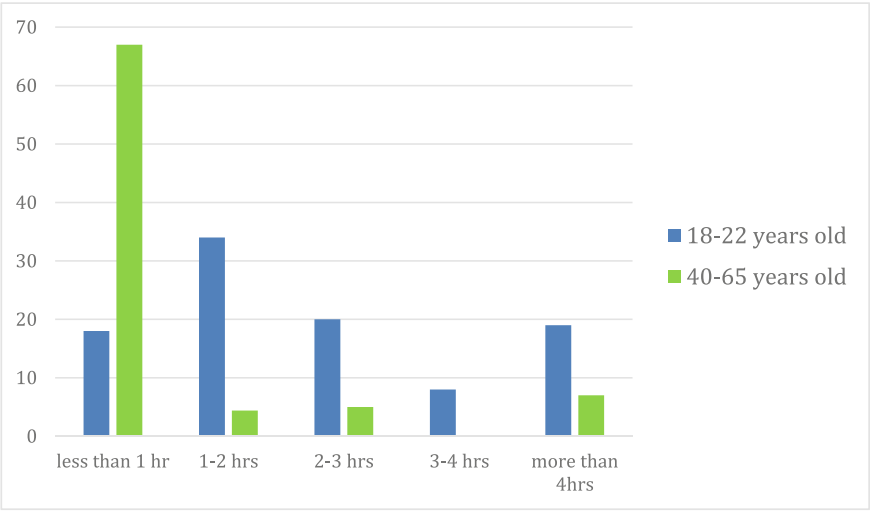

Fig. 2.1 Top Three Most Popular Social Media

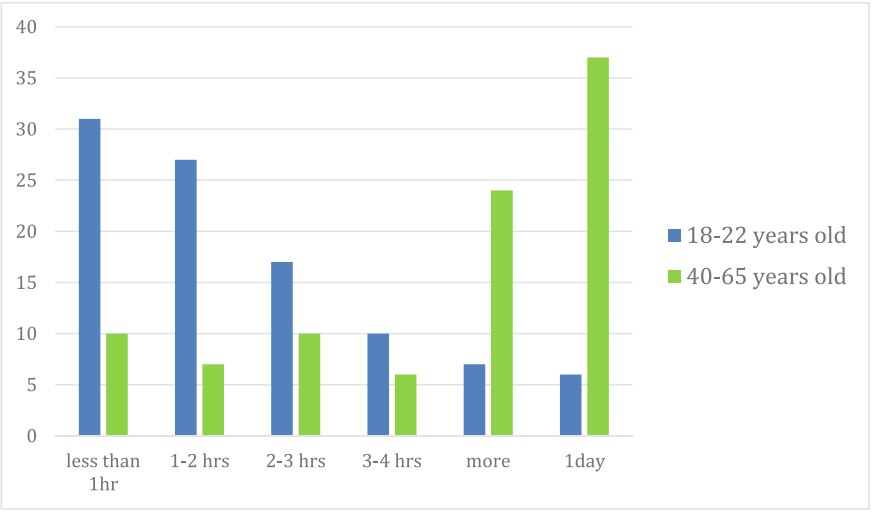

Fig. 2.2 Time and Frequency of Users Using Instagram

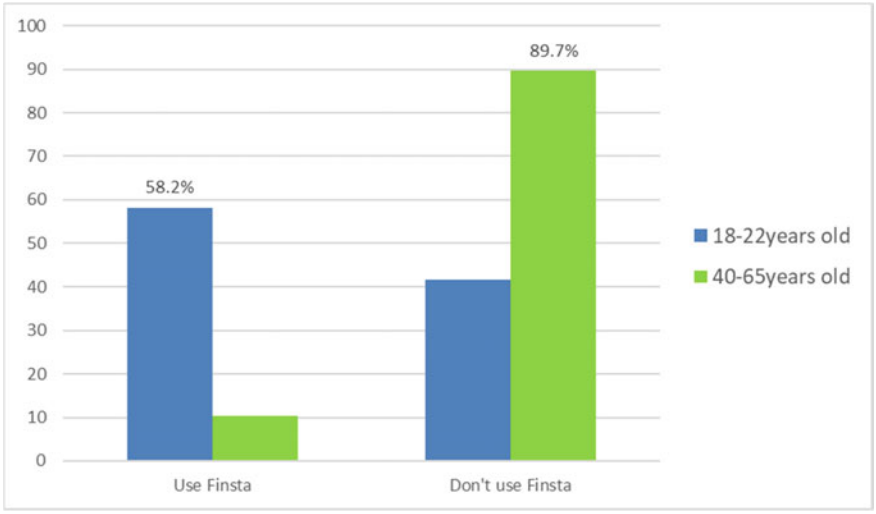

Fig. 2.3 Users' Preferences and Behaviors: Finsta Or Not

killing time. It might be fair to say that fear of missing out messages (FOMO) may be a potential sign of social media addiction.

The second part of the questionnaire surveyed users' preferences and behaviors. 58.2% of college students used Finsta, and 89.7% of middle-aged people did not. The purpose of using Finsta among college students is usually to share information about daily life with their best friends, to post nonsense and to keep records, or simply to track down things simultaneously like there are no other better things to do (Fig. 2.3).

Moreover, the respondents were asked to choose their preferences from different types of posts. The results show that 56.7% of college students browse celebrities and idols, while 75.9% of middle-aged people prefer travel posts. Interestingly, both groups frequently browse food posts (54.8 and 69%, respectively).

In addition to the original post function, IG also adds the function of time-limited 'Story', which is generally loved by young people. A survey on this was necessarily conducted. According to the results of the questionnaire, 87.4% of college students prefer to post time-limited 'Story'; 72.4% prefer Post. College students are pursuing feelings of speed and convenience, so the time-limited 'Story' function is more desirable among young people; middle-aged people, however, prefer Post, because they are more cautious of what they display (Fig. 2.4). According to the questionnaire results, 37.7% of the people published 1–4 time-limited 'Story' updates per day, while those who only published 1 time-limited 'Story' update in 2–3 days also accounted for the second biggest majority (23.9%). As this is very interesting, Instagram users are made to be perfect research subjects for understanding their intentions and behaviors.

Moreover, the responses show that 21.5% of college students post a post every 2–3 months, while 27.6% of middle-aged people post once every year. It is not surprising that most middle-aged people are digital immigrants and to them, computing skills

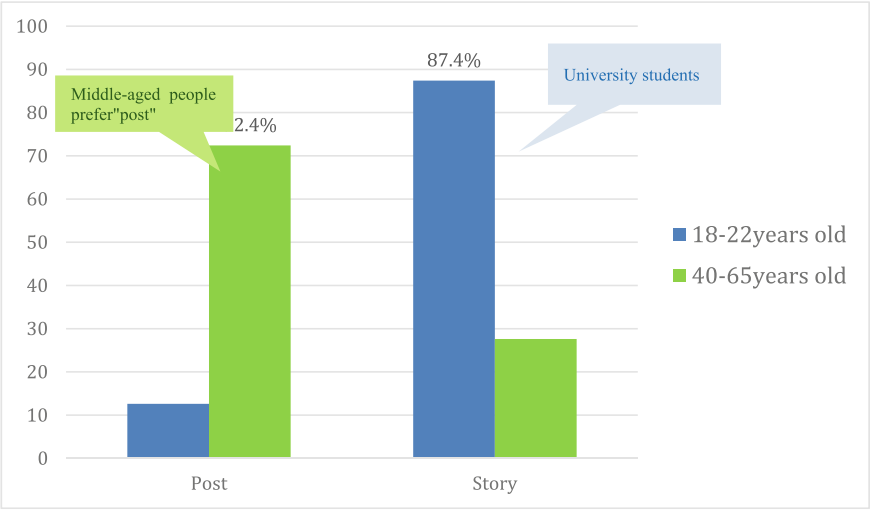

Fig. 2.4 Users' Preferences and Behaviors: Post and Story

are not their strong suit let alone the cutting edge 'flip-flap' techniques of 'editing, deleting, posting, storying' which fascinating the majority of the young people. As digital natives, college students publish time-limited 'Story' at least every three days while middle-aged people have zero 'access' to Story. Obviously, having the skill of posting Story requires even more computing skills. This shows that college students use time-limited 'Story' much more often than middle-aged people. We changed the frequency of publishing 'Story' updates to three days because not everyone updates and publishes time-limited 'Story' every day (Figs. 2.5, 2.6).

Question 11 asks 'What posts do you think are uncomfortable?' and the respondents were asked to rank the degree of discomfort for different types of subject-matter post. 78.1% of the respondents view Bloody and Violent posts, 74.3% view Verbal Abuse, and 61% view Forced Merchandising. When college students saw disliked posts, 39.8% of them chose not to care, 28.6% of them chose to report and block, 20.3% of them chose to report, and 7.6% chose to block.

As to the third part, 28.5% of the respondents set the account number to public; 71.5% of the respondents set it to private. The reason for making it disclosed is to keep away from being followed by the strangers and those who might violate your privacy. The former accounts for 37.5% and the latter accounts for 28.3%. On the other hand, the reason for making it public is to increase the number of followers, which accounts for 3.4%. However, 29.1% of the respondents don't think it matters (Figs. 2.7, 2.8).

Like Instagram, Facebook collects a lot of data about its users. Both of them collect information in relation to what you have been doing on their platforms, the third-party websites and applications which show your favorite ads. Of course, the

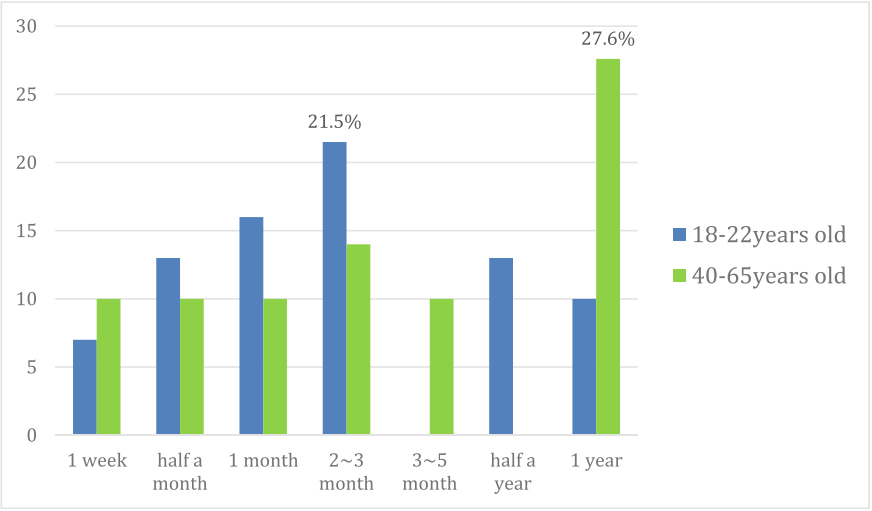

Fig. 2.5 Frequency of time-limited "Story" Update

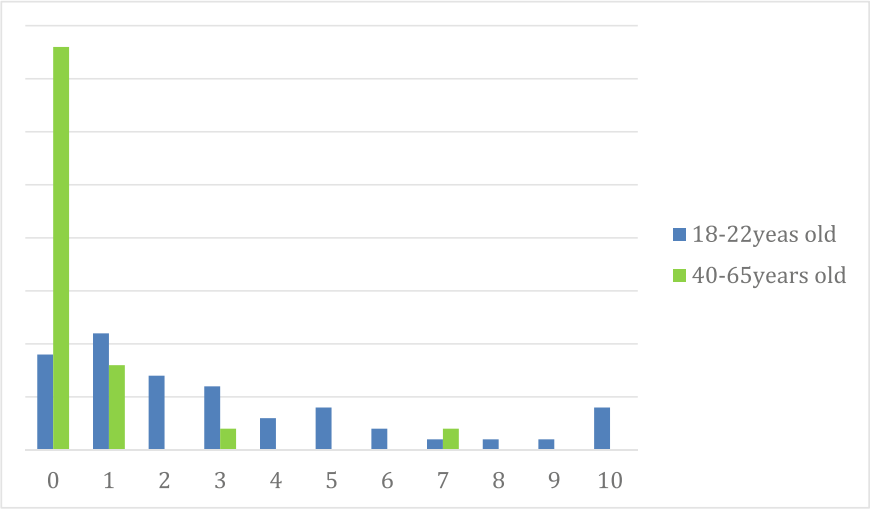

Fig. 2.6 Frequency of time-limited "Story" Update

two companies also share information. It's possible to speculate that in the future, Instagram may even hand over its users' entire location history to Facebook.

What most IG users may not know was: In order to restrict data sharing with Facebook and restrict the third-party access to your posts and privacy, one should customize one's Instagram privacy settings. The most important options can be found in Settings under Privacy and Security. To get there, first go to the profile screen in

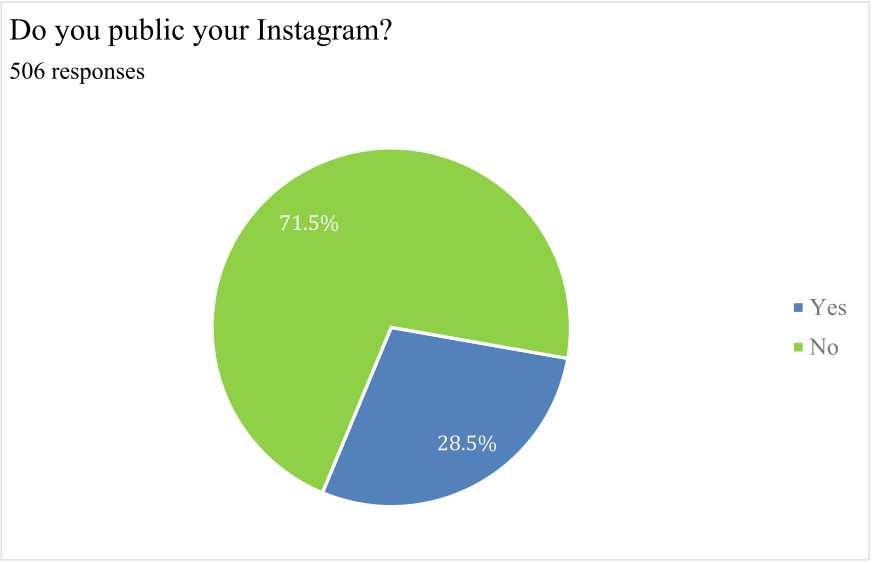

Fig. 2.7 Public Your Instagram?

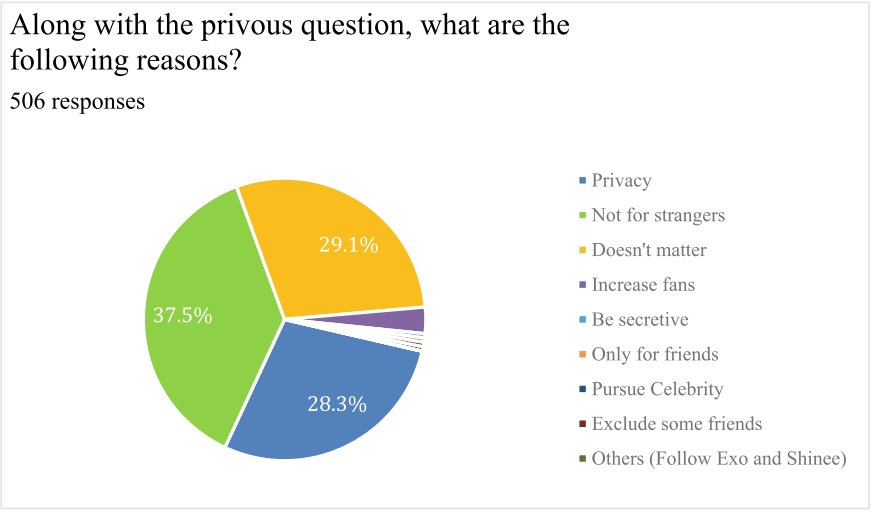

Fig. 2.8 Reasons of Public Your Instagram

the Instagram app. On Android devices, click the three horizontal lines in the upper right corner and select 'Settings' at the bottom of the menu. On iOS, just click the gear icon. This is just to give a warning of the privacy issues.

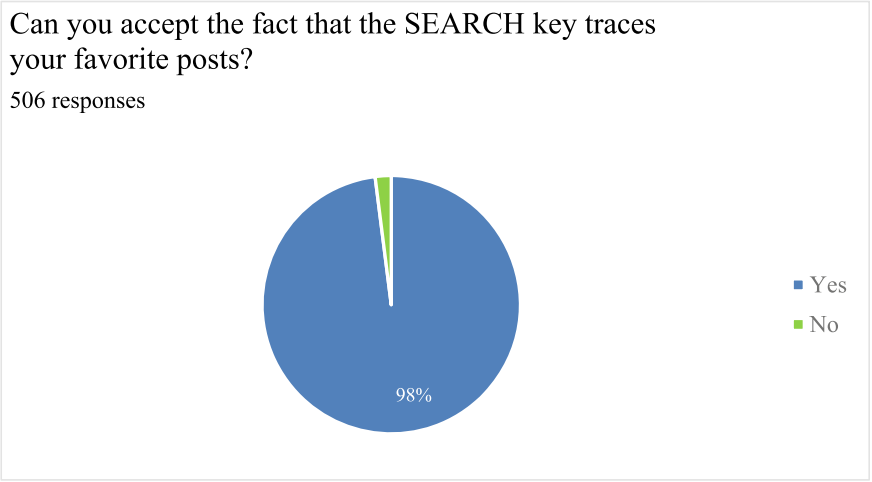

Fig. 2.9 Allow IG to recommend Posts

At this point, the discussions of etiquette in social media seem crucial. Leaving nasty comments while using an anonymous username and hiding behind a screen is common among Instagram viewers. For example, numerous celebrities are deactivating their comments so followers can't leave malicious remarks. Some users choose to message their 'victims' privately with inappropriate requests. Moreover, discussing mental health issues and body image might have to take a more careful measure on social media. This is when social media takes a toll on society.

98% of the respondents accept IG to recommend posts accordingly because it is very convenient, you can also quickly find related posts you like. Very few people feel this would possibly violate their privacy. It might be fair to say that Taiwanese people are kind and open-minded and tend to trust people (Fig. 2.9).

58.5% of the respondents support Instagram's cancellation of 'view follower activity' mainly because they believe by doing that it can protect their personal privacy. 41.5% of the respondents do not support it because they want to be able to keep track of what others are doing without revealing their identities (Fig. 2.10).

2.4.2 Qualitative Discussion and Suggestions for Future Research

Some suggestions for further exploration of the topic are presented in this section. It is hoped that researchers who are interested in the topics and issues covered in this study will benefit from the following descriptions and generate different research agenda.

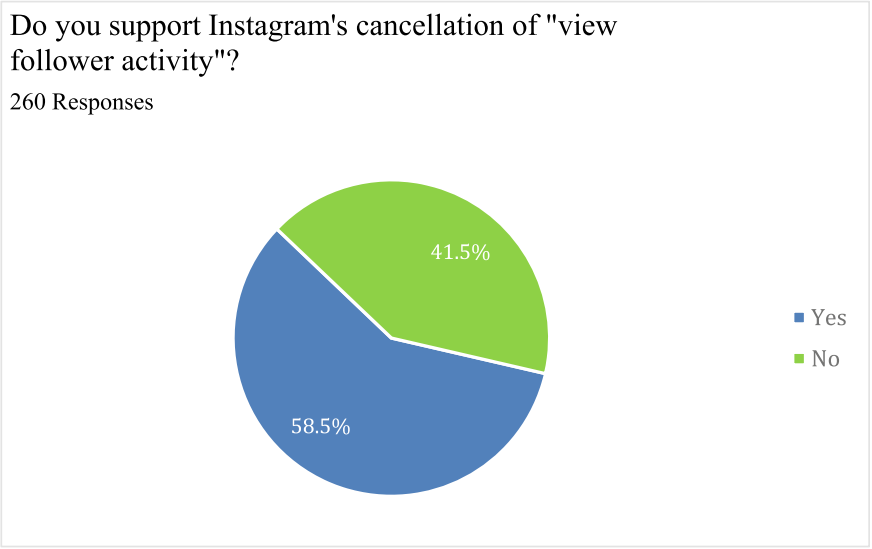

Fig. 2.10 Support of Instagram's Cancellation of "View Follower Activity"

Are we raising a generation of softies? Why is it that children from this generation cannot take criticism or low grades? Perhaps it is the parents who raise the children to be this way. Parents indirectly give children the idea that if they don't leave the nest, they are guaranteed an easy and comfortable life which is a mediocre concept. Goals such as studying, working or living abroad means 'suffering,' 'hard work,' or 'struggle' for the parents as their children would have to start their life from scratch. Thus, these types of goals are not encouraged. However, such experiences are necessary to build character, to grow and develop and to become independent, basically, to make a man out of a boy. There is nothing better than children who can bring their family bright prospects through building a life for themselves, instead of hiding beneath their parents' wings. Young people who are egocentric and narcissistic? With the help of the development of technology, we are living in a society where the younger generation is obsessed with selfies and is all about ME. If it is not narcissism, then what is it? In this study, we might have a chance to take a glimpse of mystical impacts of social Media and truly, narcissism boosts self-obsession, if not necessarily in the human nature, at least in the human propensity for making Instagram users so obsessed to it, as what can be analogized in the story of *Snow White*, 'Mirror, mirror on the wall, who is the fairest of them all?'

The issue has been addressed several times but then again, let's not forget that this generation of digital natives may argue that they are 'creative' and 'unique' which is absolutely fine provided that they are less capable of taking necessary criticism.

Comparison is the thief of joy. It is considered not ethical when people post 'photoshopped' images because they affect how people see about body image and possibly, cause the phenomenon of anorexia. Let's hope those photoshopped images

are better to encourage healthy eating and to create good body image not for making comparisons. When it comes to vulgarity, sex sells. This is the question one should ask oneself: When is it too much? What offends you the most? When does it become porn? Insinuation? How much clothing is acceptable, fully clothed, bikini, underwear, and nude? One of the respondents expressed her opinions on the issue of vulgarity: She thinks nude is offensive only if it is vulgar. If it is artistic it is fine. But then again, there is not clear line between art and vulgarity. For example, some people think a suggestive angle and a suggestive look might insinuate sex.

'Do you filter what you follow?' Here is the question the Instagram officials need to consider the abovementioned issues and resolve and help the users. Instagram explore pages and Instagram has to solicit images and videos and rule out those violate nobility.

One serious concern being repetitive posts, for instance, vegan propaganda, religion and self-help. This might be seemingly dangerous because instead of going to professionals or experts to solve problems of a psychological nature, the individual acquires information by themselves and think they can code with life problems by the online information and suggestions. Last but not least, is social media the culprit or is it rather their users? It is one's responsibility to filter what one follows. Why do we demonize these platforms that are providing employment and creating businesses? There are always two sides of a coin.

The online universe is about communication. People meet each other online, share each other their life stories. But just because people are apparently interfacing with a machine does not mean that manners should be forgotten. It is necessary to make it a rule that one never display anything online that you wouldn't be able to actually 'articulate' directly because, after all, the Internet is only there to facilitate. Going online is a way of enhancing one's life, not a substitute for living.

Another issues such as 'purchase of followers is kind of computer fraud' is not tackled and needed further investigation.

How exactly etiquette education is to be extended into the standardized English curriculum at university level would seemingly invite wide ranges of discussion. With further empirical studies related to etiquette development and intercultural understanding of globalization in Social Media etiquette, the study might boast its positive impact on developing students' inner score toward evaluating themselves.

2.5 Conclusion

Those whose age falls between 18 and 22 are more active on Instagram than those who fall between 40 and 65 years old. Instagram users prevail in all walks of life. In this fast-changing Generation E, new technology is invented every day.

The study discriminates comments and remarks from various ranges of user groups. Issues relating to awareness of bad conduct on social media platforms and whether social media users filter what they follow, and FOMO are discussed. This study found that users often lose personal joy when they compare themselves to

others on social media and how some users leave nasty comments while hiding behind a screen and an anonymous username. The social media does take a toll on society because new technology flips and flaps the modern world. It is suggested why social media etiquette teaching may need to be extended into the standardized English curriculum at university level. It is true that language, culture, and social etiquette as three Musketeers. The study might actually boast its positive impact: influencing young students to teach their parent generation how to get on with new technology and interact with their parents via social media.

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Appendix 1

1. What's your age?
   ☐18–22
   ☐40–65
2. What social media are you currently on?
   ☐Twitter
   ☐Facebook
   ☐Instagram
   ☐Weibo
   ☐Line
   ☐Snapchat
   ☐Messenger
   ☐Wechat
   ☐WhatsApp
   ☐Others
3. Are you on Instagram?
   ☐YES
   ☐NO
4. How much time are you on Instagram every day?
   ☐Less than an hour
   ☐1–2 h
   ☐2–3 h
   ☐3–4 h
   ☐More than 4 h
5. How often are you on Instagram?
   ☐Less than an hour
   ☐1–2 h

☐2–3 h
☐3–4 h
☐More than 4 h
Continuing the question, why?

6. Do you have more than one account?
☐YES
☐NO
Continuing the question, why?
7. Do you prefer posting ‘posts’ to ‘time-limited story’?
☐Posts
☐Time-limited Story
Continuing the question, why?
8. How often do you post ‘posts’ on average?
☐a day
☐2–3 days
☐3–5 days
☐a week
☐half a month
☐a month
☐2–3 months
☐3–5 months
☐half a year
☐a year
Continuing the question, why?
9. How many times have you published ‘Time-Limited Updates’ on an average of ‘three days’?
☐0
☐1
☐2
☐3
☐4
☐5
☐6
☐7
☐8
☐9
☐10
☐More than 10 times
10. What types of posts do you view on Instagram? ‘Choose three’
☐Food
☐tourism
☐pet
☐Celebrity
☐Articles
☐news

- ☐photography
- ☐Knowledge learning
- ☐Funny things
- ☐art
- ☐makeups
- ☐fashion
- ☐Other:

11. What posts do you think are uncomfortable?
    - ☐Posts with strong subjectivity
    - ☐Too many time-limited Story
    - ☐Upload overexposed photos
    - ☐Verbal abuse
    - ☐Forced merchandising
    - ☐Bloody photos/violent text
    - ☐Other:
12. Continuing the question, what would you do if you saw a post you dislike?
    - ☐Report
    - ☐blockade
    - ☐Report + Block
    - ☐Does not care
    - ☐Other:
13. Is your Instagram account public or private?
    - ☐public
    - ☐private
14. Continuing the question, why do you want to make it public or private?
    - ☐Privacy
    - ☐Not for strangers
    - ☐Doesn't matter
    - ☐Increase fans
    - ☐Be secretive
    - ☐Pursue Celebrity
15. Do you support Instagram's ability to cancel (view follower activity)?
    - ☐Yes
    - ☐No

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Hsing-Chin Lee was a Ph.D. student of Tim Johns, whose concept of Data-Driven-Learning (DDL) and analogy of students as, Language detectives inspired her throughout her teaching career. A large portion of her work has been dedicated to English children's literature in the belief that through interesting, entertaining methods, she can captivate the attention of English learners by engaging them to read. She then, realizes the fact that students do not really read, or better say they do read, but only short messages. Inspired, she started this study and is keeping her hope high for the future.

Chapter 3
Creating an Interactive Virtual Environment for Promoting Tourism English

Siao-Cing Guo and Yu-Ju Lan

Abstract EFL classrooms may, understandably, be unable to provide all of the authentic contexts essential for language learners. Today's virtual technology is able to provide realistic situations that can complement what traditional classrooms provide. Past research has shown that learning in a virtual environment greatly enhances students' interests as well as their academic abilities. Because the virtual platform allows learners to interact with objects, events, and other users in virtual space, it creates a meaningful learning experience in which learners can more effectively expand and perfect their knowledge. This research project involved students in a multi-user e-project effort to promote tourism English and to cultivate critical thinking and creativity. A quasi-experimental study was adopted to investigate the effects of a VR-design project and a traditional web-design project and to compare students' motivation, collaboration, perception of task value, and technology use. The study results showed that between the two groups there was no statistically significant difference in their language performance in regard to tourism English. However, significant differences were found with the VR group in terms of students' intrinsic motivation, collaboration, and technology use.

Keywords Virtual environment · Virtual reality · Technology-enhanced language learning · Experiential learning

3.1 Introduction

Virtual technology combined with language learning is a fairly novel approach to pedagogy that has proven to be effective. Recent research on its effectiveness has

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shown that learning in a virtual environment does result in a measurable increase in students' interests as well as a growth in the knowledge and skills acquired in the subject areas (Fox, Arena, & Bailenson, 2009; Lan, 2014; Shih, 2015). Language resources and environment provide essential support for the construction of the new target language. Many EFL classrooms lack authentic language environment. Traditional technology in combination with multimedia may bring authentic language resources to classrooms, but students may not be able to interact with the resources. However, in the virtual environment, students can immerse and interact in the real-world scenarios, thus giving them a sense of the immediacy of the situation.

Virtual reality (VR) with real-life experiences enables students' interaction and allows them to play a role within that environment. Through their participation in VR, students are able develop a deeper understanding of the situation and of their experience in the action, and as a result the effect is more sustainable (Condliffe, 2016). Students can immerse themselves in the situation as active participants with the objects and the environment. Virtual environments offer students an opportunity to experience the real-life situation in which students can relate information to the real-life context. The context in VR usually filled with visual cues, and the authentic environment and motions allow users to feel as if the scenes and actions they are viewing were taking place in the real world. A VR tour to YuShan (Jade Mountain) created an in-depth feeling about the context and helped Taiwanese high school students improve the quality of their English writing (Huang, Hwang, & Chang, 2019). The visualization of the real-world contexts enhances students' learning motivation and transforms their learning experience. If the applications of the platform allow learners to navigate and operate the interactive features and if those features support them for learning creation, it can create an innovative learning environment where learners can construct knowledge (Aixia & Wang, 2011). This kind of learning process is an experiential form of learning in which knowledge is created through the transformation of the experience (Kolb, 2014). This learning creation approach shifts learners from consumers to creators by promoting autonomous learning and ownership (Lan, 2018).

The construction of a virtual environment such as building a supermarket scene or a hotel lobby, provides not only the opportunity to practice the language, but also the context and interaction support necessary for language education. Constructing a virtual environment is a rather novel teaching strategy that enables learners to participate in, negotiate and complete missions, a situation in which learners no longer passively receive knowledge, but they accumulate experience to construct new knowledge through hands-on tasks. Scholars have pointed out that knowledge is formed through experiences (Kolb, Boyatzis, & Mainemelis, 2000). This type of learning by means of doing can promote the knowledge and skills needed for current academic and future professional careers (Diem, 2001).

The online environment featuring virtual technology and interactive functions is attractive to the e-generation students (Bhatt, 2004). This research project adopted a virtual environmental construction form of strategy that utilized a virtual environment system (Omni-immersion Vision: OIV) to cultivate students' ability in tourism English. The OIV system is a 3-dimensional flat-screen virtual environment,

which is a computer-based software and it does not require a headset. This research was designed to investigate the effects of utilizing different online environments, including a VR platform and a web platform, both integrating with a constructive strategy and then to examine whether the virtual environment affected students' learning motivation, learning strategies and, ultimately, their English achievement.

3.2 Literature Review

3.2.1 Constructive Learning

Knowledge is learned through actual interaction with other persons, objects, and the environment in the real-world context. Learners can create knowledge through participation, reflection, analysis, and evaluation. When learners interact with their teachers and peers, they are able to establish new knowledge through discussions and engagement in various activities. In the process of knowledge construction, if learners demonstrate a lack of comprehension, the teacher provides learners with the necessary knowledge or resources, so as to eliminate confusion and narrow the knowledge gap. The instruction and guidance offered by the teacher serve as the scaffold that supports learners as they construct new knowledge. The feedback and assistance given in the process are essential support in reaching the ultimate learning goals. The support in the learning process is the zone of proximal development proposed by Vygotsky (1978). In the classroom context, if language teachers can plan or design learning activities that offer the natural language context and provide interactions that are similar to real-life communication, it can effectively improve the target language communicative competence of students.

Knowledge is created when learning involves a participatory process (Kolb et al., 2000). Participation has positive effects particularly on language learning (Kohonen, 1992). Often times, the actual contexts and tasks are overemphasized in experiential learning, but deeper learning such as thinking, analyzing, and problem-solving are downplayed (Kolb, 2014). If the learning activity further allows learners to not only participate, but also to create and solve problems, learners are no longer passively receiving knowledge, but are actively accumulating experience to construct new knowledge through practical exercises.

In the process of learning, if they gained experience is novel and positive, the generated pleasure will indirectly affect students' interest in the subject being learned. The way in which knowledge is learned will affect learners' interest and willingness to learn (Ainley & Ainley, 2011). The role learners play and the behavior they demonstrate have tremendous effects on their future learning. The learning process and experience affect the degree to which students become invested in future tasks (Diekman, Steinberg, Brown, Belangerl, & Clark, 2017). Therefore, involving students in active roles and having them perform meaningful tasks in the learning process which places

them in a learner-centered situation (Kolb, 2014) can stimulate their interest, enrich their learning process, and guide them to envisioning applications of the domain knowledge.

3.2.2 Virtual Technology

Virtual reality (VR) is a technology that creates a three-dimensional environment that simulates real-life situations, thus allowing users to feel immersed in a real world. The VR environment often allows users to interact with the objects or characters in the virtual environment (Shih & Yang, 2008). Therefore, it has the potential to enhance and change learning in various teaching and training applications (Mantovani, Castelnuovo, & Gaggioli, 2003). VR brings many possibilities into the teaching experience. For example, the immersion experience and the visualization of the content materials offer a real-life simulation that traditional classrooms may not be able to offer. Incorporating learning activities into the virtual environment enriches both content and the interactive experiences, which generally changes the third-person passivity in learning to first-person engagement, including in the original classroom.

According to the studies conducted by the University of Georgia, Stanford University, and the University of Connecticut, it has been found that the experience of VR deepened people's feelings of empathy in relation to situations (Condliffe, 2016). Compared to watching movies, VR participation puts users in the immediate situation, thus creating a deeper understanding of the urgency of the presented problem, and making a stronger impact (Ahn et al., 2016).

3.2.3 Project Design

Based on the previous studies (Aixia & Wang, 2011; Lan, 2014, 2018), we believed that engaging learners in a real-life project would enable them to comprehend and create deeper knowledge. This research study created a real-life tourism e-project utilizing two different online environments in the hope of cultivating students' target language and integrated skills. Students have access to website information all the time, and many of them even have had a prior experience of designing one. Thus, accessing different interfaces of a website is quite manageable for most students. This study utilized a website platform and a VR construction system as the e-platforms for the tourism creation projects.

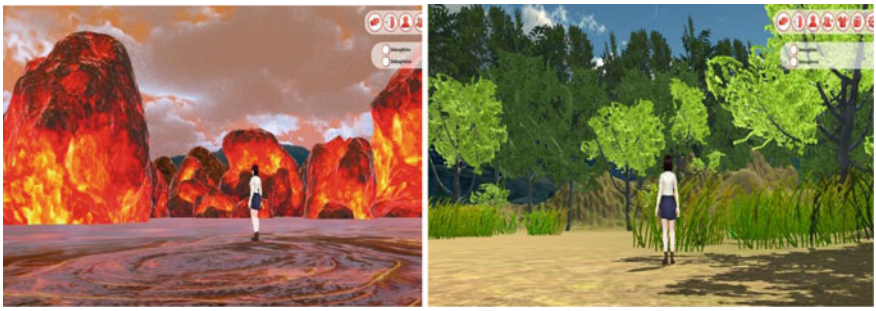
The new generation of the world wide web is a system of communication containing features that allow users to interact with information and other users (Fuchs et al., 2010). While the web features social interaction among users, a virtual reality environment offers users not only interactivity but also immersion (Shih, 2015). This study intended to utilize both website technology and virtual technology to guide students to construct a tourism environment using the target language, while

hoping to create a practical and meaningful experience in learning the subject of "tourism English." The intention of researchers was to compare the effects of different e-platforms and the impact of this technology on students' language performance and learning.

3.2.4 Virtual Constructive Project

The other online environment utilized in this study is a virtual environment system platform (Omni-Immersion Vision: OIV). The Omni-immersion Vision (OIV) system was created and managed by a team from National Normal University in Taiwan. It is an easy-to-operate 3D virtual environment construction system. Through the construction of scenes and objects (see Fig. 3.1), the OIV system allows students to navigate the characters and objects anywhere they want. They can also interact with the characters and objects in the environment. Because students all appear in the same virtual environment, they need to communicate and collaborate with their peers to design and develop their own scene and scenario. In the midst of the construction, they need to utilize the target language and the subject content.

The OIV system with built-in 3D features enables students to construct their virtual environment with chosen scenes, roles, objects, and modes of transportation. The VR creation language-learning project proposed in this study required students to plan roles, scenes, objects, movie footage, and conversation content in the virtual environment they created.



Volcano virtual environment Forrest virtual environment

Fig. 3.1 Samples of virtual scenes

3.3 Research Method

3.3.1 Research Participants

This research aimed to implement an e-construction project with a pre-designed web site and a virtual environment. The study recruited 56 students from two classes to participate in the study. These students were in their second year of a five-year college in Taiwan, and they were studying tourism English at the time. These two classes of students were randomly assigned to a control group and an experimental group. The control group students underwent a traditional web content design whereas the experimental group experienced a VR environment construction.

3.3.2 Research Procedures

Prior to the experiment, both groups of students were taught by the same teacher for over one semester and underwent the same instruction on tourism English. Students from both groups were administered a language test on tourism English and a pre-questionnaire. After that, the groups were instructed to choose a tourist attraction site and some Taiwanese delicacies available nearby and write an introduction of the attraction and the delicacies for foreigners. The control group was given two hours of instruction on the web page design using an existing website while the experimental group was given a two-hour instruction of the OIV system. The study intended to provide students with an experience of creating their own work and narrative content in a real-life situation.

For this tourism project, students were instructed to work in groups of four or five to gather related materials on an attraction site and a choice of delicacies that foreigners may enjoy. Both groups of students had to visit the site, take pictures, gather materials, and finally generate content to introduce the attraction and food. They also needed to shoot a short introductory video of the site. Students from both groups were required to upload all their creative work on the designated e-platforms.

What differentiated the control group from the other was that when the experimental group entered the VR system, they had to choose their roles, objects, and buildings in the virtual scene, and to create their virtual environment. During the task, students needed to plan, discuss, reflect on, and solve problems, which involved a higher level of thinking and performance skills. On the other hand, the control group also had to plan, discuss, and make arrangement of their works and to create their tourism web page on the website.

During the construction process of the two groups, teachers and teaching assistants were available for assistance. They also observed and took notes on students' learning process and its effectiveness as well as the problems of the technology used for various applications. At the end of the experiment, students were administered a

post-language test and a post-questionnaire. In addition, semi-structured interviews were conducted to further understand the learning insights of students and their views on virtual technology-assisted learning.

3.3.3 Research Instruments

To examine the effect of different e-platforms using web technology and virtual technology on students' language performance on the subject of tourism English, two research instruments were created including a language test and a questionnaire. The pre- and post-language tests were designed according to the learning content of tourism English including features of attractions and food delicacies. Both pre- and post-language tests were similar with twenty multiple-choice items among which ten were grammar questions and ten were vocabulary. There were also five items on translation from Chinese to English. The language pre- and post-tests were reviewed by two English teachers with at least ten years of teaching experience in the subject area.

As for the learning questionnaire, it contains items on a five-point Likert scale in seven different constructs, including motivation, the perceived task values, time, effort, peer learning, needed help, and technology use. The participating students expressed "strongly agree," with a "5" to "strongly disagree" with a "1" on a scale of 5 to 1, according to their personal circumstances. The questionnaire was adopted from the Motivated Strategies for Learning Questionnaire (MSLQ) survey by Pintrich, Smith, Garcia, and McKeachie (1991). For the purpose of this study, only items on motivation including intrinsic and extrinsic motivation, task values, time, effort, peer learning, and support were used. The items on technology were adopted from survey items by Hwang, Yang, and Wang (2013). The inter-item reliability of the questionnaire in the abovementioned constructs was between 0.72 and 0.93.

3.4 Results and Discussion

This research project is intended to involve students in a creative project on tourism utilizing different e-platforms to promote language use and to cultivate students' thinking and creativity. The two e-platforms utilized in the project were the tourism website for the control group, and the virtual reality environment for the experimental group. Both groups had to create introductory written content on an attraction and delicacies, take pictures, and create a video, and finally to post their work onto their designated sites, one of which was the website platform and the other site was the virtual environment platform.

To examine the effect of the different e-platforms on students' language performance, ANCOVA was chosen for the language performance analysis because this statistical analysis eliminates the extraneous factors that may influence the dependent

variable (Schneider, Avivi-Reich, & Mozuraitis, 2015). The Levene's test showed that the homogeneity of two groups was confirmed. The ANCOVA results of this research study showed that after experiencing the virtual creation project on the subject of tourism English, students from both groups did not have a statistically significant difference in their language performance in tourism English ($F(1, 44) = 0.51$, $p > 0.48$). Further analysis was conducted to examine the effect on specific language skills including grammar, vocabulary, and translation, but the results showed no significant difference. These results demonstrated that both creation projects, regardless of web technology and the VR technology, increased students' language achievement. Because students regardless of the e-platforms used, students underwent the same process from gathering information, sorting and organizing information, to designing and presenting their work. It is not surprising that students from both groups all learned and improved their target language on the subject of tourism.

As for the questionnaire, because various dependent variables were examined, MANOVA was utilized to avoid type I error inflation and to calculate the power of the variable (Warne, 2014). There was a significant difference in the learning process based on the type of e-platform construction ($F(9, 38 = 3.27$, $p < 0.005$). The MANOVA results yielded significant differences between the types of e-platforms on students' intrinsic motivation, help and technology use (Please see Tables 3.1 and 3.2). However, no significant difference was noted in students' extrinsic motivation, time, task value, efforts, and peer learning. The results indicate that the creation of the 3D virtual environment greatly enhanced their intrinsic motivation, their peer learning, and their perception of the value of the task, the help needed and the technology use compared to the results gained from the creation of the tourism website. Because of the complexity of the virtual platform, the need for the instructor's support also increased.

The MANOVA results revealed significant differences from the use of different e-platforms on intrinsic motivation, needed help, and attitudes toward technology. The utilization of the 3D virtual technology on the creation of a tourism introductory site increased students' intrinsic motivation significantly more than the website did.

Table 3.1 The descriptive statistics of dependent variables

	Website	(N = 28)	VR	(N = 28)
Variables	M	SD	M	SD
Intrinsic	3.2946	1.10146	3.8839	0.96341
Extrinsic	3.6607	1.27514	3.7321	0.97403
Task value	3.4464	1.26080	3.8661	0.98008
Time	3.6075	1.18634	3.8096	1.00400
Effort	3.4521	1.14479	3.7268	0.93903
Peer learning	3.4164	1.10978	3.8579	0.90474
Help	3.4046	1.15971	4.0950	0.93339
Technology	2.9286	1.14208	3.7500	1.05075

Table 3.2 Significant univariate for the type of tools

Variables	Groups	Mean	Std. error	Lower bound	Upper bound
Intrinsic	Web	**0.589***	0.277	– 1.144	– 0.035
	VR	**0.589***	0.277	0.035	1.144
Extrinsic	Web	– 0.071	0.303	– 0.679	0.537
	VR	0.071	0.303	– 0.537	0.679
Task value	Web	– 0.420	0.302	– 1.025	0.185
	VR	0.420	0.302	– 0.185	1.025
Time	Web	– 0.202	0.294	– 0.791	0.387
	VR	0.202	0.294	– 0.387	0.791
Effort	Web	– 0.275	0.280	– 0.836	0.286
	VR	0.275	0.280	– 0.286	0.836
Peer learning	Web	– 0.441	0.271	– 0.984	0.101
	VR	0.441	0.271	– 0.101	0.984
Help needed	Web	**– 0.690***	0.281	– 1.254	– 0.126
	VR	**0.690***	0.281	0.126	1.254
Technology	Web	**– 0.821***	0.293	– 1.409	– 0.233
	VR	**0.821***	0.293	0.233	1.409

*$P < 0.05$

The novelty of characters, scenes, and the choices over the design increased their motivation throughout the process. However, the complexity of the operation in the virtual system is greater than the operation on a general website. Thus, students required more assistance from the instructor and the teaching assistants. The virtual technology created a sense of immersion in the real world for students. They found the technology rich in context and interesting for learning. All students already had experienced browsing websites and interacting with information on websites. But most of the participating students had not had any experience in the construction of their own virtual environment. They felt that they learned new skills in technology. Both groups of students had to invest time and effort, and had to work collaboratively with their peers. Therefore, there was no significant difference between the groups on the constructs of time, effort, and peer learning.

The results from the semi-formal interview with six students, three from each group yielded similar results. Students from both groups expressed positive attitudes toward the tourism construction project on different e-platforms. They particularly liked the fact that they created a project online to introduce pleasant attractions and delicacies in Taiwan for foreigners. They found this type of real-life task meaningful and felt proud of their work. Students from both groups all spent time gathering materials and creating their tourism sites. But the students from the VR group expressed more excitement on working in a virtual environment. When students saw the finished product of the virtual scene constructed by themselves, their sense of achievement was greatly enhanced (Lan, 2018).

3.5 Conclusion

In the process of this study we examined the effect of two different e-platforms—a website and a virtual reality system (OIV)—on students' language performance and their learning process for the subject of tourism English. The real-life project in construction of a tourism site engaged students in more meaningful tasks and a deeper learning process. The construction of a tourism site for foreigners was a complicated project requiring students to collect information and use different media to present their work. Regardless of any e-platforms, students had to work collaboratively in planning, analyzing, organizing, and creating works of their own. Students from both groups improved their language skills during the constructive process and developed positive feelings for the integration of technology in learning. Students from the virtual reality group were particularly motivated by the novelty and immersive factors. Students enjoyed immersing in the virtual environment and found they had no difficulty when operating the system. Although they required more help from the instructors and TAs, they learned new technology applications in the process. The creation of a tourism site for foreigners is a real-life project fostering experiential learning and promoting a higher level of knowledge and skills integration. As was found in an earlier study by Shia, Dub, Lavyc, and Zhaod (2016) because of the collaborative elements in the project, students improved their language communication skills during the process. Students utilizing different technologies both learned and created their own ideas and work in an authentic context. Virtual technology provides an alternative for experiential learning and higher level learning. It offers components that stimulate learners and immerse them into the real situation.

Limitations in this study needed to be addressed. The integration of virtual technology is common in commercial games, but the construction of a virtual reality system that simulates the real world such as OIV or Second Life is costly. Therefore, the system still has limited built-in functions and components and needs significant expansion. Teachers may consider VR with lesser immersive interactions such as *Aurasma* and *Google expeditions*. VR can open doors to the outer world and will certainly create a novel experience for learners. As technology develops and its costs fall, VR will be more accessible for both teachers and students.

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Chapter 4
A Review of Literature to Understand Student's Perceptions Regarding Online Assessments

Arif Cem Topuz and Kinshuk

Abstract Online assessments have been widely used in many disciplines (such as language learning, mathematic, and medical) as a kind of learning technology. Since students are users of online assessments, it is important to consider the perceptions of these assesses. Therefore, this study focused on understanding students' perceptions of online assessments via reviewing the existing literature. This research includes a total of 61 studies and the common point of these studies is the inclusion of students' views on online assessments. Students' perceptions of online assessments were categorized in terms of (1) positive attitudes, (2) negative attitudes, (3) perceptions of cheating and plagiarism, and (4) perceptions of effect on learning. The expressions that stood out in category of positive attitudes towards online assessments were as follows: they wanted to use it in the future; and, online assessments did not increase anxiety. Besides, the most stressed negative attitude was about technical issues in online assessments. Thirdly, there were disagreements among students' perceptions about cheating and plagiarism. For instance, some of the students stated that cheating was easy and higher in online exams, but others stressed the opposite. Finally, students' statements showed that online assessments helped to learn class better. The findings of this study can help researchers in finding out which topics they could focus on in future research. For example, the reason for various disagreements in students' perceptions warrants further investigation. Some of the areas of students' disagreements were: fairness of online exams, students' effort to study, and students' level of comfort.

Keywords Online assessment · E-assessment · Students' perception · Online exam

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4.1 Introduction

Measurement, assessment, and evaluation are some of the most important parts of education in many disciplines (such as language education, mathematics, medical, etc.) and help to analyze the level of learning achieved by the students (Khan & Khan, 2019). For instance, online assessments can be used as formative assessment tools to determine the level of understanding after each subject (Petrisor, Marusteri, Simpalean, Carasca, & Ghiga, 2016) and as summative assessment tools to grade at the end of the course (Kuriakose & Luwes, 2016). Online assessments have several advantages over paper-based exams, such as: feeling comfortable (Bloom, Rich, Olson, & Adams, 2018; Zheng & Bender, 2019); more reliable and systematic (Battal & Cagiltay, 2015); and, feeling like a game (Escudier, Newton, Cox, Reynolds, & Odell, 2011). Furthermore, in one of the language learning studies (Garcia Laborda, Magal Royo, & Bakieva, 2016): reading, writing, listening, and speaking exams were done online via tablet PC, and the results showed that the tablet PC could be adequate for not only language tests but also for most standardized tests. Therefore, online assessments can be applied in lots of courses (Sorensen, 2013).

Online assessments are generally utilized by the decision of the school administrators or teachers, and students attend exams via software that has been developed without considering the pedagogical dimension by the system developers. However, considering the students' preferences and abilities can allow a positive effect on students' learning experience, motivation and academic achievement (Cakiroglu, Erdogdu, Kokoc, & Atabay, 2017; Okada, Whitelock, Holmes, & Edwards, 2019). Therefore, for assessments to be effectively undertaken online, since students are the users of online assessments, their perceptions should be considered (Wadley, Weaver, Curry, & Carthon, 2014). Thus, research examining students' perceptions of online assessments could help researchers and system developers to understand students' perceptions and that could contribute to improving students' academic achievement, motivation, and other associated factors.

There are several studies in the literature that focused on online assessments from the perspective of students. Some of the topics discussed in these studies were as follows: access support for students with disabilities (Peytcheva-Forsyth, Yovkova, & Ladonlahti, 2017); students' experiences towards using their own laptop in online assessments (Hillier & Lyon, 2018); students' perceptions on improving the design of online assessments (Daradoumis, Puig, Arguedas, & Liñan, 2019); proposed features towards interface design of online assessments (Karim & Shukur, 2016); impact of online assessments on student exam performance (Bloom et al., 2018; Cakiroglu et al., 2017); exploring the perspectives of university students (Khan & Khan, 2019); usability and security in online assessments (Ullah, Xiao, & Barker, 2019; Yildirim, Erdogan, & Cigdem, 2017); students' acceptance of online assessments in an EFL course (Cigdem, Ozturk, & Topcu, 2016); gender differences and test anxiety in mobile based assessment (Karadeniz, 2011); and, comparing the online and paper-based assessments (Spivey & McMillan, 2014). Interestingly, some topics have been

addressed under more than one category. For instance, "perception" and "perspective" concepts do not have clear separation in the literature, and although students' statements regarding "attitude," "cheating," "concerns," "feedback," and "technical issues" were presented under the title of "perception" in some studies (Ozden, Erturk, & Sanli, 2004; Richardson et al., 2002; van de Sande & Lu, 2018), they were also undertaken under the title of "perspective" in other studies (Douglas, Paullet, & Chawdhry, 2015; Khan & Khan, 2019; Kocdar, Karadeniz, Peytcheva-Forsyth, & Stoeva, 2018).

At this point, to the best of our knowledge, there is a lack of systematic review studies that have focused on online assessments from the students' perspective. To close this gap, this research aims to understand students' perceptions of online assessments through reviewing the existing literature. Thus, we systematically examined students' perceptions of online assessment in the existing literature which were then analyzed thematically in order to answer the following research questions:

1. What are the factors leading to students' positive attitudes towards online assessments?
2. What are the factors causing students' negative attitudes towards online assessments?
3. What are the factors affecting students' perceptions of the impact of online assessment on learning?
4. What are the factors affecting students' perceptions of cheating and plagiarism in the online assessment?

4.2 Method

In this study, data were collected from existing literature and analyzed systematically. This section includes the explanations of the data collection process, data distribution, and data analysis process.

4.2.1 Data Collection Process

In this study, data consisting of the electronic documents were collected via Google Scholar, which allowed for multiple databases (such as ERIC, Scopus, Science Direct, and Web of Science) to be scanned at once, without having to filter duplicate papers, and easily reaching free alternatives for paid papers (such as accessing researchers' own institutional repositories). The keywords used for the electronic search were as follows: "student," "perspective," "perception," "opinion," "view," "experience," "online," "assessment," and "exam". Criteria for inclusion of studies to this literature review research were as follows:

- be accessible electronically
- be accessible free of charge from researchers' universities

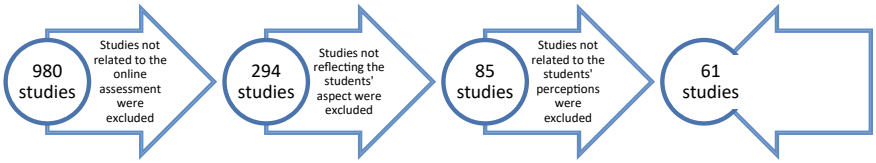

Fig. 4.1 Study selection procedure

- be written in English
- include at least one student in the sample (studies just involving teachers or administrators were excluded)
- consist of the students' perceptions on online assessments (studies just involving teachers or administrators' perceptions were excluded).

Figure 4.1 shows the study selection procedure. Firstly, a total of 980 studies were listed in the search engine as a result of the search via the keywords. Then, studies were filtered via abovementioned inclusion criteria. Three main themes emerged from the literature towards online assessments from the aspects of students, namely acceptance, perception, and preferences. In this paper, due to space limitation, part of the perception theme has been addressed. Therefore, a total of 61 studies that focused on the perception theme were analyzed systematically.

4.2.2 Data Distribution

Figure 4.2 shows the distribution of the studies on students' perceptions of the online assessments. The distribution shows that the number of studies has increased gradually in the last 20 years. Furthermore, it also shows that online assessment studies have started right after that Web 2.0 technology and the amount of studies have increased with the developments in web technologies.

Figure 4.3 shows the frequency distribution of words in the included studies. The

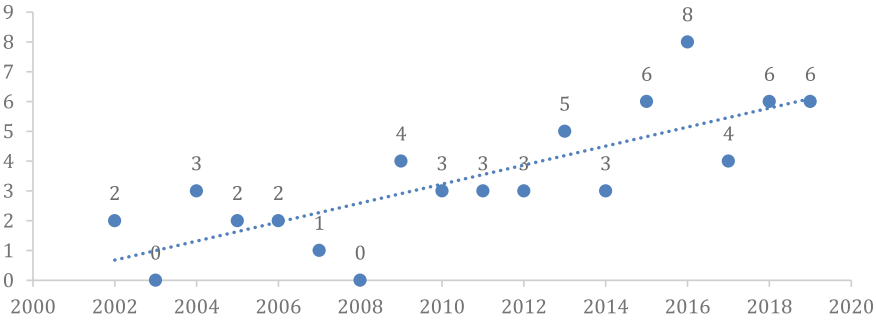

Fig. 4.2 The distribution of the included studies

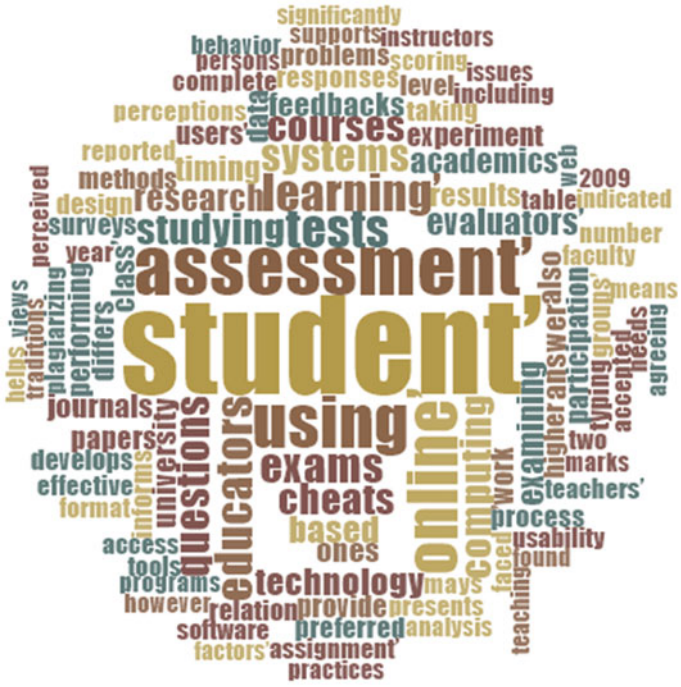

Fig. 4.3 The frequency distribution of the words

word cloud was obtained via NVivo 12 software with using full text of the studies and shows the 100 most frequently repeated words by highlighting the frequency of repetitions in the font size. The words determined by this word cloud show that the studies included in the research were related to the keywords used for the search. In this figure, besides the words "*student*," "*evaluation*," "*exams*," and "*tests*," the other stand out words are: "*cheats*," "*feedback*," "*learning*," "*problems*," and "*effective.*" Therefore, the words determined by this word cloud are also compatible with the category and theme names presented in this research.

4.2.3 Data Analysis Process

Selected studies were analyzed thematically according to the approach of Thomas and Harden (2008). This approach has 3 main stages: (1) coding text, (2) developing descriptive themes, and (3) generating analytical themes. Therefore, firstly, each study was coded line-by-line. Then, category names were generated considering the determined codes and each code was moved to the related category. Finally, analytical themes were generated according to category names. Thus, systematic analysis process was carried out in this way.

Studies were coded both automatically and manually by NVivo 12 software. This software has "auto code" option for the documents which are written in English, but manual coding option was first used, and then "auto code" feature was used to cross-check the codes and categories, hence increasing the validity and reliability of data and results. Besides, while generating codes, categories, and themes, attention was paid to using the expressions specified in the studies.

4.3 Results and Discussion

In this section, students' perceptions of online assessments are presented under 4 main categories, including (1) positive attitudes, (2) negative attitudes, (3) impact of online assessment on learning, and (4) cheating and plagiarism in online assessment.

4.3.1 Positive Attitudes Towards Online Assessments

Codes that reflect students' perceptions regarding positive attitudes towards online assessments were categorized in terms of (1) intention to use in the future, (2) level of comfort in online assessment, (3) perception of reliably and systematically, and (4) others.

The most emphasized positive attitude was related to students' intention to use in the future. In literature, based on students' statements, they would like to use online assessments (Richardson et al., 2002; Sorensen, 2013; Stowell & Bennett, 2010; Uddin, Ahmar, & Alraja, 2016). Their intention was valid regardless of program level, gender, and experience (Donovan, Mader, & Shinsky, 2007). They wanted to see online assessments at their university (Betlej, 2013; Dermo, 2009). The vast majority of them suggested using online assessments more frequently (del Mar Sánchez-Vera, Fernández-Breis, Castellanos-Nieves, Frutos-Morales, & Prendes-Espinosa, 2012). They would recommend online assessments to other students (Hillier & Lyon, 2018) and hoped to see in other courses (Ozden et al., 2004). And, they enjoyed using it both in classroom as a formative assessment and in tests or exams as a summative assessment (Kuriakose & Luwes, 2016). Based on the majority of students' statements in literature (Marriott, 2009; Sheader, Gouldsborough, & Grady, 2006), it can be said that students wanted to use online assessments in future exams. However, students, who did not understand why it was done online, did not want to use online assessments (Khan & Khan, 2019). Therefore, an explanation might be given to students about why the exam will be done online to improve positive attitudes towards students' intention to use. However, students pointed out incompatibility issues regarding macOS and Safari, and these students expressed that they would love to be involved in future testing once incompatibility issues were fixed (James, 2016). On the other hand, determining the other factors that contribute to students' intention to use is still one of the issues that can be explored in the future.

The second code was about the comfort level of students in online assessments. Students expressed that they felt more comfortable in online assessment than paper-based exams (Bloom et al., 2018; del Mar Sánchez-Vera et al., 2012; Isabwe, 2012); their level of comfort was improved and level of anxiety was decreased (James, 2016; Richardson et al., 2002); and, they felt less stressful, less pressure, and more relaxed than traditional exams (Betlej, 2013; Dermo, 2009; Holmes, 2015; Okada et al., 2019). In addition, students felt more comfortable once they had more experience (Petrisor et al., 2016; Zheng & Bender, 2019); even in a summative and high-stake exams, the online format did not have any disadvantages (Escudier et al., 2011); and, e-authentication instruments were neither stressful nor onerous (Okada, Whitelock, Holmes, & Edwards, 2017). Besides, one student stated that sitting in a room full of people made her extremely anxious and to have this kind of system (online assessment) implemented really would reduce anxiety and make the learning experience more pleasurable (Okada et al., 2019). However, there were some disagreements among the students, as well. For instance, do online assessments increase (Bloom et al., 2018) or decrease (Okada et al., 2019) the level of anxiety and do online assessments improve the level of comfort (Isabwe, 2012) or improve the level of stress (Betlej, 2013)? Therefore, additional studies on these topics are still clearly needed.

The third code revealed that online assessments were perceived as more reliable and systematic (Battal & Cagiltay, 2015; Ozden et al., 2004). The students stated that they found online assessments more reliable by pointing out the following cases: it is reliable against technical failures (Hillier & Lyon, 2018); cheating or plagiarism could be determined in a faster and more secure way (Kocdar et al., 2018); and, it was perceived more reliable if face notarization (verify a user's identity) process was fair (Liu, Chen, & Lu, 2015). Therefore, students' perceptions concerning reliability and systematicity were related to the online assessment system's security features for preventing or detecting cheating and plagiarism. In other words, if an online assessment system has security techniques for fraud, students perceive exams as reliable and systematic. However, students stated that they did not want to use some particular security techniques, such as using fingerprint (Kaur, Prasad, Alsadoon, Pham, & Elchouemi, 2016) and random questions from question bank (Dermo, 2009). Therefore, it can be said that the security techniques used in the online assessment systems to prevent or detect cheating should be planned very carefully. In addition, it is important to investigate the security techniques which can be applied in online assessment systems that both make the exams more reliable and affect students' perceptions positively. Besides, future studies may focus on whether using random questions from item banks are fair (Sorensen, 2013) or not (unfair) (Dermo, 2009).

The other codes regarding students' positive attitudes towards online assessments were as follows: immediate results and personal feedback were useful (Bardesi & Razek, 2014; Holmes, 2015; Sorensen, 2013; Yildirim et al., 2017); flexibility in answering, reviewing and changing answers was one of the best benefits (Battal & Cagiltay, 2015; Escudier et al., 2011); and, exams could be taken easily via mobile devices (Treadwell, 2006; Tufekci, Ekinci, & Kose, 2013). Besides, e-exam was perceived as easy to use (Bardesi & Razek, 2014; Donovan et al., 2007; Hillier &

Lyon, 2018) and the online format felt like a game (Escudier et al., 2011). Furthermore, understanding questions was easier than handwritten ones and there was no disturbances or distractions during exams (Battal & Cagiltay, 2015); focusing was easier in online assessments (Holmes, 2015); and, students appreciated being able to use their own computer (Hillier & Lyon, 2018). In addition, based on the students' statements: submitting the answer was easier in online assessments (Holmes, 2015; Sheader et al, 2006); online assessments were better for objectively determining the level of knowledge (Petrisor et al., 2016); online assessments gave an opportunity to practice for future exams (Bloom et al., 2018); boring tests may not be boring when done online, and writing in online assessment was easier than handwriting (Richardson et al., 2002). As a result, it can be said that these positive attitudes can be generalized as an advantage of online environments, however, flexibility in answering and feedback requires extra effort in the online assessments.

When students' positive attitudes towards online assessments are synthesized, we can say that the majority of the students would like to use online assessments in the future because of their perceptions regarding the advantages of online assessments. Furthermore, future studies may focus on students' disagreement topics, such as online assessments' effect on the level of comfort, stress, and anxiety. Besides, using random questions from item banks are fair or unfair? Furthermore, additional studies are needed to determine the proper security techniques which do not disturb students.

4.3.2 Negative Attitudes Towards Online Assessments

There were four main aspects of perceptions regarding students' negative attitudes towards online assessments: (1) technical issues, (2) perceptions regarding anxiety and concern, (3) difficulties in using technological equipment, and (4) others.

The most stressed negative attitude towards online assessments was about technical issues and these issues were categorized in terms of (1) Internet connection issues, (2) software usability issues, (3) computer errors, and (4) software coding issues. The Internet connection issues were stated as the most common challenge in online assessments studies (Donovan et al., 2007; Vairamuthu & Anouncia, 2016). Codes regarding Internet connection issues were as follows: problems with slow (Tufekci et al., 2013) or intermittent Internet connection (James, 2016); losing answers in the middle of taking the quiz due to disconnected WiFi (Kim, 2015); and, delaying the examination start time due to interruptions or delays in uploading or downloading process (Zheng & Bender, 2019). Secondly, students' expressions on software usability issues, which includes the specific problems in the online assessment system that they used, were gathered under this technical issue category. Students' statements regarding usability issues were as follows: usage of the backspace caused the webpage to expire and also it worked to go back a question but only on certain ones (Sim & Read, 2016); the lack of immediate feedback when they submit an assignment (Heng, Joy, Boyatt, & Griffiths, 2005); and, laptop's touch pad sensitivity issues (Hillier & Lyon, 2018). Besides, operating system (especially

MacOS) and web browser (particularly Safari 6 and Opera 7) incompatibility, such as the shortcuts and keystrokes not being compatible (James, 2016); sending same assignment many times due to the delay in the notification email that would be sent by the system about the delivery of an assignment (Joy, Griffiths, & Boyatt, 2005); and, not seeing the entire interface due to the test page that opened in a small popup window and the lack of user confirmation before exiting the application (Sim, Horton, & Strong, 2004). The third technical issue was related to computer errors stemmed from students' computer, such as viruses, malfunction, security, and connection speed (Richardson et al., 2002), and possible computer glitches (Sheader et al., 2006). Fourth technical issue was related to software coding errors. Students expressed the coding errors as follows: features (such as the calculator) that were presented in the software interface and problems regarding attached files used with an exam question (Bloom et al., 2018); server-side rejection of POST request because of the upload size (Okada et al., 2019); and, although the exam was taken one time, getting two points as if the exam was taken twice at different times (Sim et al., 2004). On the other hand, computer errors were emphasized as the reason for choosing paper-based exams (Holmes, 2015), and this perception shows the importance of fixing the technical issues in online assessments. Although it was stressed that technical issues increased students' level of anxiety, students also stated that experience of online assessment decreased the level of anxiety (Zheng & Bender, 2019). Therefore, in order to fix technical issues and reduce students' level of anxiety, students may make practice via online assessment systems before the exams. Thus, students may gain experience, and also technical issues might be detected and fixed.

Secondly, anxiety and concern were other negative attitudes towards online assessments. In some studies (Betlej, 2013; James, 2016; Khan & Khan, 2019), few students stated that online assessment increased the level of anxiety, unlike the vast majority who said it was comfortable (Bloom et al., 2018; Dermo, 2009). For instance, technical issues were highlighted as one of the factors that made them feel anxious with statements as follows: feeling anxiety due to possible computer or Internet connection errors that might occur during exams (Battal & Cagiltay, 2015; Kim, 2015); delaying the examination start time due to failure to download the exam file (Zheng & Bender, 2019); and, losing saved answers or denying upload requests, due to server-side errors (Okada et al., 2019). Another anxiety factor stemmed from concerns about the health implications of using the computer for long periods of time. For example: one of the reasons for not to take an online exam was emphasized as a concern on working under webcam for long periods of time (James, 2016); sitting for more than hour was stated as an issue (Okada et al., 2019); and, students shared their concerns about the hurts of eyes (Khan & Khan, 2019). In addition, the other anxiety factors were categorized as follows: not starting the exam immediately after entering the password (Zheng & Bender, 2019); feeling ill-equipped to use technology used in online assessments (Khan & Khan, 2019); taking more assignments to do, and thinking of the cheating attempts (Kim, 2015). On the other hand, the presence of remaining time on the screen was also expressed as a factor that increased the level of anxiety and caused difficulty in concentration (Battal & Cagiltay, 2015; Sim et al., 2004). One student stated that the countdown timer was like a bomb that would explode in their

face (Khan & Khan, 2019). Furthermore, Karim and Shukur (2016) explored the students' timer type selection and research results showed that the preferences distribution was as follows: countdown counter (42%), analog clock (30%), ascending counter (22%), and no counter (6%). However, Sim et al. (2004) expressed that there was no evidence that digital clock has an impact on performance, but, new studies (Karim & Shukur, 2016; Khan & Khan, 2019) revealed that clock has an effect on motivation and distraction. Hence, motivation and distraction may have an indirect effect on exam performance. Thus, future studies may address whether the clock on the screen affects the exam performance or not. Besides, the following technical issues may be considered in future exams to change students' negative attitudes towards online assessments: students would like to know about what they must do if the computer crashes during the exam, if the system does not recognize their identity, or if the Internet connection is lost (Battal & Cagiltay, 2015; Okada et al., 2019).

Thirdly, difficulties in using technological equipment were other negative attitudes towards online assessments. Slow typing speed was the most emphasized issue among these difficulties (Betlej, 2013). Furthermore, having to write the answers was seen as an unfair method for online assessments since typing speeds varied (Escudier et al., 2011). Besides, some students stated that they did not prefer online assessments because of their slow writing problem (Richardson et al., 2002). The other difficulties were expressed as follows: inability to focus on the computer screen (Kim, 2015); the feeling of tiring to answer the online questions (Escudier et al., 2011); difficulties due to computer software (Betlej, 2013); and, absence of enough time and computers to access (Yildirim et al., 2017). Furthermore, students stated that writing speed would also affect their performance (Okada et al., 2019). Therefore, the factors affecting the performance of students during online exams could be explored extensively.

The other codes regarding students' negative attitudes towards online assessments were as follows: teachers were not well trained in online assessment techniques (Khan & Khan, 2019); they were accustomed to paper-based exams (Battal & Cagiltay, 2015; Holmes, 2015) and traditional verification of knowledge (Betlej, 2013); and, they preferred face-to-face feedback (Kim, 2015). Besides, online exams were more difficult than traditional (Betlej, 2013); paper-based exams were easier to have an overview of the whole paper (Escudier et al., 2011); online assessment should be the supplementary method in evaluating students instead of the main method (Betlej, 2013; Kim, 2015); and, paper-based exams helped to focus more on the test (Kim, 2015). Moreover, other negative attitudes were as follows: forgetting to do the online assessment (Donovan et al., 2007; Holmes, 2015); lack of communication with instructors (Khan & Khan, 2019); lack of asking for help and guidance, and lack of familiarity with the online assessment format (Donovan et al., 2007; Marriott, 2009). Besides, lack of possibility to present a person's line of thinking for getting partial credit (Betlej, 2013); and, need to share personal data (Peytcheva-Forsyth, Aleksieva, & Yovkova, 2018a).

When students' perceptions regarding their negative attitudes towards online assessments are synthesized, we can say that the majority of the negative attitudes stemmed from the technological issues. These issues can be categorized into two main topics, such as originating from students (virus issues, losing WiFi, etc.) and

the assessment systems (losing answers, usability issues, etc.). Therefore, to the reduction of negative attitudes, online exams can be conducted in the laboratory environment after the users' computers and online assessment systems tested adequately. Besides, if the system developers and designers can not foresee all possible technical challenges, then all these technical issues will occur.

4.3.3 Impact of Online Assessments on Learning

Codes that reflect students' perceptions regarding the impact of online assessments on learning were categorized in terms of (1) feedback, (2) exam performance, and (3) motivation.

Firstly, students stated that feedback from online assessment contributed to their learning, helped them to learn better, and added value to their learning (del Mar Sánchez-Vera et al., 2012; Dermo, 2009; Kim, 2015; Sorensen, 2013; Zheng & Bender, 2019). In some studies (Marriott, 2009; Ozden et al., 2004), majority of the students stated that the system feedback helped them to understand their weaknesses and reflect on their learning. In particular, "strengths and opportunities report" was expressed as a feedback tool that showed what they learned and what they needed to study further (Zheng & Bender, 2019). In addition, the rationale for answers was highlighted that this feedback helped to know why an answer choice was correct or not enhanced their learning (Richardson et al., 2002; Zheng & Bender, 2019). Furthermore, students found the automated feedback useful, fast and effective in understanding how successfully they had learned and identifying strengths and weaknesses (Bardesi & Razek, 2014; Iahad, Dafoulas, Kalaitzakis, & Macaulay, 2004; Manoharan, 2019; Marriott, 2009). In addition to system feedback, it was emphasized that instructor feedback improved students' learning and also had a motivating effect (Turner & Uludag, 2013; Yildirim et al., 2017). Furthermore, it has been stated that the pre-test increased the level of understanding of the lesson (Gardner, Sheridan, & White, 2002). Additionally, students pointed out that feedback should be personal (Yildirim et al., 2017) and immediately (Bardesi & Razek, 2014; Marriott, 2009; Sorensen, 2013). On the other hand, Daradoumis et al. (2019) revealed that feedback had different effects on students with poor programming skills. Therefore, other effects of feedback on learning in online assessment should be addressed in future studies.

Secondly, students' perceptions regarding the impact of online assessments on their learning was related to exam performance. According to Isabwe (2012), students realized their mistakes via online assessment and they worked again in order to improve their performance. Furthermore, it was pointed out that there were no correlations among exam performance—testing format (online-based and paper-based) and exam performance—student's preferred format (Bloom et al., 2018; Cakiroglu et al., 2017; Hewson, 2012; Spivey & McMillan, 2014). Although there was no significant difference between exam scores and test anxiety in mobile based tests (Karadeniz, 2011), the correlation between exam performance and anxiety was

found stronger in the classroom than online assessments (Stowell & Bennett, 2010). On the other hand, there were two disagreements among students and one of them was related to the effort to work for exams. Spivey and McMillan (2014) revealed that students did not work less in online assessment than paper-based exams, but in different study (Kim, 2015), students expressed that online assessment reduced effort to study. Another disagreement was related to grades. Although some students stated that online assessments were useful to reinforce knowledge and reinforcement process helped them to get a better result (del Mar Sánchez-Vera et al., 2012; Holmes, 2015), few students expressed their grades were falling when exams were done online (Khan & Khan, 2019). Therefore, these disagreements can be addressed comprehensively in future studies.

The third code was related to the motivational impact of online assessments on students' learning. According to Marriott (2009), students' motivation to learn was affected positively through the online assessment and the majority of students stated that poor performance motivated to work harder. Furthermore, the use of online assessments was considered as an encouraging step in the university (Uddin et al., 2016). In addition, it was stated that the responsibility of learning increased in the online assessments (Kim, 2015). Besides, continuous assessment pushed students to study, helped them to improve learning, and made them spend more time to learn (Holmes, 2015). Moreover, considering the students' preferences and perspectives in the assessments process had a positive impact on students' academic achievement (Cakiroglu et al., 2017).

When students' perceptions regarding the impact of online assessments on learning are synthesized, we can say that online assessments help the majority of the students to learn better. Students prefer especially personal and immediate feedback. However, although the majority of students stated that poor performance motivated them, it would be better if future studies investigate comprehensively the effect of poor performance. In particular, the score limit between motivation and abandonment can be explored.

4.3.4 Cheating and Plagiarism in Online Assessments

There were three main aspects of students' perceptions regarding the cheating and plagiarism in online assessments: (1) disagreements of cheating and plagiarism, (2) fairness and honesty, and (3) misunderstanding of cheating and plagiarism.

Firstly, there were several disagreements among students about the cheating in online assessments. For instance, although some of the students expressed that cheating was easy in online assessments (King, Guyette Jr, & Piotrowski, 2009; Larkin & Mintu-Wimsatt, 2015; Swartz & Cole, 2013), different students found the cheating so difficult (Escudier et al., 2011; Hillier & Lyon, 2018). Another disagreement was about cheating attempts. In some studies (King et al., 2009; Larkin &

Mintu-Wimsatt, 2015), students stated that cheating was higher in online assessments, but in different studies (Peled, Eshet, Barczyk, & Grinautski, 2019; Peytcheva-Forsyth et al., 2017; Watson & Sottile, 2010), students emphasized that cheating was higher in face-to-face assessments and also cheating attempts reduced in online assessments. Besides, students stressed that online assessments did not increase cheating (Peytcheva-Forsyth et al., 2018a; Spaulding, 2009). As final disagreement, one student stated that all students tried to learn and no one cheated, but in same study another student expressed that if there was no system to prevent cheating, they would easily cheat (Kocdar et al., 2018). At this point, these disagreements may have stemmed from the presence or absence of security features that prevent or detect cheating in online assessments.

Secondly, fairness and honesty were the other emphasized concepts related to students' perception of cheating and plagiarism in online assessments. Although there were few students that expressed their concerns over cheating attempts (Reiner & Arnold, 2010), the majority of the students reflected their perception regarding the online assessments as fair, trusty, acceptable, and more advantageous than traditional exams (Escudier et al., 2011; Kim, 2015; Okada et al., 2017; Ozden et al., 2004; Peytcheva-Forsyth et al., 2017). Besides, while assessments were done online, students were much more honest (Donovan et al., 2007; Peytcheva-Forsyth, Aleksieva, & Yovkova, 2018b). Moreover, most of the students stated that they trusted all online assessments, electronic systems and plagiarism detection software (Kocdar et al., 2018; Okada et al., 2017; Peytcheva-Forsyth et al., 2018a). Furthermore, Okada et al. (2017) presented the students' perception regarding the institutions which used secure online assessment in a part of their research and the majority of the students' attitudes were positive towards these types of institutions. In addition, students' perceptions were as follows (Okada et al., 2017): university was working to ensure the quality of the assessment process and students did not feel like the university did not trust them. On the other hand, to ensure fairness in online assessments, some features in assessment systems may have a deterrent effect for cheating. Therefore, future studies may investigate these types of features to prevent cheating.

The third code was related to students' misunderstanding of cheating in online assessments. For instance, one student expressed that the purpose of sharing the answer was to understand the homework better (Turner & Uludag, 2013). Moreover, the ability to view the book and lecture notes were expressed as an advantage of the online exam (Peytcheva-Forsyth et al., 2017). Fortunately, cheating and using external resources were emphasized as unacceptable for both online proctored and online unproctored assessments in some studies (Douglas et al., 2015; van de Sande & Lu, 2018). Besides, using external resources was perceived as acceptable and ethical while completing coursework outside of exams (Douglas et al., 2015). Consequently, reporting exam rules to students before exams without assuming that students know the exam rules may eliminate misunderstandings about cheating and plagiarism.

When students' perceptions regarding the cheating and plagiarism in online assessments are synthesized, we can say that the majority of the students trust the security-enhanced online assessment systems to prevent or detect the cheating and plagiarism. However, the presence or absence of security techniques in online

assessments may affect lots of other factors, such as; exam performance, anxiety, and intention to use. Therefore, it would be better to address these effects in future studies.

4.3.5 Summary of the Research Results

In summary, all results are presented within the framework of research questions, categories, and codes in Appendix 1. Besides, there were disagreements among students' perceptions about some topics, and to indicate these disagreements, double star symbol (**) was used in the table shown in Appendix 1.

4.4 Conclusion

This study aimed to understand students' perceptions of online assessments by reviewing the existing literature. A total of 61 studies were analyzed systematically and research results were summarized in Appendix 1. When students' perceptions regarding online assessments were synthesized, this research revealed that the majority of the students were willing to use online assessments in the future because of the advantages stemmed from: personal and immediate feedback, cheating and plagiarism prevention, level of comfort, exam performance, motivation, and fairness. However, students' perceptions were negatively affected, especially due to technical issues and difficulties in using technological equipment. According to these results, research questions and implementation suggestions for future studies have been presented below.

4.4.1 Suggestions Towards Research Questions for Future Studies

The results showed that there were several disagreements among students, therefore future studies may address these disagreements with the research questions as follows: do online assessments increase or decrease the level of anxiety; do online assessments improve the level of comfort or improve the level of stress; and, using random questions from item banks are fair or not?. Furthermore, students' expressions regarding their positive attitudes towards online assessments were generally related to not only advantages of online assessments, but also advantages of online environments. Thus, could positive attitudes only stem from the advantages of online environments?

On the other hand, students stated that several factors affected their intention to use, exam performance, motivation, learning, and effort to study. Therefore, future studies may focus on these factors with the research questions as follows: which factors contribute to students' intention to use towards online assessments; which factors affect the performance of students during online exams; and, what is the impact of feedback on learning in online assessments. In addition, what is the effect of online assessments on spending time and effort to work; what is the effect of online assessments on students' grades; what is the effect of poor performance on motivation in online assessments; and, does the clock on the screen affect the exam performance?

Moreover, based on the students' statements, we can say that security techniques in online assessments to prevent or detect cheating affect students' perceptions. Therefore, future studies may investigate these cases comprehensively with the research questions as follows: what is the impact of presence or absence of security features in online assessments to prevent or detect cheating on students' perception, exam performance, level of anxiety, and intention to use; which features to prevent cheating in the online assessments are perceived as a deterrent by students in applying for cheating; and, which security techniques can be applied in online assessment systems to make the exams both more reliable and also affect students' perceptions positively?

4.4.2 Suggestions Towards Implementation for Future Studies

According to students' statements, several implementations can be suggested regarding the integration of online assessment. Firstly, explanations may be given for the cases as follows: students would like to know about what must they do if the computer crashes during the exam, or the system does not recognize their identity, or the Internet connection is lost; and, why the exam will be done online. Besides, reporting exam rules to students before exams without assuming that students know the exam rules may eliminate misunderstandings about cheating and plagiarism.

Secondly, students emphasized the technical issues and difficulties in using technological equipment. Therefore, to reduce negative attitudes towards online assessments, online exams can be conducted in computer laboratory environment after the users' computers and online assessment systems tested adequately. Furthermore, in order to fix technical issues and reduce students' level of anxiety, students may make practice via online assessment systems before the exams. So, students may gain experience, and also technical issues might be detected and fixed.

Finally, students stressed several useful features in online assessments. Therefore, these features can be implemented in online assessment systems, such as; flexibility in answering (allow the user to go back to previous questions and change selection), and immediate and personal feedback.

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Appendix 1

Summary of the results

Research Questions	Categories	Codes
1. Students' positive attitudes towards online assessments	1.1 Intention to use in the future	* They would like to use and see at their university * Their intention was valid regardless of program level, gender, and experience * They suggested using more frequently * They recommended to other students * They hoped to see in other courses * They enjoyed using it both in formative and summative assessments
	1.2 Level of comfort	* They felt more comfortable * Level of anxiety was decreased * They felt less stressful, less pressure, and more relaxed * They felt more comfortable once they had more experience * Even in a summative and high-stake exam, the online format did not have any disadvantages * E-authentication instruments were neither stressful nor onerous
	1.3 Perception of reliably and systematically	* They found more reliable * Reliable against technical failures * Cheating or plagiarism could be determined in a faster and more secure way * Perceived more reliable if face notarization process was fair
	1.4 Others	* Immediate results and personal feedback were useful * Flexibility in answering, reviewing and changing answers was one of the best benefits * Exams could be taken easily via mobile devices * E-exam was perceived as easy to use * The online format felt like a game * Understanding questions was easier than handwritten ones * There was no disturbances or distractions during exams * Focusing was easier

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Research Questions	Categories	Codes
		* They appreciated being able to use their own computer * Submitting the answer was easier * Better for objectively determining the level of knowledge * Opportunity to practice for future exams * Boring tests may not be boring when done online * Writing in online assessment was easier than handwriting
2. Students' negative attitudes towards online assessments	2.1 Technical issues	* Internet connection issues (problems with slow or intermittent Internet connection; losing answers in the middle of taking the quiz due to disconnected WiFi; delaying the examination start time due to interruptions or delays in uploading or downloading process) * Software usability issues (usage of the backspace caused the webpage to expire and also it worked to go back a question but only on certain ones; the lack of immediate feedback when they submit an assignment; laptop's touch pad sensitivity issues; operating system and web browser incompatibility; sending same assignment many times due to the delay in the notification; not seeing the entire interface due to the test page that opened in a small popup window; the lack of user confirmation before exiting the application) * Computer errors (viruses, malfunction, security, and connection speed and possible computer glitches) * Software coding issues (errors in features; problems regarding attached files used with an exam question; server-side rejection of POST request; getting two points as if the exam was taken twice at different times)
	2.2 Perceptions regarding anxiety and concern	* Few students stated that online assessment increased the level of anxiety, unlike the vast majority who said it was comfortable * Feeling anxiety due to possible computer or Internet connection errors that might occur during exams * Delaying the examination start time due to failure to download the exam file * Losing saved answers or denying upload requests due to server-side errors * Concern on working under webcam for long periods of time * Sitting for more than hour was stated as an issue * Students shared their concerns about the hurts of eyes

(continued)

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Research Questions	Categories	Codes
		* Not starting the exam immediately after entering the password * Feeling ill-equipped to use technology * Taking more assignments to do * Thinking of the cheating attempts * Presence of remaining time on the screen
	2.3 Difficulties in using technological equipment	* Slow typing speed * Having to write the answers was seen as an unfair method for online assessments since typing speeds varied * They did not prefer online assessments because of their slow writing problem * Inability to focus on the computer screen * The feeling of tiring to answer the online questions * Difficulties due to computer software * Absence of enough time and computers to access * Students stated that writing speed would affect their performance
	2.4 Others	* Teachers were not well trained in online assessment techniques * They accustomed to paper-based exams * They accustomed to traditional verification of knowledge * They preferred face-to-face feedback * Online exams were more difficult than traditional * Paper-based exams were easier to have an overview of the whole paper * Online assessment should be the supplementary method in evaluating students instead of the main method * Paper-based exams helped to more focus on the test * Forgetting to do the online assessment * Lack of communication with instructors * Lack of asking for help and guidance, and lack of familiarity with the online assessment format * Lack of possibility to present a person's line of thinking for getting partial credit * Need to share personal data
3. Students' perceptions about the impact of online assessment on learning	3.1 Feedback	* Feedback contributed on their learning, helped them to learn better, and added value to their learning * System feedback helped them to understand their weaknesses * Strengths and opportunities report showed what did they learn and what did they need to study further * Rationale for answers helped to know why an answer choice was correct or not enhanced their learning

(continued)

(continued)

Research Questions	Categories	Codes
		* Automated feedback was useful, fast and effective in understanding how successfully they had learned and identifying strengths and weaknesses * Instructor feedback improved students' learning and had a motivating effect on their learning * Pre-test increased the level of understanding of the lesson * Feedback should be personal * Feedback should be immediately * Feedback has different effects on students with poor programming skills
	3.2 Exam performance	* Students realized their mistakes via the online assessment and they worked again in order to improve their performance * There were no correlations between exam performance and testing format * There were no correlations between exam performance and student's preferred format * There was no significant difference between exam scores and test anxiety in mobile based tests * The correlation between exam performance and anxiety was found stronger in the classroom ** Students expressed that online assessment reduced effort to study, but in different study, students stated that they did not work less in online assessment than paper-based exams ** Although students emphasized that online assessments were useful to reinforce knowledge and reinforcement process helped them to get a better result, different students stated that their grades were falling when exams were done online
	3.3 Motivation	* Students' motivation to learn was affected positively * Poor performance motivated to work harder * Use of online assessments was considered as an encouraging step in the university * Responsibility of learning increased * Continuous assessment pushed students to study, helped them to improve learning, and made them spend more time to learn * Considering the students' preferences and perspectives in the assessments process has a positive impact on students' academic achievement

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Research Questions	Categories	Codes
4. Students' perceptions about cheating and plagiarism in the online assessment	4.1 Disagreements of cheating and plagiarism	** Some of the students expressed that cheating was easy in online assessments, but others said that cheating was difficult ** Although some students stated that cheating was higher in online assessments, others said higher in face-to-face assessments and online assessments did not increase cheating ** One student stated that all students tried to learn and no one cheated, but another said if there was no system to prevent cheating, they would easily cheat
	4.2 Fairness and honesty	* Few students expressed their concerns over cheating attempts * Online assessments are fair, trusty, acceptable, and more advantageous than traditional exams * While assessments were done online, students were much more honest * They trust all online assessments, electronic systems, and plagiarism detection software * Students' perceptions regarding intuitions which use secure online assessment were positive
	4.3 Misunderstanding of cheating and plagiarism	* The purpose of sharing the answer was to understand the homework better * The ability to view the book and lecture notes were expressed as an advantage of the online exam

Note To indicate the disagreements, double start symbol (**) was used

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Chapter 5
An Investigation into Virtual Immersion Mandarin Chinese Writing Instruction with Student with Autism

Pei-Ying Lo and Yu-Ju Lan

Abstract Research findings show that using virtual world environments, such as Second Life (SL), for language learning can create a more comfortable yet authentic learning environment for language learners. This research focused on the influence of virtual immersion Mandarin Chinese writing instruction with a participant with autism by conducting an action research to seek possible solutions for teaching and learning needs. In this research, there were 2 cycles: traditional writing instruction (TWI) and virtual immersion writing instruction (VIWI). Three writing topics were presented to the participant. The topics were: describe the kitchen, going to the convenience store, and comparisons between different transportations. Each topic was presented to the participant during 2 class sessions, 50 min each. First session was for prewriting planning activities by using mind maps. Second session was to review the prewriting materials and then move on to the writing activity. For results, summarization and comparison of the mind maps and essays from the participant were conducted. The essays were graded then the scores were compared. Oral interviews regarding attitudes toward Mandarin Chinese learning, Mandarin Chinese writing learning, and 3D virtual reality learning were collected further to understand the participant's thoughts in these areas. Results show that the incorporation of VIWI not only changed the participant's attitude toward Mandarin Chinese learning, and Mandarin Chinese writing learning but also enhanced the participant's prewriting planning skills and Mandarin Chinese essay writing skills.

Keywords 3D virtual reality · Second Life · Autism · Mandarin Chinese writing

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5.1 Introduction

Around the world, an increasing amount of classrooms have started incorporating technologies in their learning environments. Keifer-boyd (2010) mentioned, "…an inquiry-oriented activity in which learners construct knowledge through interacting with, evaluating, and connecting diverse, and resources on the internet to form new insights that they share in tangible form to make a difference in the world." Virtual immersion instructions, have emerged into the education field. According to Rahim (2013), "Research has shown that e-learning via Second Life (SL) not only provides students with engaging interactions and community presence but also helps students develop skills related to socialization, peer and group work, critical thinking and problem solving" (p. 40). With the incorporation of the virtual environment into lessons, it provides endless possibility.

With programs like SL, educators can create scenes and virtual environments that students' see in daily life, insert objects seen daily, or even record and upload familiar sounds and voices. According to Henderson, Huang, Grant, and Henderson (2012), learnings that occurred within an authentic environment can have better learning outcomes. SL is a free downloadable software program where users can create avatars and enroll in variety activities solo or with others in the 3D virtual environment (Gilbert, Murphy, Krueger, Ludwig, & Efron, 2013). SL has been the first choice of educators when it comes to creating virtual immersion learning environments.

There are many ways to assess the students' understanding of the materials that have been taught to them, and the most common assessment used in classrooms is through writing. Writing skill is critical for all because not only it is one of the best ways for students to show what they have learned but also a great skill to have when trying to secure a job in the future. Writing is often considered the primary means for demonstrating one's knowledge of content in educational contexts (Mercer & Mercer, 1998). Lots of companies now require candidates to be proficient writers to obtain and maintain the position. Having good writing skill is not only for better academic performance but also plays a crucial role in students' future career path.

5.2 Purpose of the Study and Questions

There are only few researches explored the benefits that virtual immersion instructions could bring for people with disabilities for language learning. Within the resources that could be found, there are some research results show how various technologies could help people with disabilities in learning environments, such as using videos (Moore et al., 2013), computers (Ramdoss et al., 2011), and other technology resources to help with handwriting (Kinney, Vedora, & Stromer, 2003) or learning social cues (Cobb & Sharkey, 2007). Overall, there are minimal findings, specifically with teaching writing using technologies for students with ASD.

The following questions were proposed based on the student's unique needs and challenges that the teacher faced.

According to the above, this research strives to answer the following questions:

1. Will the incorporation of virtual immersion writing instruction change the attitude of the participant with ASD about learning writing in Mandarin Chinese and learning Mandarin Chinese in general?
2. Will the incorporation of virtual immersion writing instruction increase participant with ASD's ability with planning for writing and writing skills in general?
3. What does participant with ASD think of the incorporation of virtual immersion writing instruction?

5.3 Literature Review

5.3.1 Virtual Immersion Instruction for People with Disabilities

The internet has created new benefits for individuals with disabilities. "A virtual world is not limited by the physical laws experienced in real life" (Stendal, Balandin, & Molka-Danielsen, 2011). The virtual world creates possibilities to establish social interactions, conducting business, attending courses, and learning a new language. Potentially, the virtual world can create different opportunities for both personal and social value for people with different disabilities. Limited researches have explored the benefits of people with disabilities using virtual environment platforms for language learning. There are some researches explored in a variety of different influences that the virtual environment platforms could bring for people with different disabilities. Smith (2011) categorized different types of virtual world users into three main categories among people with disabilities, which are augmentations, immersionists, and experimentalists. This specific study used SL as their instrument and found out about the following. Augmentations are using SL as a way to enhance their real life, which users using the virtual characters as another version of themselves from reality in the virtual world. For immersionists, they view the virtual world as a parallel reality to reality. Experimentalists perceive the virtual worlds as a construable reality such as a laboratory. Smith (2011) also mentioned, "Experimentalists usually take the form of educators and trainers, or perhaps a counselor working with patients dealing with substance abuse" (p. 3). Hence, virtual environments can bring benefits and fit the varieties of needs for people with different types of disabilities. There are many ways that the virtual environment platforms can be utilized for people with different disabilities. Due to its uniqueness and versatility, virtual environments can bring endless potentials to the education field for educators who serve people with special needs and for learners who have disabilities.

Not only the virtual environments can be individually designed for people with different special needs but also found to bring other positive influences into the special education field. Such as training for better social skills, Stendal et al. (2011) talked about recent years virtual world training has been utilized often for social skill training. Custom-designed virtual worlds are being used to repeatedly represent specific social situations to promote knowledge to people who lack social skills. This research concluded that virtual world gave people with lifelong disability who have difficulties connecting with their peers a chance to interact and practice communication and social skills within the virtual environment. Some other researches touched on the topic of how virtual world training can enhance people with disabilities' communication and social skills. Burke et al. (2018) investigated into using virtual interactive training agents with adults with ASD and other developmental disabilities and found participants developed their communication ability after series of virtual interactive training with online virtual agents. Both of these studies shown the potential of using a virtual environment for training social skills and for people with disabilities to learn by using virtual environment platforms.

A study by Gilbert et al. (2013) found 61 participants with different kinds of disabilities were benefited from the activities in the 3D virtual contexts that can help reduce depression, anxiety, and aloneness. Research results by Maskey, Rodgers, Parr, Lowry, and McConachie (2014) shown evidence that cognitive behavior therapy with virtual reality environment can be a highly effective treatment for specific phobia/fear for some young people with ASD. Virtual environments not only help people with disabilities build their academic skills but also support their mind and soul. Overall, the internet has changed the teaching and learning methods for people with different disabilities. The virtual environment platforms can be tailored in specific ways to fit in each of their unique needs. The virtual environment platforms not only helped with building life skills but also can take care of things related to the emotional states.

5.3.2 Language Learning for People with ASD

For typical children, learning languages refines critical thinking and executive function, which includes skills such as attention to details, self-control, and mental flexibility (Griswold, 2016). For children with developmental delays, such as children with ASD, they often use more gestures when communicating with others. It is as vital for children with autism to learn languages skills as to typical children. Both groups need to acquire social and cognitive skills, which includes having good language skills. A typical child starts to develop language skill from the day when they were born, but children with ASD tend to delay such development about twelve months late. That is because children with ASD tend to show way less interest with people and things around them and also does not have a strong desire to interact with their surroundings. Hence children with ASD do not get any chance to develop their language skills as typical children. Some of the following methods can better support

language development for children with ASD: creating reasons to use the language, using play, modeling, and set a reward system for language use. A study conducted by Lan, Hsiao, and Shih (2018), they have looked into the effective learning design of game-based 3D virtual language learning environment for special education students. In this study, four students included two students with attention-deficit hyperactivity disorder (ADHD), one student with ASD, one other student with mental retardation. The student with ASD shared with the researchers with high satisfaction with the use of the game-based 3D virtual language learning program. The same student also found the program was easy to use and very beneficial for language learning.

Many people with ASD have difficulty with building their language skills, especially with speaking. According to Boucher (2003), "It is interesting to note that individuals at the other end of the spectrum, that is to say, those with Asperger syndrome or high functioning autism, sometimes find the written language easier to learn than spoken language" (p. 160). Perhaps building writing skills with people with ASD can help them express themselves and communicate better with others. Although it might be easier for people with ASD to learn writing better than speaking, they still face some difficulties such as lack of theory of mind and understand others think differently than they do. And without such ability, it will affect their ability to write for an absent audience, which means they are unable to anticipate the reader's reaction (Asaro-Saddler & Bak, 2014). Other difficulties found by Pennington, Stenhoff, Gibson, and Bailou (2012) include decreased legibility, complexity, and a minimal number of words used during writing tasks. People with ASD appeared to write in more basic grammar, produce less complicated written pieces, and consistently struggle with different writing tasks. Asaro-Saddler (2016) mentioned some teaching methods such as explicit instruction, step-by-step guide, and visual supports would be useful to use when to teach writing to people with ASD.

5.4 Methodology

5.4.1 Design of the Research

An action research was conducted. A consent form was sent to the parents which can be found in Appendix 1. The following writing topics were presented to the participant in both instruction cycles: describe the kitchen, going to the convenience store, and comparisons between different transportations. Cycle one is proceed with Traditional Writing Instruction (TWI) and cycle two is Virtual Immersion Writing Instruction (VIWI). Each writing topic was presented over two class sessions, 50 min each (see Fig. 5.1). Detailed lesson plans for each class session can be found in Appendix 2. All classes were conducted using Mandarin Chinese. There was a thirty-day gap in between the last class session of cycle one and the first class session of cycle two. An overview of lesson provided during the on-month gap can be find in Appendix 3. The gap was to insure that the participant can have a fresh start for cycle

Cycle 1: TWI (2D Pictures)		**Cycle 2: VIWI (3D Scene in SL on Computer)**
Describe the scene, "Kitchen" • (1)50 minutes session: Learning & Planning • (2)50 minutes session: Review & Writing	30 Days Gap	Describe the scene, "Kitchen" • (1)50 minutes session: Learning & Planning • (2)50 minutes session: Review & Writing
Going to the convenience store • (1)50 minutes session: Learning & Planning • (2)50 minutes session: Review & Writing		Going to the convenience store • (1)50 minutes session: Learning & Planning • (2)50 minutes session: Review & Writing
Comparisons between different transportations • (1)50 minutes session: Learning & Planning • (2)50 minutes session: Review & Writing		Comparisons between different transportations • (1)50 minutes session: Learning & Planning • (2)50 minutes session: Review & Writing

Fig. 5.1 Procedures for TWI and VIWI

two. For cycle one, 2D pictures of SL scenes were presented to the participant on standard letter paper size, which is eight-and-half inches by eleven inches during cycle one. Three 2D pictures for each writing topics were use (see Figs. 5.2, 5.3, and 5.4). In cycle two instead of using the 2D pictures, SL scenes were presented and explored on the computer by using an avatar with the researchers and participant.

Fig. 5.2 2D colored pictures of the kitchen scene from SL

Fig. 5.3 2D colored pictures of the convenience store scene from SL

Fig. 5.4 2D colored pictures of the transportation stations scene from SL

5.5 Participant

The participant of this study was a 12-year-old sixth-grade student at a Mandarin Chinese Immersion school located in the mid-west of the United States. He was formally diagnosed with Autism Spectrum Disorder (ASD) at the age of seven in

China. He was evaluated prior to placement for his Mandarin Chinese skills in the following area using the school's own Mandarin Chinese materials, reading, writing, listening, and speaking. He was at a second grade level for speaking, listening, and first grade level for writing and reading. Listening and speaking were identified as areas of strength while writing and reading identified as areas that needed improvement. He showed a low interest in learning languages, especially with Mandarin Chinese. The participant is very profound with online games and loves watching videos and view pictures on his iPad. He knows how operate computer, laptop, mouse, keyboard, and iPad, and iPhone.

5.6 Instruments

5.6.1 Second Life

The following scenes were utilized from the National Taiwan Normal University (NTNU) language island in SL: kitchen, convenience store, and transportation stations (see Figs. 5.5, 5.6, and 5.7). These scenes were originally designed and created by the NTNU Technology-Enhanced Language Learning (TELL) laboratory, which is led by Yu-Ju Lan. The scenes were chosen in order to fit in the academic curriculum of the participation's school.

Fig. 5.5 NTNU language island—kitchen

Fig. 5.6 NTNU language island—convenience store

Fig. 5.7 NTNU language island—transportation stations

5.6.2 Mind Map

In this study, the mind map and SL were utilized as visual supports for the participant. A mind map is a diagram used to visually organize information. A mind map shows relationships among pieces of the whole. People can create mind maps using pen and paper, or you can use an online mind mapping tool such as MindMeister. In this study a pencil and a paper were utilized with the participant. When creating a Mind Map, there are several elements to consider, such as the map's central idea, branches, colors, keywords, and images.

5.6.3 Questionnaires

The following questionnaires were used for oral interviews after the last class session of TWI and VIWI: Mandarin Chinese writing attitude questionnaire (see Appendix 4) and Mandarin Chinese learning attitude questionnaire (see Appendix 5). An additional questionnaire was used after the last class session of VIWI is the 3D virtual reality learning attitude questionnaire (see Appendix 6). The questionnaires were used to access the participant's opinion and feedback for both TWI and VIWI. Both the Mandarin Chinese writing attitude questionnaire and Mandarin Chinese learning attitude questionnaire was created by Lan, Lyu, and Chin (2019). The Mandarin Chinese writing attitude questionnaire have 21 questions, with four subcategories, which are ability, pragmatic, missions, and effective. The Mandarin Chinese learning attitude questionnaire has 22 questions, with three subcategories, which are effective, pragmatic, and educational context-related. The 3D virtual reality learning attitude questionnaire was created by Lan et al. (2018). The original questionnaire includes 17 questions. Seven questions were not included in this study because they were related to verbal abilities, which were explicitly designed for the initial research by Lan et al. (2018). Since verbal ability was not relevant to this study, the questions were excluded from the oral interview with the student.

5.7 Data Collection

During each class session for both cycles, observation notes were taken by a trained paraprofessional through each class session, including what was said from both the teacher and the participant. The teacher is a licensed teacher who also owns a bachelor's degree in elementary education and a master's degree in special education with a specialization in ASD. She is fluent in both English and Mandarin Chinese in both speaking and writing. All data that were originally presented in Mandarin Chinese were all later translated into English by the researchers. All essays produced by the participant were graded by two evaluator. The evaluators are both trained and licensed Mandarin Chinese teachers. The scoring rubric can be found in Appendix 7. The scores are collected and compared and so does the mind maps. The questionnaires' results were obtained, then summarized and reflected afterward by the end of both cycles. Transcript of each class sessions for both cycle one and two can also be found in Appendices 8, 9, and 10.

5.8 Results

Cycle 1 and Cycle 2 Essay Scores Comparisons

The score of the evaluators were collected by operating the Spearman correlation (see Table 5.1). While the significant value of .985 meant that the score of two evaluators was highly correlated, therefore the score can be used for further analysis and examinations. According to the above, the evaluators graded the essays using the writing rubric and scored each essay individually, and the scores were highly correlated. Table 5.2 contains the mean score of each essay and scores across each different scoring categories. According to Table 5.2, the average total score from the VIWI was higher than the TWI. For the topic of describing the kitchen scene, the average score of organization and vocabulary were improved from the TWI to the VIWI. For the topic of going to the convenience store, the average score of content, organization, and vocabulary was enriched. For the topic of transportation, the following subcategories were developed: content, organization, vocabulary, and grammar.

Cycle 1 and 2 Mind Maps and Essays Comparisons

The following figures are minds maps and essays produced by the participant over the three writing topic for both cycles. Figures 5.8 and 5.9 are from the writing topic describe the kitchen. For the TWI class session's wiring products, sentences are not connected with transitional words. There are individual and straightforward sentences. Putting the mind mad and the essay side by side, they share lots of the simple elements that were created by the participants. Looking over to the writing products from VIWI class session, the mind map and the essay were better organized.

Table 5.1 Spearman correlation of two evaluator's score on essays

		Evaluator A	Evaluator B
Evaluator A	r_s	1.000	0.985
	P-value	.000	.000
Evaluator B	r_s	0.985	1.000
	P-value	.000	.000

Table 5.2 Essay scores comparison from TWI and VIWI

Topics	Instruction Style	Total	Content	Organization	Vocabulary	Grammar	Punctuation
Kitchen	TWI	10.0	2.0	1.0	2.0	2.0	3.0
	VIWI	12.0	2.0	2.0	3.0	2.0	3.0
Convenience Store	TWI	13.5	3.0	3.5	2.0	2.0	3.0
	VIWI	16.5	4.0	4.0	3.5	2.0	3.0
Transpiration	TWI	14.0	2.5	2.5	3.0	2.0	4.0
	VIWI	17.0	4.0	3.5	3.5	3.0	3.0

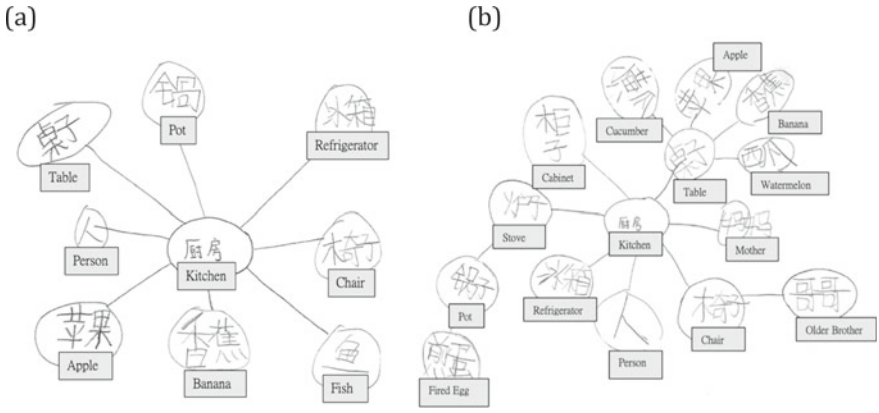
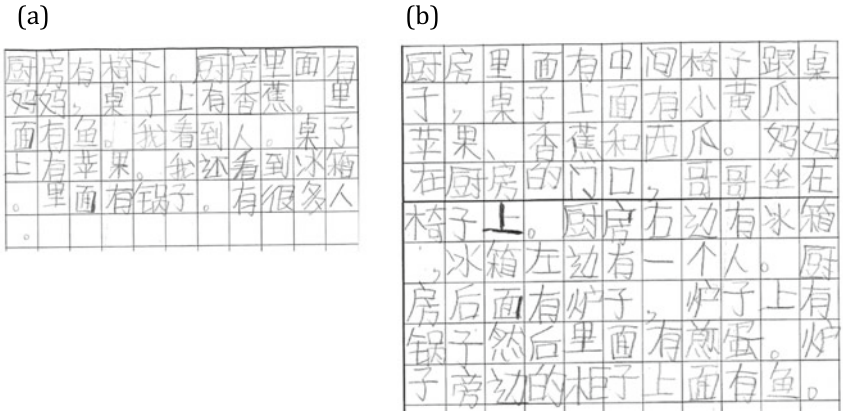


Fig. 5.8 Mind maps with translation: describe the kitchen scene. **a** from TWI. **b** from VIWI



In the kitchen, there is a chair. The mother is in the kitchen. On the table, there is a banana. Inside there is fish. I see a person. On the table, there is an apple. I also saw a refrigerator. Inside, there is a pot. I see many people

In the middle of the kitchen, there is the chair and table. On the table, there are cucumber, apple, banana, and watermelon. Mom is at the entrance of the kitchen. The brother is sitting on the chair. There is a refrigerator on the right side of the kitchen. On its left, there is a person. In the back of the kitchen, there is a stove. On top of it, there is a pot, and there is a fried egg in it. There is a fish on top of the cabinet that is on the side of the stove.

Fig. 5.9 Essays by participant with translations: describe the kitchen scene. **a** from TWI. **b** from VIWI

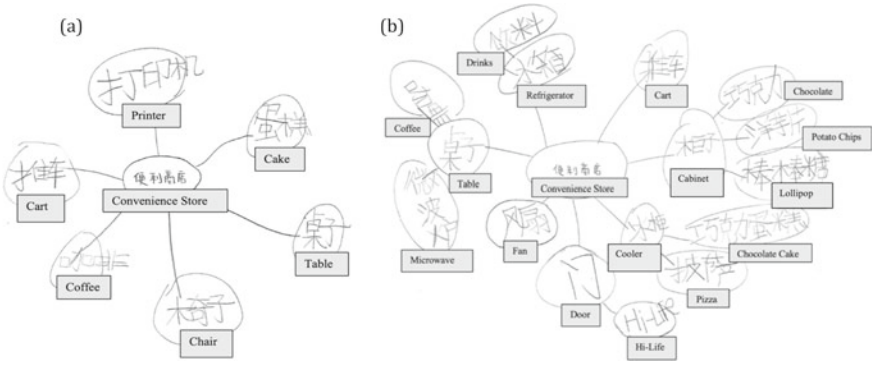


Fig. 5.10 Mind maps with translations: going to the convenience store. **a** from TWI. **b** from VIWI

The student indicate the relationships clearly in between the objects. Such as items on the table were connected which was not shown during the TWI class session. The essay was also better organized and presented.

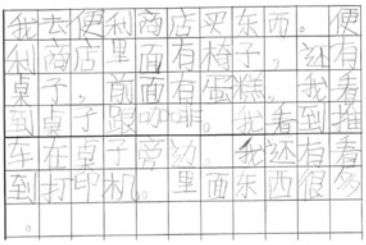
Figures 5.10 and 5.11 are from the writing topic going to the convenience store. Again with TWI class session, same finds as the last topic. Both the mind map and essay were simple and straightforward. Organization of the essay was poor, and sentence structures were modest. For the VIWI class session, the mind map was well created and organized with lots of relations between the objects. The essay had a greater opening and ending.

Figures 5.12 and 5.13 are from the writing topic going to the convenience store. The sentences are still simple and lack of proper organization from TWI class session. Although, the student did notice and showed the similarities and difference between the public bus and the school bus on the mind map. But he fails to reflect the same in the essay. For the VIWI class session, he had very detailed notes in his mind map and has reflected the same observation into his essay. Overall, the mind map and essay from this specific topic was well done.

5.9 Summary of the Mandarin Chinese Writing Attitude Questionnaire

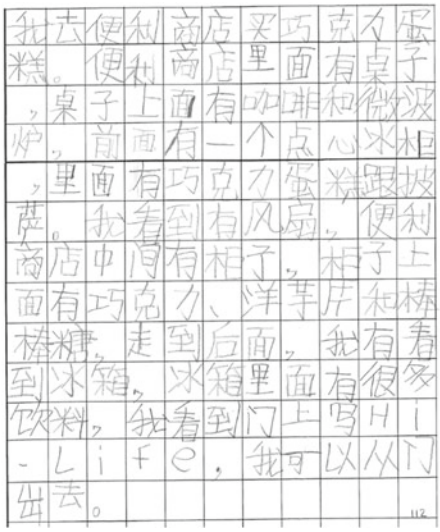
The following summary was collected after the last class session of both cycles. After the TWI, for all the questions related to abilities, the student's answers were all negative. He did not think having the ability to write in Mandarin Chinese or having the ability to produce decent Mandarin Chinese essays would benefit him in any way. He said: "My mother wants me to learn Mandarin Chinese. Mandarin Chinese is boring. I do not want to learn Mandarin Chinese." He also shared with the researcher that he does not think he can produce good quality Mandarin Chinese essays. He said: "I cannot write! This is too hard!" For all the pragmatic questions, he

(a)



I go to the convenience store to buy things. There is a chair in the convenience store and table. In the front, there is cake. I see the table and coffee. I see the cart beside the table. I also see a printer. Inside, there are many things.

(b)



I am going to the convenience store to get a chocolate cake. In the convenience store, there is a table. On the table, there are coffee and microwave. There is a cooler in the front, and there are chocolate cake and pizza in it. I see a fan. In the middle of the convenience store, there is a cabinet. On the cabinet, there are chocolate, chips, and lollipop. Then walk towards the back, I saw a refrigerator. In the refrigerator, there are lots of drinks. I saw there is 'Hi-Life' written on the door. I can leave the door.

Fig. 5.11 Essays by participant with translations: going to the convenience store. **a** from TWI **b** from VIWI

did not understand the importance of Mandarin Chinese writing. He believed it was useless because it was not fun at all. He said: "It is not useful. It cannot help me with playing on the iPad. I think the iPad is more fun." Under the mission subcategories, completing Mandarin Chinese writing activities did not make him feel successful or happy. When asked the affective questions, he thought that writing Mandarin Chinese essays were wasting his time to play and rest. He said: "Not as good as playing with my iPad. I would rather have more time to play on the iPad." He considered writing Mandarin Chinese essays as very dull work.

After the VIWI, his interests in Mandarin Chinese writing shifted utterly. He had a more positive feeling toward completing Mandarin Chinese writings. He expressed

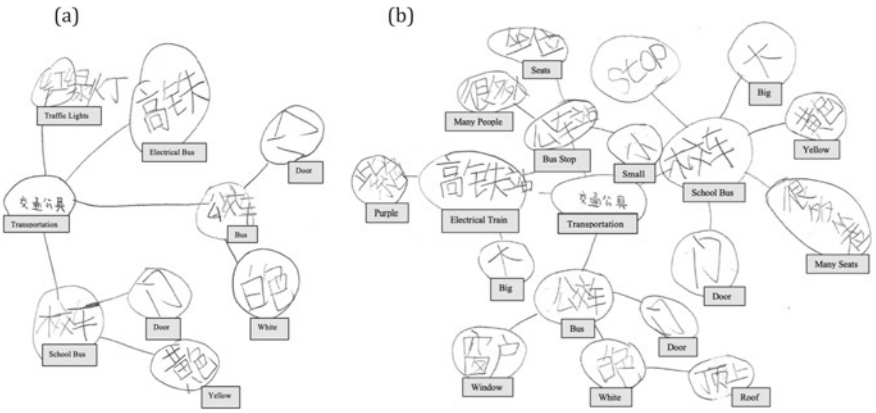


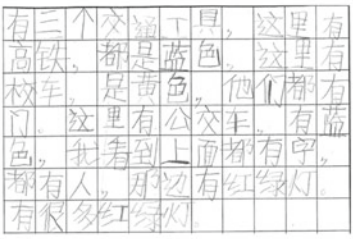
Fig. 5.12 Mind maps with translations: comparisons between different transportations. **a** from TWI. **b** from VIWI

a positive attitude toward writing Mandarin Chinese essays and thought it was super fun with the use of SL. He said: "I think SL is super fun. It is just like my iPad. I like to learn Mandarin Chinese by using SL." He believed he can produce better quality Mandarin Chinese essays by using SL more in the future. He would like more Mandarin Chinese writing activities with SL in the future if time allows. He said: "I want more time on SL. It is super fun. I hope I get another chance next time to play with it again."

5.10 Summary of the Mandarin Chinese Learning Attitude Questionnaire

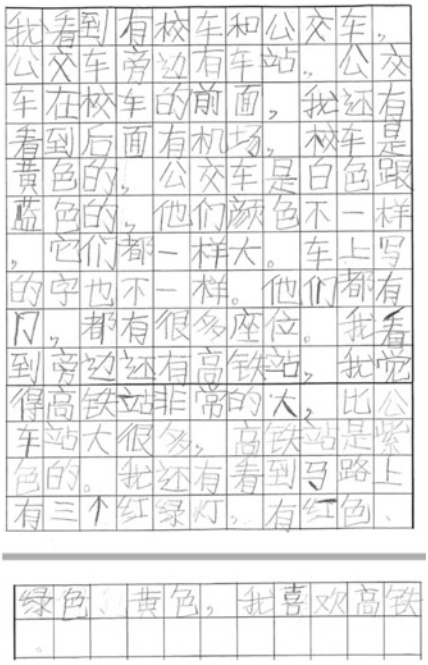
The following summary was collected after the last class session of each writing instructions. Regarding the affective questions, the student did not find it to be pleasant when learning Mandarin Chinese, but it was better than learning English. He said: "Learning Mandarin Chinese is boring but better than learning English." He did not understand how learning Mandarin Chinese can bring any benefits to his daily life. He said: "I think it is useless." He thought his Mandarin Chinese abilities were fine. He said: "I think I am doing fine!" For education-related questions, he thought Mandarin Chinese activities were boring and too hard. He said: "I think it is too hard. Let's learn something easy." He only wanted to do easy tasks with Mandarin Chinese. He did not enjoy Mandarin Chinese classes. He said: "I do not like Mandarin Chinese classes." The student did not understand the benefits of learning Mandarin Chinese can bring. He said the only time he uses Mandarin Chinese was when he searches up videos online. After the VIWI, the student had a better attitude toward Mandarin Chinese learning. He enjoyed the activities by using SL. The student thought learning Mandarin Chinese using SL was very fun. He said: "Using SL to learn Mandarin

(a)



There are three different transportations. There is a speed rail train. They are all blue. There is a school bus and its yellow. They all have doors. There is a public bus and its blue. I see there are words on it. There are people. I see traffic light over there. There are many traffic lights.

(b)



I see there is a station beside the school bus and public bus. The public bus is in front of the school bus. I also see there is an airport in the back. The school bus is yellow. The color of the public bus is both white and blue. They have different colors, and their size is different. The words written on them are different as well. They both have doors and lots of seats. I see there is a speed rail train station on the side. I think it is very big. It is much bigger than the public bus station. The speed rail train station is purple. I also see there are three traffic lights on the road. They are red, green, and yellow. I like the speed rail train.

Fig. 5.13 Essays by participant: comparisons between different transportations. **a** from TWI. **b** from VIWI

Chinese is super fun!" He would work harder and was willing to practice more with SL. He would like to continue working on Mandarin Chinese using SL.

5.11 Summary of the 3D Virtual Reality Learning Attitude Questionnaire

The following information was collected after the VIWI. About how much he liked 3D Virtual Reality Learning, the student stated he loved it because he loved using the computers to learn. He liked the fact that he got to "walk around in the pictures." He loved all the activities and wanted to "walk" around in the SL for the whole day. He loved "walking" around in the scenes and looked at different items within it. He said: "I want to get on the bus and ride home with mom." The operation of the activities on the computer was very easy for him. The students had no problem operating within each scene in SL.

5.12 Discussion

Each individual with ASD is unique and requires individualized designed programs. Regardless of whether primary instruction occurs in general education or individual education classrooms, individualized programming is a critical element in when teaching to individual with ASD. It is crucial for education professionals to have a better understanding of the unique learning styles of students with ASD. This research was to aim to find better writing instruction for the participant with ASD to increase his Mandarin Chinese learning attitude and Mandarin Chinese essay writing skills.

The internet has formed a new way for individuals to communicate, learn, and develop critical thinking skills. Many researchers looked into the influences that virtual environments have brought into the education field (Godwin-Jones, 2011; Keskitalo, Pyykko, & Ruokamo, 2011; Yilmaz, Bayda, Karakus, & Goktas, 2015). According to Jena's (2016) research results, there is a correlation between learning readiness, attitude, and learning style, and each of these factors influences the effective use of the virtual learning environment. One of the purpose of this study was to find out the influences that virtual environment platform could bring for the individuals with ASD and also was eager to see if it will make changes to the participant's learning attitude. According to the findings of the oral interview, class observations, and learning outcomes, the participant was much eager to participate and learn during with the incorporation of virtual environment platform. Not many researchers have examined in the same direction of this research, which made the findings of this research unique.

Another unique features of this study was that it explicitly aimed to answer questions about the influences that the virtual environment could have for individuals with ASD. Individuals with ASD face many challenges in life, but most individuals with ASD have in common are strong visual skills. For children with ASD, it is important for teachers and caregiver to better utilized visual supports. According to Brandner (2017), "Images not only improve memory and recall but also help the child to comprehend information and express their thoughts."

A surprise finding from this research results was also the growth of the participant's spatial concept. At the start, the participant was not able to show the awareness of spatial concepts in his mind maps, but later on, he was able to both show it verbally and also in his mind maps. Rao and Gagie (2006) mentioned, supporting the development of problem-solving through the use of embedded visual instruction using a problem-solving poster will contribute to the reduction of stress associated with not knowing how to handle difficult situations and, in turn, increase appropriate behavior during problem situations. The participant made growth with the visual support provided during this study. The improvements were shown in both the mind map developments and writing activities outcomes.

According to Cromby, Standen, and Brown (1996), virtual environments are effective, affordable, accessible, and safe training and educational media for people with learning disabilities. Recent years, virtual environments have been widely implemented when training t to establish teaching methods for people with disabilities. Pelagia and Goldschmidt (2017) mentioned the initial virtual reality technologies have been unable to sustain engagement with students with ASD. In this study, the participant had a blast by using SL. The participant loved exploring each scene and sparked more conversation between the student and others. When verbally interviewed the participant for his thoughts on the use of SL, he told the researcher that it was fun, and he wishes to use it more during other lessons. Overall, the participant had a very positive experience with the use of virtual immersion instruction with the use of SL. These findings were rare since none other research only focused on the thoughts of people with ASD about the use of virtual environment platform.

5.13 Limitations and Recommendations

Due to the needs and nature of this research, an action research method was used. There was only one participant. The results would be stronger if there were a bigger group of participants involved. Secondly, the duration of this study was short. There were only six 50 min of class sessions for each writing instruction methods. In total there were twelve class sessions combined for the TWI and VIWI. Since this was an action research with one participant, the duration of the study could affect the results of the participant's attitude and learning outcomes. In the future, researchers can consider a more extended period for another study. In future studies, more writing activities should be created to have more data and writing samples.

Appendices

Appendix 1. Parent Consent Form

虚拟实境中文写作教学对自闭症学生中文写作之影响
家长同意书

研究课题：虚拟实境中文写作教学对自闭症学生中文写作之影响
项目顾问：篮玉如博士（国立台湾师范大学）
项目总监：篮玉如博士（国立台湾师范大学）
研究员：罗佩英（英华学院）
电话/电邮：612-636-4033/ann.lo122591@gmail.com
地址：1616 Buchanan Street NE Minneapolis , MN 55413

研究目的：研究证实利用 3D 虚拟实境有助于提升并辅佐语言学习，并有一定成效。
研究过程：在本实验中，参与者将被要求进行中文写作，实验中学生将在写作前利用电脑在虚拟还近中进行真实实验体验活动。参与的学生也将参加前/后侧问卷调查。
研究周期：本研究为期三个月（2018 年 10 月至 2019 年 1 月）。
保密宣言：所有参与研究的个人资料将将受到保密。实验资料分析结果将得到谨慎处理，仅供研究所用，不对外公开。
相关影响：我们已和相关学校人员协调好，这项研究将完全不影响您孩子的正课学习。
研究益处：参与本研究将可能提高您孩子对中文写作的兴趣与能力。
参与研究是自愿的：如果您的孩子不想参与本研究项目，或于研究中途希望退出研究项目，您可以随时以书面形式通知研究员。
其他资讯：若您对本研究项目有任何疑问，尽管联系项目总监。
家长声明

本人已获知上述研究项目及信息，并**同意/不同意**我的孩子参与该项研究。

家长签字： 日期：
家长姓名： 学生姓名：

The Study of "An Investigation into Virtual Environments on Mandarin Chinese Writing with Student with Autism—A Case Study at Yinghua Academy" Consent Form (For Parents).

Title of project: An Investigation into Virtual Environments on Mandarin Chinese Writing with Student with Autism—A Case Study at Yinghua Academy.

Project Consultants: Dr. Lan (National Taiwan Normal University, NTNU)

Project Director: Dr. Lan (National Taiwan Normal University, NTNU).

Researcher: Pei-Ying, Lo (Yinghua Academy).

Telephone/Email: Pei-Ying, Lo—612-636-4033/ann.lo122591@gmail.com.

Address: 1616 Buchanan Street NE Minneapolis, MN 55413.

Purpose of the study: Research has shown that the use of 3D virtual environments has positive results in language learning.

Procedures to be followed: In the study, the participant will be required to write Chinse essays. The participant will have experience in 3D Virtual World via computers before writing. Participants will also be required to participate in pre/post-surveys.

Duration: This study will commence.

Confidentiality: The participant's personal details will remain confidential. All reasonable measures to protect the confidentiality of your child's identity will be taken.

Interference: We have communicated and made an arrangement with the participating staffs at Yinghua Academy so that this study will not affect the learning of the usual curriculum of your child's.

Benefits: Participation in this study may raise your child's interest in learning Chinese and improve your child's Chinese writing skill.

Participation is voluntary: If you decide to opt or discontinue your child's participation in this research, you are free to withdraw at any time by writing to the researcher.

More information: You are encouraged to contact the project director if you have any queries or concerns about this study.

Acknowledgement (Please circle as appropriate):

I was informed of the abovementioned project and its details, and I **agree/disagree** that my child participates in the project.

Signature of Parent Date:
Name of Parent Name of Student:

Appendix 2. Detail Lesson Plans for the Writing Activities (TWI and VIWI)

Writing Activity One: describe the scene: kitchen

Activity one: describe the scene: kitchen	
Time Duration	• Activity will be presented over two class periods (50 min each)
Goal:	• Describe the scene with structured descriptions
Objectives:	• Describe the scene: – Describe the scene using details within
Overview of the activity:	• *Traditional Writing Instruction:* Use colored 2D pictures of the kitchen for student to describe the scene in details • *Second Life Writing Instruction:* Use the kitchen room in Second Life for student to describe the scene in details

(continued)

(continued)

Materials:	• Second Life scene of the kitchen (VIWI) • 3 Colored 2D pictures of the screen shots from the kitchen scene (TWI) • Papers for mind map drawing to plan prior to writing the essay • Grid papers for writing the essay	
First class session		
Time	Content	Notes
5 min	• Overview for the day – "For this class period, we will be talking about how to describe a room/scene. First, I will show you some pictures of a kitchen then we will use mind map to plan what we will be writing about it for our next class"	Traditional writing instruction
	• Overview for the day – "For this class period, we will be talking about how to describe a room/scene. First, I will show you a scene in Second Life then we will use mind map to plan what we will be writing about it for our next class"	Second Life writing instruction
20 min	• Talk about describing the room using structured descriptions by following these steps: (1) Describe the room as a whole (2) Describe the room in details • Talk about sentence structure that can be used and vocabularies that might be unfamiliar to the student	
25 min	• Present the colored 2D picture of the kitchen to the student along with the sentence structure and vocabularies that were disgusted • Start planning for the essay using mind map	Traditional writing instruction
	• Present the kitchen scene in Second Life to the student along with the sentence structure and vocabularies that were disgusted • Start planning for the essay using mind map	Second Life writing instruction
Second class session		

(continued)

(continued)

2 min	• Overview for the day – "For this class period, we are going to review the mind map, sentence structures, and vocabularies from last class period about the kitchen room. Then we will start the writing activity. While you are writing your essay, you will still have access to the pictures, mind map, sentence structures, and vocabularies. You will have 45 minutes to write so you will have plenty of time"	Traditional writing instruction
	• Overview for the day – "For this class period, we are going to review the mind map, sentence structures, and vocabularies from last class period about the kitchen room. Then we will start the writing activity. While you are writing your essay, you will still have access to Second Life, mind map, sentence structures, and vocabularies. You will have 45 minutes to write so you will have plenty of time"	Second Life writing instruction
3 min	• Review the mind map, sentence structure, and vocabularies with the student before letting student start writing the essay	
45 min	• Start writing	
Activity two: going to the convenience store		
Time duration	• Activity will be presented over two class periods (50 min each)	
Goal:	• Describe the scene with structured descriptions in certain order	
Objectives:	• Describe the scene: – Describe the scene using details within – The details describe should follow a certain order, for example from left to right	
Overview of the activity:	• *Traditional Writing Instruction:* Use colored 2D pictures of the convenience store for student to describe the scene in details and follow a certain order • *Second Life Writing Instruction:* Use the convenience store in Second Life for student to describe the scene in details and follow a certain order	

(continued)

(continued)

Materials:	• Second Life scene of the convenience store (VIWI) • 3 Colored 2D pictures of the screen shots from the convenience store scene (TWI) • Papers for mind map drawing to plan prior to writing the essay • Grid papers for writing the essay	
First class session		
Time	Content	Notes
5 min	• Overview for the day – "For this class period, we will be talking about how to describe a room/scene and follow a certain order. First, I will show you some pictures of a convenience store then we will use mind map to plan what we will be writing about it for our next class"	Traditional writing instruction
	• Overview for the day – "For this class period, we will be talking about how to describe a room/scene. First, I will show you a scene in Second Life then we will use mind map to plan what we will be writing about it for our next class"	Second Life writing instruction
20 min	• Talk about describing the room using structured descriptions and in certain order by following these steps: (1) Describe the room by using details within (2) Start with a certain direction such as from left to right • Talk about sentence structure that can be used and vocabularies that might be unfamiliar to the student	
25 min	• Present the colored 2D picture of the convenience store to the student along with the sentence structure and vocabularies that were disgusted • Start planning for the essay using mind map	Traditional writing instruction

(continued)

(continued)

	• Present the convenience store scene in Second Life to the student along with the sentence structure and vocabularies that were disgusted • Start planning for the essay using mind map	Second Life writing instruction
Second class session		
2 min	• Overview for the day – "For this class period, we are going to review the mind map, sentence structures, and vocabularies from last class period about the convenience store. Then we will start the writing activity. While you are writing your essay, you will still have access to the pictures, mind map, sentence structures, and vocabularies. You will have 45 minutes to write so you will have plenty of time"	Traditional writing instruction
	• Overview for the day – "For this class period, we are going to review the mind map, sentence structures, and vocabularies from last class period about the convenience store. Then we will start the writing activity. While you are writing your essay, you will still have access to Second Life, mind map, sentence structures, and vocabularies. You will have 45 minutes to write so you will have plenty of time"	Second Life writing instruction
3 min	• Review the mind map, sentence structure, and vocabularies with the student before letting student start writing the essay	
45 min	• Start writing	
Activity three: comparisons between different transportations		
Time duration	• Activity will be presented over two class periods (50 min each)	
Goal:	• Comparison between different transportations	

(continued)

(continued)

Objectives:	• Compare different transportations – Describe different transportations – Then compare different transportations
Overview of the activity:	• *Traditional Writing Instruction:* Use colored 2D pictures of the transportations for student to describe the scene in details and follow a certain order • *Second Life Writing Instruction:* Use the transportation stations scene in Second Life for student to describe the scene in details and follow a certain order
Materials:	• Second Life scene of the transportation stations on computer (VIWI) • 3 Colored 2D pictures of the screen shots from the transportation stations scene (TWI) • Papers for mind map drawing to plan prior to writing the essay • Grid papers for writing the essay

First class session

Time	Content	Notes
5 min	• Overview for the day – "For this class period, we will be talking about how to describe a room/scene and follow a certain order. First, I will show you some pictures of the transportation stations then we will use mind map to plan what we will be writing about it for our next class"	Traditional writing instruction
	• Overview for the day – "For this class period, we will be talking about how to describe a room/scene. First, I will show you a scene in Second Life then we will use mind map to plan what we will be writing about it for our next class"	Second Life writing instruction
20 min	• Talk about Comparison between different transportations by following these steps: (1) Describe different transportations (2) Compare different transportations • Talk about sentence structure that can be used and vocabularies that might be unfamiliar to the student	

(continued)

(continued)

25 min	• Present the colored 2D picture of the transportation stations to the student along with the sentence structure and vocabularies that were disgusted • Start planning for the essay using mind map	Traditional writing instruction
	• Present the transportation stations scene in Second Life to the student along with the sentence structure and vocabularies that were disgusted • Start planning for the essay using mind map	Second Life writing instruction
Second class session		
2 min	• Overview for the day – "For this class period, we are first going to review the mind map, sentence structures, and vocabularies from last class period about comparison between different transportations. Then we will start the writing activity. While you are writing your essay, you will still have access to the pictures, mind map, sentence structures, and vocabularies. You will have 45 minutes to write so you will have plenty of time"	Traditional writing instruction
	• Overview for the day – "For this class period, we are going to review the mind map, sentence structures, and vocabularies from last class period about the comparison between different transportations. Then we will start the writing activity. While you are writing your essay, you will still have access to Second Life, mind map, sentence structures, and vocabularies. You will have 45 minutes to write so you will have plenty of time"	Second Life writing instruction

(continued)

(continued)

3 min	• Review the mind map, sentence structure, and vocabularies with the student before letting student start writing the essay	
45 min	• Start writing	

Appendix 3. One-Month Gap Lessons Overview

Days	Lessons	Lesson's title
Day 1–5	Characters: 人、火、冰、田、水、手、山、眼、奶、猫、云、蛋、刀、花、马 Vocabularies: 火车,上课,失火了,雪人,巨人,冰块,冰箱,喝水,手套,山洞,眼球,爬山,手表	L1 笔画在字的里面 (Strokes) L2 快乐学中文 (Learning Chinese happily)
Day 6–10	Characters: 人、火、冰、田、水、手、山、眼、奶、猫、云、蛋、刀、花、马 Vocabularies: 唱歌,画图,写字,跳舞,问好,说话,快快乐乐学中文,合唱,听写,名字,打字,问题,好心,好棒,快跑	L1 笔画在字的里面 (Strokes) L2 快乐学中文 (Learning Chinese happily)
Day 11–15	Characters: 人、火、冰、田、水、手、山、眼、奶、猫、云、蛋、刀、花、马 Vocabularies: 快点,游乐场,音乐,学校,中间,中国,文具,眼镜,牛奶,奶奶,乌云,熊猫,蛋糕,剪刀,花瓶,马车,鳥字,說話,問好	L1 笔画在字的里面 (Strokes) L2 快乐学中文 (Learning Chinese happily)
Day 16–20	Characters: 我、多、不、怕、是、校、爱、书、老、师 Vocabularies: 我自己,我们,校车,老鼠,老虎,厨师,书包,多汁,多云,书柜,有爱心,害怕	L3 我爱学习 (I love learning!)
Day 21–25	Characters: 我、多、不、怕、是、校、爱、书、老、师 Vocabularies: 我自己,我们,校车,老鼠,老虎,厨师,书包,多汁,多云,书柜,有爱心,害怕	L3 我爱学习 (I love learning!)
Day 25–30	Characters: 我、多、不、怕、是、校、爱、书、老、师 Vocabularies: 我自己,我们,校车,老鼠,老虎,厨师,书包,多汁,多云,书柜,有爱心,害怕	L3 我爱学习 (I love learning!)

Appendix 4. Mandarin Chinese Writing Attitude Questionnaire

中文写作态度调查问卷
Mandarin Chinese Writing Attitude Questionnaire

问题 (Questions)	非常不同意 (Extremely disagree)	不同意 (Disagree)	同意 (Agree)	非常同意 (Extremely agree)
1. 我觉得我无法成功写出一篇中文作文。(I feel I cannot successfully write a Chinese essay.)				
2. 我写中文作文,因为我想让其他人知道我可以做得很好。(I write Chinese essays, because I want people to know that I can do very well.)				
3. 如果我希望提升我的中文,我需要写中文作文。(If I want to improve my Chinese, I need to do Chinese compositions.)				
4. 写中文作文对于日常生活和中文学习是很有帮助的。(Writing Chinese essays is useful for my daily life and learning Chinese.)				
5. 我可以用中文作文表达我的想法和情感并且很享受写作过程。(I can express my thoughts through writing essays and enjoy writing.)				
6. 我认为可以通过更难的写作任务,提升我的中文。(I think that I can improve my Chinese better by doing more difficult writing tasks.)				
7. 我喜欢写中文作文。(I enjoy writing Chinese compositions.)				

(continued)

(continued)

问题 (Questions)	非常不同意 (Extremely disagree)	不同意 (Disagree)	同意 (Agree)	非常同意 (Extremely agree)
8. 我不介意做中文写作的任务。(I do not mind doing Chinese writing and assignments.)				
9. 我觉得中文写作任务很无趣。(I find Chinese writing tasks boring.)				
10. 我觉得我的华文作文没有新意,让我很厌烦写作。(I think my Chinese writing is not original and I am bored with writing.)				
11. 当我的中文能提升时,我感到很高兴。(I feel excited when my Chinese skills are improved.)				
12. 我喜欢写中文作文,因为这让我感到很开心。(I like writing Chinese essays because it makes me happy.)				
13. 我写中文作文因为我想和我的朋友保持亲密的关系。(I write Chinese essays because I want to maintain close relationships with my friends.)				
14. 当我完成了中文写作任务我觉得很满足。I feel satisfied when I finish the Chinese writing tasks.				
15. 我觉写中文作文很有趣。(I find writing Chinese composition is interesting.)				

(continued)

(continued)

问题 (Questions)	非常不同意 (Extremely disagree)	不同意 (Disagree)	同意 (Agree)	非常同意 (Extremely agree)
16. 如果我的华文写作成绩比我预期要好,我会感到很兴奋。(I will be very excited if my Chinese writing is better than I expected.)				
17. 我不知道我为什么要写中文作文。(I do not know why I have to write Chinese essays.)				
18. 当我写中文作文时我觉得很兴奋。(I feel excited when I write Chinese essays.)				
19. 我觉得写华文作文浪费时间精力。(I think that writing Chinese essays is wasting my time and energy.)				
20. 我在写中文作文时不知道应该写什么,让我沮丧。(I do not know what to write while writing Chinese essays, which makes me frustrated.)				
21. 我覺得寫中文作文很難,我不喜歡。(I think writing Chinese essays is difficult, I do not like to write Chinese essays.)				

Appendix 5. Mandarin Chinese Learning Attitude Questionnaire

中文学习态度调查问卷

Mandarin Chinese Learning Attitude Questionnaire

问题 (Questions)	非常不同意 (Extremely disagree)	不同意 (Disagree)	同意 (Agree)	非常同意 (Extremely agree)
1. 我可以从学中文的过程中得到乐趣。(I find great pleasure in learning Chinese.)				
2. 当遇到和课程中学习内容相似的情况时,我有信心能和说中文的朋友用中文沟通。(I have the confidence to communicate with a Chinese.)				
3. 说中文能让我从事更好的、更有趣的工作。(If I can speak Chinese, I can find more interesting jobs.)				
4. 中文课里的任务活动很有趣,对我的中文能力也有帮助。(The language tasks in our Chinese lessons are interesting and helpful!)				
5. 学习中文可以扩展我的视野。(Learning Chinese broadens my horizons.)				
6. 我常常思考如何把中文学得更好。(I often think about how I can learn Chinese better.)				
7. 中文让我成为更有竞争力的求职者。(Chinese will makes me more competitive in job market.)				
8. 我喜欢学中文。(I enjoy learning Chinese.)				
9. 学习中文对我未来的事业有帮助。(Learning Chinese is helpful for my future career.)				

(continued)

(continued)

问题 (Questions)	非常不同意 (Extremely disagree)	不同意 (Disagree)	同意 (Agree)	非常同意 (Extremely agree)
10. 我的中文沟通技巧不错。(My communication ability in Chinese is good.)				
11. 我觉得中文课里的任务活动对于提高我的中文水平很有用。(I found the task-based lessons we have done were useful to improve my Chinese.)				
12. 如果我在中文课表现得很好,是因为我很努力。(If I do well in this course, it will be because I work hard.)				
13. 我会尽全力学习中文。(I put in all my efforts in learning Chinese.)				
14. 我对中华文化、历史及文学有兴趣。(I am interested in Chinese culture, history and/or literature.)				
15. 如果我被要求在中文课发言会觉得不舒服。(I feel uncomfortable if I am asked to speak in my Chinese class.)				
16. 我觉得我的中文还不错。(I think my Chinese is quite good.)				
17. 学中文帮助我了解说中文的人和他们的生活方式。(Learning Chinese helps me understand Chinese-speaking people and their way of life.)				

(continued)

(continued)

问题 (Questions)	非常不同意 (Extremely disagree)	不同意 (Disagree)	同意 (Agree)	非常同意 (Extremely agree)
18. 我认为学习中文能让我得到更好的教育机会。(I think learning Chinese will enable me to get a better education opportunity.)				
19. 我会持续学习中文。(I will keep learning Chinese.)				
20. 如果我在中文课上表现不好,是因为课程太难了。(If I do not do well in Chinese classes, it is because the lessons are too hard.)				
21. 学习中文让我觉得很有成就感。(Learning Chinese makes me feel successful.)				

Appendix 6. 3D Virtual Reality Learning Attitude Questionnaire

学习者运用3D虚拟实境学习态度访谈表

3D Virtual Reality Learning Attitude Questionnaire

1. 这学习老师利用3D 虚拟情境教学,你喜欢这样上课吗?为什么?(Do you like using Second Life in class? Why?)
2. 这学期老师利用3D 虚拟情境教学,你觉得这样的课程有趣吗,为什么?(Do you think the incorporation of Second Life in lessons made them more interesting? Why?)
3. 这学期老师利用3D 虚拟情境教学,你觉得这样得课程可以帮助你学习吗?为什么?(Do you think Second Life helped you learn better? Why?)
4. 这学期老师利用3D 虚拟情境教学,你觉得这样的课程设计可以帮助你上课专心吗?为什么?(Do you think these type of lessons made you more focused in class? Why?)
5. 这学期老师利用3D 虚拟情境教学,你觉得这样的课程设计可以加深你的学习印象,不容易忘记吗?为什么?(Do you think the concepts in each lessons are more memorable for you due to the use of Second Life? Why?)

6. 你觉得使用3D 虚拟情境容易操作吗?为什么?如果不是,是有哪些问题呢?(Do you think Second Life is user friendly? Why? If not, what are some issues that you encounter?)
7. 你觉得使用3D 虚拟情境学习很顺利,有没有遇到过让你等很久、当机或其他问题呢?如果有,是哪些?(Were there any problems occurred while you were using Second Life, such as waiting for long time, program not running, or etc.? If you, what are some problems you encountered?)
8. 如果有时间,你会想再上一个学期的3D 虚拟情境教学吗?为什么?(If there are more time, would you like to have more instructions with Second Life? Why?)
9. 你最喜欢哪一个3D 虚拟情境?为什么?(Which scene was your favorite from Second Life? Why?)
10. 对于这次老师使用3D 虚拟情境教学,你希望哪些地方做修改或是你还有什么要建议的事项呢?(Do you have any recommendations for me?)

Appendix 7. Writing Rubric

Writing Rubric

Categories (评量项目)	Points (分值)	Standard (标准)
Content (内容) (4)	5	符合文章主题,描述较为生动,有3处细节描写
	4	基本符合文章主题,描述普通,有2-3处细节描写
	3	不太符合主题,描述单调,只有1处细节
	2	不太符合主题,缺乏细节描述
	1	不符合主题
Organization(组织) (4)	5	结构完整,条理较为分明,按照一定的描写顺序描写
	4	结构基本完整,条理基本清楚,描述顺序不太明显
	3	结构不太完整,条理不太分明,描述顺序混乱
	2	结构不完整,条理不分明,无描述顺序
	1	结构不完整,调理不分明,描述无逻辑结构
Vocabulary(词汇) (4)	5	词汇生动形象,使用恰当
	4	词汇恰当
	3	词汇单调
	2	词汇单调,使用不恰当
	1	词汇使用错误较多
Grammar (文法) (4)	5	语句通顺流畅,句式多样
	4	语句大部分通顺流畅,句式较多
	3	语句基本通顺,能正确使用常见句式
	2	语句不通顺,句式简单且错误较多

(continued)

(continued)

Categories (评量项目)	Points (分值)	Standard (标准)
	1	大量错误,文不达意
Punctuation (标点符号) (4)	5	汉字和标点错误在2个以下
	4	汉字和标点错误在3个以下
	3	汉字和标点错误在4个以下
	2	汉字和标点错误在5个以下
	1	汉字和标点错误在6个以上

Appendix 8. Lesson Transcripts: Describe the Kitchen (TWI and VIWI)

TWI:

At the start of the first class session, the teacher began by pointing to the pictures and asked: "What do you see in the pictures?"

The student answered: "This is a kitchen."

The teacher then further prompted him and said: "What do you see in these kitchen pictures?"

The student paused and started answering slowly: "I see a table. There are banana and apple up there."

The teacher then asked: "Anything else?"

The student pointed to the refrigerator and answered: "There are a refrigerator and a person. I also see a chair."

He then looked at the picture again and saw the pot in the back with a fish on top of the counter and said: "There is a pot. And on top of there, is a fish."

Then he said: "I am done with this."

The end.

VIWI:

At the start, the teacher asked: "What do you see?"

The student was moving the avatar around in the kitchen scene toward the table and said: "I see the brother sitting on the chair."

He then circled the avatar around the table about five times.

The student said: "I also see there is a table, and there are watermelon, banana, apple, and cucumber on it."

He moved the avatar toward the cabinet beside the table.

The teacher prompted: "Anything else?"

The student answered: "I see a cabinet."

The student moved the avatar to the other side of the kitchen towards the stove. He said: "There is also a stove. On top of it, there is a pot. I think I also see the fried egg in there."

He turned the avatar around toward the refrigerator.
He said: “I see the refrigerator and a person.”
The end.

Appendix 9. Going to Convenience Store

TWI:

The teacher began by pointing to the pictures and asked: “What do you see in the pictures?”

The student was excited to see the cake and said: “I see a cake! I see a cake!”

He then noticed there was a table on the side, and he said: “I see there is a table and has coffee on it.”

The teacher prompted again: “Anything else?”

Afterward, he saw the printer and said: “There are printers, too.”

The student then added and said: “I also see there are chairs.”

The end.

VIWI:

The teacher first asked: “What do you see?”

The student moved the avatar in front of the cooler and said: “Wow! There is a chocolate cake in the cooler! And a pizza!”

He moved the avatar around the cooler two times then headed behind the cooler toward the cabinet. He said: “There is a cabinet here. There are chocolate, potato chips, and lollipops!” He moved the avatar toward the back of the store then turned back to explore at the front near the entrance.

Followed by the observation of the table on the side and he said: “There is a table over there. There is coffee, and microwave up there.”

He moved the avatar around at the front of the store. He was looking around at the area with chairs and table before he moved the avatar toward the back of the store again. He then said: “Here is a refrigerator full of beverages.”

The teacher then asked: “Anything else?”

He moved the avatar away from the refrigerators and moved toward the cabinet again then he realized that there was a fan on the roof. He answered: “Ah! There is a fan up there!”

Then he started moving the avatar toward the front of the convenience store and said: “There is a cart. Oh! Over there on the door, there are words. There are English words. It says Hi-Life.”

The end.

Appendix 10. Comparisons Between Different Transportations

TWI:

First, the teacher asked: "What do you see in the pictures? What are some similarities and differences that you see here?"

The student was very excited when he saw the pictures of different transportations. He eagerly answered: "I see the school bus and public bus."

The teacher asked: "Anything else? What do they have in common? What are some differences?"

The student looked at the picture for a while and answered: "Public bus and school bus both have doors. School bus is yellow, and the public bus is white."

Then he saw the speed rail train station and said: "There is a speed rail train."

He also added and said: "There are traffic lights at the back."

The end.

VIWI:

The teacher asked: "What do you see? What are some similarities and differences that you see here?"

The student was very excited and immediately moved the avatar toward the bus and circled it about three times.

The student said: "There is a school bus. It is big, has many seats, and it is yellow. Hmm, there is also STOP written on it."

He circled around the school bus a few more times then moved toward the public bus. When looking at the public bus, he said: "The public bus is big, and has a door as well. The top of it is white, and it also has windows."

He circled around the public bus then moved back to the school bus again before heading toward the public bus station. He moved the avatar to the other side of the bus and said: "There is a small public bus stop, there are seats and many people."

He was moving the avatar around between the school bus and the public bus. He was going back and forth between the two buses. About three minutes later, he moved toward the speed rail train station. When he saw the speed rail train station, he said: "Wow, it is enormous and purple."

The end.

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Chapter 6
Exploring the Possibility of Using a Humanoid Robot as a Tutor and Oral Test Proctor in Chinese as a Foreign Language

Hsuan Li, Da Yang, and Yoshihiro Shiota

Abstract College students studying foreign languages have the capability to learn vocabulary and grammar and can practice listening, reading, and writing skills by themselves, but they often lack opportunities for speaking and conversation. Robot-assisted language learning (RALL) provides a solution. In this paper, we present an exploratory study on using humanoid robots as tutors to automatically conduct dialogue-based tests with freshman. In the test, students examine pictures, listen to questions asked by the robot, and then say an answer. The test has three parts: answer freely, choose the correct answer by speaking the number, and read the sentence aloud, listen to some options, and choose the best sentence. After each answer, through speech to text (STT) technology, the students' responses will display on a screen immediately so that the students can ascertain whether their pronunciation or speech output is correct. In this paper, we describe the test design and setup and conduct a preliminary experiment. Finally, we provide an analysis from observations of video data and from students' comments and discussion. We also identify some necessary improvements for the robot, such as improving its sensitivity to the foreign language learner's voice.

Keywords Robot-Assisted Language Learning (RALL) · Human–Robot Interaction (HRI) · Educational robot · Chinese as a Foreign Language (CFL)

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6.1 Introduction

The development of science and technology has brought more possibilities to language teaching and learning. Technology-enhanced language learning (TELL) has facilitated unusual and novel teaching forms, such as learner-centered teaching, personalized learning, immediate feedback, practice through agents, and diversified learning styles. Furthermore, learning environments have also extended from physical classrooms to online virtual worlds (Golonka, Bowles, Frank, Richardson, & Freynik, 2014; Kessler, 2018). One new form of technology is robotics. Robot-assisted language learning (RALL) uses robots to improve people's language expression and skills (such as listening, speaking, reading, and writing). RALL can support both native and non-native language skills as well as verbal and non-verbal language skills, such as sign language (Randall, 2019). Other advances in technology, such as automatic speech recognition (ASR), text to speech (TTS), and speech to text (STT), have promoted the development and application of commercial and research robots for language learning. RALL has developed rapidly in recent years, and the techniques and research related to the concept have promoted the understanding of language acquisition (Randall, 2019).

Language education is in great demand from elementary school to college and even to adults who have otherwise completed their studies. In Japan, freshman need to study a second foreign language in addition to English. In Waseda University in Japan, Chinese as a second foreign language classes are generally large, with about 35 to 40 students and a single teacher in each class. In order to effectively teach a foreign language in a large class, the existing teaching materials have been designed sequentially by combining a physical textbook (including vocabulary, grammar explanations, articles, and listening and translation exercises), audio recordings, and an online learning system focused on listening, typing, and word order exercises. The teaching methods are a combination of physical teaching (including teacher teaching, multimedia assisted teaching, and teaching activities) and students' individual online learning in the classroom. At present, the teaching materials and teaching methods focus on reading, grammar, listening, and word order training. For oral skill development, there is a lack of opportunities for practical practice and no suitable mechanism for real assessment of oral ability. When taking an oral test, each student needs to read aloud an assigned text, and the teacher judges the pronunciation and grades it. Since there is only one teacher in the class, during oral teaching activities students mainly practice with two or three peers, in addition to answering the teacher. However, lower intermediate students are often unable to accurately inform each other of any speech problems. Therefore, students have no reliable way to confirm whether their own pronunciation or the sentences they read aloud are correct or not. In the past, teachers and students had to talk face-to-face to assess oral ability. RALL provides a feasible alternative.

Our purpose is to explore the possibility of using a humanoid robot as a tutor to automatically conduct a dialogue-based test in Chinese as a foreign language. The target users are freshman whose native languages are Japanese and who are

studying Chinese as a foreign language. First, we designed the robot with its own teaching style and dialogue-based test. In the test, students look at a picture displayed by the robot and use language skills, including listening, speaking, and reading, to answer the question asked by the robot. After each answer, through STT technology, what the student says will be converted into text and be presented on the screen, allowing students to immediately know if their pronunciation or speaking output is correct. Next, we conducted a preliminary experiment. We aim to address three main questions in this study: (1) to explore the possibility for robots as tutors to automatically guide freshmen by conducting a group test (2) to observe robot-human interactions during the test (3) to identify improvements required of the robot in this setting.

6.2 Related Work

6.2.1 Robot-Assisted Language Learning

RALL is a way of teaching that is distinct from using computers, tablets, mobile phones, and intelligent agents. Humanoid robots are characterized by automation, three-dimensional spatial entity, repeatability, flexibility, digitization, humanoid appearance, body movement, interaction, anthropomorphism (Chang, Lee, Chao, Wang, & Chen, 2010) and human–robot Interaction (HRI) (Han, 2012; Randall, 2019). Compared with other forms of TELL, RALL has at least two advantages. First, learners can interact with the real physical environment and learn the language from it. Second, both children and adults tend to personify the robot. Users used more interactional features of language toward robots, such as directly addressing them by name (Fischer, Lohan, & Foth, 2012). In this atmosphere, robots provide users with a more natural and real interaction than other technological tools (van den Berghe, Verhagen, Oudgenoeg-Paz, van der Ven, & Leseman, 2018).

Some surveys collating previous RALL-related research pointed out that in both first and foreign languages, the role of the robot is as a teacher, teaching assistant, tutor, peer tutor, peer learner (van den Berghe et al., 2018), partner in solving a task, opponent in a game, social companion (Engwall, Lopes, & Åhlund, 2020), student, and native speaker (Han, 2012). The learners can be divided into preschool, school-age, and adult, among which there are few studies on learners younger than 2 and adults (Randall, 2019; van den Berghe et al., 2018). RALL can be implemented in class, after class, and during leisure time (Lin, Lin, & Shen, 2019). Besides language ability, robot collaborative learning also affects students' learning strategies, motivation, and emotions. Some research has established that robots can be effective in a language classroom (Randall, 2019; van den Berghe et al., 2018).

6.2.2 RALL for Undergraduates or Adults

Since this work is developing a robot tutor that is suitable for freshman and is realistic, we focus on the research using humanoid robots and on college students or adults. Compared with RALL for children, there are few studies on college students or adults (Randall, 2019; van den Berghe et al., 2018). The robot can act as a tutor to teach vocabulary (Kose, Akalin, & Uluer, 2014; Schodde, Bergmann, & Kopp, 2017; Wedenborn, 2015), grammar (Ishida, Khalifa, Kato, & Yamamoto, 2016; Khalifa, Kato, & Yamamoto, 2017), and speaking skills as well as lead conversation practice (Khalifa, Kato, & Yamamoto, 2016; Lin et al., 2019; Rosenthal-von der Putten, Strasmann, & Kramer, 2016); a moderator (Engwall et al., 2020; Lopes, Engwall, & Skantze, 2017); a teacher assistant to help human teacher to do the mechanical work in class (Shen, Tsai, Wei, Lin, & Lin, 2019) or a peer learner (Ishida et al., 2016; Khalifa et al., 2016, 2017). We concentrate on related studies where the robot acts as a tutor and in verbal language.

Some RALL studies use humanoid Nao robots. Khalifa et al. (2016) studied Japanese college students whose second language was English using two Wizard-of-Oz controlled Nao robots to conduct a conversation. One robot acted as a teacher to ask questions, and the student and other robot answered, with the second robot acting as an advanced learner of English. In the data, an alignment of utterances between the robots and human was noticed, which means that the human learner imitated the speech or important parts of the response made by the peer-learning robot. In their 2017 study, they used the same two robots to teach human learners tenses through dialogues. The results showed that when specific grammatical answers were repeated across different questions, L2 learners improved their grammar significantly when the peer-learning robot answered first and they answered after. In a study by Rosenthal-von der Putten et al. (2016), three types of AI tutors (the solely language-based agent, a virtual Nao, and a physical Nao robot) were used to lead the speech output activities of a German as a foreign language class, such as introducing a picture in detail, playing a guessing game, playing a search game, and describing a picture. The results showed that there were no differences in evaluation, but the participants were more excited when they met the physical robot when compared to the other two. Lin et al. (2019) designed Nao as the tutor for oral speaking exercises after a English as a second language class in a university in Taiwan. After the practice, the robot provided information such as the correct answer rate by comparing the text content with the text read aloud by the student using ASR and pronunciation level by examining the students' speed of speech.

Some research use the robot head name Furhat. Wedenborn (2015) used three different technologies (a non-embodied voice, an animated face displayed on a screen, and a robot head controlled by Wizard-of-Oz named Furhat) as tutors to teach undergraduate and graduate Russian as a foreign language. The people who interacted with the robot tutor were significantly better at word retention. Lopes et al. (2017) used the social anthropomorphic robot Furhat with Wizard-of-Oz controls as the moderator in a language café. In the experiment, Furhat played the role of a

Swedish native speaker and led the conversation with two Swedish foreign language learners, while a second set of experiments was hosted by real native speaker. The results showed that in almost every dimension, the interaction with the human moderator was significantly better than the one with the robot, but there were no significant differences in their understanding of the moderator, and some participants actually found the robot easier to understand.

Based on the above research, we find that many studies have used robots' dialogue and human-like movement to design language activities and direct learner speech output. However, spoken interaction with a robot may fail when the ASR does not properly detect what a leaner is saying or when the learner does not understand the TTS generated robot utterance. ASR for the foreign language learners is still a challenge because their speech not only contain the pronunciation, lexical, and grammatical errors, but is also sometimes totally disordered and also because ASR has not been trained (Engwall et al., 2020; Khalifa et al., 2016). It is worth noting that in these studies, no related research on RALL was about Chinese as a foreign language. Since Chinese is a tonal language, we need to conduct a preliminary experiment to observe the improvements required of the robot when guiding a Chinese oral test. Besides, robots are not completely autonomous; some are Wizard-of-Oz, for example. These controlled robots are difficult to use for a long time (Lin et al., 2019) and cannot really reduce the burden on teachers or assistances. Therefore, we design our robot as completely autonomous tutor to conduct the test. The robot utterance is generated through TTS, and through ASR and STT technology, what the student says are converted into text and be presented on the screen.

In the social dimension, a peer or collaborative setting can support each other for interpersonal, collaborative language learning (Engwall et al., 2020; Lopes et al., 2017). Also, the human learner imitated the speech or important parts of the response made by the peer-learning robot (Ishida et al., 2016; Khalifa et al., 2016, 2017). As our setting is a group test, we can expect to observe some interpersonal interactions among students.

6.2.3 The Design of the RALL System

We take advantage of the dialogue function of a robot to develop a robot-guided test for freshman that promotes the comprehensive use of students' listening and reading skills while practicing speaking. We chose RoboHoN to be the tutor. In order to make the robot more humane and make the setting close to the Japanese student current learning style, we joined a Chinese as a foreign class to observe the classroom language of the teacher and student learning style. Then we design the test.

6.2.4 The RoboHoN Humanoid Robot

The robot used in this study, RoboHoN, is a social humanoid robot standing 19.5 cm tall and with free movement of head and limbs. When placed on a table, the eyes of the robot are slightly lower than the eyes of sitting students. Compared to Nao, 58 cm tall, RoboHoN can reduce the pressure on students because of the students looking down to the robot instead of looking up. Equipped with a projector and camera on its forehead, the robot can project and take pictures or video in front or below, and it also features facial recognition. Its synthetic voice is modeled on a boy's voice and equipped with four sets of microphones, which are on the two sides of the head, the rear of the head, and behind the hip. RoboHoN adopts Android OS and value-added Scratch functions. In Scratch, STT and TTS in Japanese, Korean, English, traditional Chinese, and simplified Chinese are included. Movement and action can also be programmed, and speaking speed can be adjusted so that language teachers can expand the robot's functions in a simple way and design scripts for teaching activities or dialogues (Fig. 6.1).

The default setting of RoboHoN's utterance is that it will do some corresponding actions when he is saying some key words. Since we also hoped that RoboHoN's teaching process and responses could have its own style and react like a human language teacher, we first conducted classroom observation in a Chinese as a second foreign language classroom for freshman in Waseda University. We joined the second-semester course. Students were almost all native Japanese speakers, and 16.7% of them passed the level 3 Chinese proficiency test held by The Society for Testing Chinese Proficiency, Japan. We designed the teaching style of the robot tutor by referring to the current teaching mode and classroom language of the teachers. The robot explained how the test works in Japanese. After each question and answer, the robot would give a response combining verbal and body movements. Using a little Japanese to be the medium of instruction for Japanese learners in Chinese language

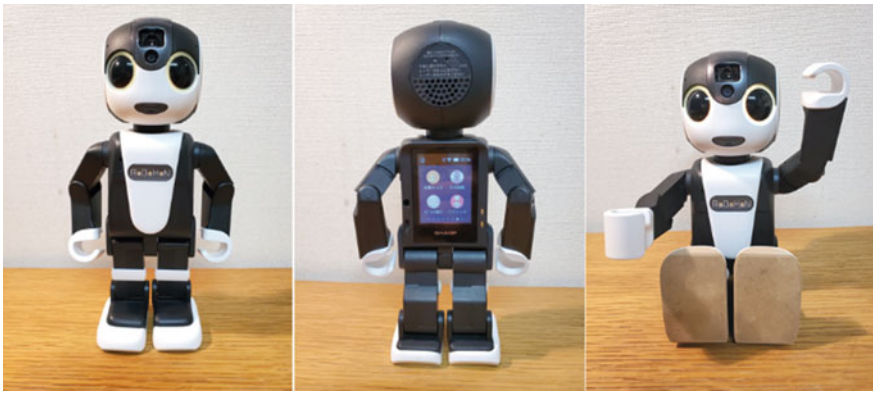

Fig. 6.1 RohoHoN

classroom can regulate the atmosphere and the teacher can praise in Japanese when the student's answer is correct (Takahashi, 2010). We turned to the teachers' classroom language for the robot's responses in Japanese, and we added some phrases to motivate students and interesting responses to build a response database. There were responses to correct answers, such as "オーケー" (okay), "うまい" (good), and "せいかい" (correct answer), and to wrong answers like "だめ、次の人" (wrong, next one), "つぎ、次の人" (next one's turn), and "やりなおし" (redo). The robot randomly chose how to respond.

6.3 Test Design

We designed a dialogue-based unit test. In the test, students used both listening and reading skills as well as oral skills. We chose three pictures from one unit in the textbook, *Basic Chinese 2*, compiled by the SANSHUSHA Publishing Co., Ltd, as the problem stem, and we designed the questions and options in a grouped way. The robot plays the role of tutor, displays pictures, and takes a test with students in a question-and-answer manner.

In the test, the robot first greets the student and introduces itself, including its name in Chinese in conjunction with music and body movements. It then briefly explains the test in Japanese and projects pictures. The test has three parts:

1. Look at the picture and answer freely. In this part, there is one picture and five questions. The robot explains how to answer in Japanese and then asks each question in Chinese. The student speaks out the answer according to the picture. In this section, the student answers freely. As it is aimed at intermediate level learners, we expected students' answers to be grammatically correct. Therefore, the answer database contained an exhaustive list of correct answers that students learned in the textbook, including detailed answers and short answers.
2. Look at the pictures and choose the correct answer by saying the number and reading the sentence aloud. In this part, there is one picture with three descriptions shown on the screen at the same time along with five questions. The robot explains how to answer in Japanese and then asks each question in Chinese. This part of the answer is divided into two stages: first, state the correct choice number, and then the robot displays the correct sentence on the screen for the student to read aloud.
3. Look at the picture, listen to the options and choose the best sentence. There is one picture and five questions. Each question is composed of three descriptive sentences. The robot explains how to answer in Japanese and then says three sentence options in Chinese. Students choose the most suitable description of the picture and state the sentence number (Fig. 6.2).

During the test, one person answers and then the next person answers. Each question provides two chances to answer. After the student answers, the robot immediately identifies the sentence or number through STT technology and displays the text.

Fig. 6.2 The three parts of the test. The pictures are selected from the textbook, *Basic Chinese 2*, compiled by the SANSHUSHA Publishing Co., Ltd

The students immediately know whether the sentence they speak is correct or not. Then the robot responds with a random positive or negative phrase in Japanese and commands the next student to answer. The test consists of 20 questions. Finally, the robot adds up the number of correct answers of the group and shows the score to the students.

6.4 Preliminary Experiment

We completed the system implementation and the content was based on the final lesson of *Chinese Basic 2*. ASR and STT functions were used to judge the learner's speech output. Automatic speech recognition technology for non-native speaker is still a challenge (Engwall et al., 2020; Khalifa et al., 2016). A particular challenge of Chinese is that it is a tonal language. In order to explore the possibility of this RALL system used for Chinese as foreign language learners, we conducted a preliminary experiment. Also, we observed the human–robot interactions and what may happen during the whole operation, including the ASR result.

6.4.1 Experimental Setup

The environment of the preliminary experiment consisted of robot RoboHoN and the students sharing a classroom. The robot was placed on the table first. The robot's projection direction setting was set to project forward, and we placed a white paper as the projection screen. One digital camera was set on the side and a second was set at the back to record the preliminary experimental process. The entire experimental setup was as shown in Figs. 6.3 and 6.4. Each time, five students conducted the experiment as a group. Once the students were seated, the assistant pressed the start button on the screen on the back of the robot. After that, the robot acted as a tutor to guide the test process automatically, conducting question-and-answer test exercises with the students. We estimate the whole exercise took about 10 min. An assistant

Fig. 6.3 Experimental setup (from the camera on the side)

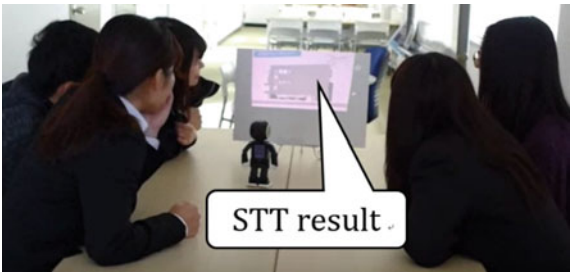

Fig. 6.4 Experimental setup (from the camera at the back)

sat in the back of the classroom to deal with contingencies. Students completing the experiment were asked to fill out a short questionnaire.

6.5 Methodology

We asked the students to fill in a short questionnaire when they finished the experiment. Questionnaire was with basic personal information, 10 questions about the thoughts on the robot-guided oral test (Fig. 6.5), an open-ended question about the

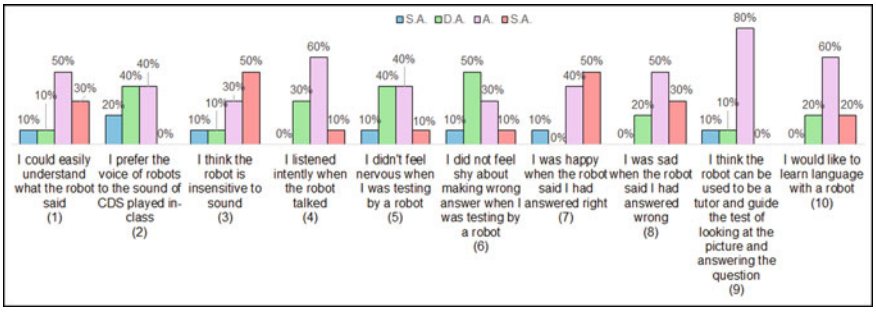

Fig. 6.5 The result of the questionnaire

comments of using a robot to guide a oral test and a question of the suggestion of suitable size of participants. Data was also collected on the students' experience of using robot and RALL. We also transcribed the recordings into verbatim including the student's response time, oral output of student, interaction, ASR result and then do the qualitative description.

6.5.1 Participants

Participants were from a large-sized class of Chinese as a second foreign language students in the first grade of Waseda University. We recruited learners after the entire textbook had been taught. There were ten freshmen, three males and seven females, whose mother languages were all Japanese. Their first foreign language was English, and the second foreign language was Chinese. Two students had used robots before, and none of them had any experience of RALL. We randomly divided the 10 students into two groups for the preliminary experiment.

6.5.2 Limitations

This preliminary experiment was set to observe and explore the students' responses and problems with the interactive test conducted by the robot and to collect the comments of the participants. No control group was set. Each group interacted with the robot for a total of 10–15 min and each student actually only interacted for two to three minutes, few conclusions may be drawn for long-time oral test.

6.5.3 Analysis

Because no control group was set, it was not allowed for a rigorous statistical analysis. However, some observations may nevertheless be made based on the user questionnaires and/or the video recordings to guide the future development. The following describes the result of the questionnaire and the observation from the recordings separately.

6.5.4 User Comments

The result of the four point scale questionnaire is as shown in Fig. 6.5. Questions 1–3 were designed to discover the students' thoughts about the robot's speaking and

listening performance. Half of the students strongly agreed that the robot was insensitive to sound, and 30% simply agreed. Questions 4–8 evaluated the performance and feelings of students during the test. Contrary to our expectations, when testing with robots 40% of students disagreed and 10% strongly disagreed that they were not nervous; 50% disagreed and 10% strongly disagreed that they did not feel shy when making a wrong answer. In the open-ended part of the questionnaire, students also responded with positive emotions, such as "although the robot was strict with the answer but still interesting," and "although it was hard to receive my voice, but having fun learning language with the robot." Another student said it was good because he was less embarrassed when making pronunciation mistakes. Another student felt negatively, stating "I was worried about being dominated by artifacts."

Questions 9–10 were designed to determine the students' view of RALL. In question 9, 80% of students agreed the robot can be used as a tutor and guide the test of looking at the picture and answering the question. In question 10, over 80% of students agreed or strongly agreed that they would like to learn language with a robot. Finally, there was a question about the size of participants: 70% felt the robot and test was suitable for groups of two to five, and 30% felt it was suitable for individuals.

In the open-ended part, some comments were focused on their pronunciation problem, the sound sensitivity of the robot, and the strictness of the ASR. Other responses were: "it is a good idea to read the number first and then practice the correct sentence. I think that answering by number is fine"; "I hope I can hear the correct pronunciation; since everyone's pronunciation is different, due to the current technology, I think it is better for the human teacher to make pronunciation"; "through the robot I could easily learn languages at home, which I think is good."

6.6 Observations from Recordings

6.6.1 Interaction Between Student and Robot

Students are excited about the robot. When they came into the classroom for the experiment and first met the robot, they could not resist saying "cute." They were also surprised when the robot made sound effects, played music, moved around, or smoothly switched the language output between Chinese and Japanese. The students also personified the robot: after the robot said "你好" (nǐ hǎo, hello) in Chinese, the students immediately said "你好" (nǐ hǎo) back. Student A waved and greeted the robot as it faced him. Students also imitated how the robot responds, such as saying "OK." At the end of the experiment, the students in one group finally said "bye bye" in English to the robot in a loud voice. Student A also said "再见" (zài jiàn, goodbye) and "谢谢老师" (xiè xiè lǎo shī, thank you, teacher) to the robot in Chinese. When the other group left, they also waved and said "bye bye."

Quite naturally, the students' confidence and speaking skill level enabled them to communicate with the robot in different ways. In the first part, when the robot

said student A's answer was wrong, student A actively indicated that he would try a second time and not follow the robot's instructions to allow the next person to answer. Then he adjusted his tone on his own for the second speech output. After the robot responded "OK," student A immediately said that he felt a sense of accomplishment in Japanese. It was seen that Student A enjoyed the challenge of letting the robot know what he wanted to say.

Student F thought for quite a long time about how to read aloud the sentence before she read it. She seemed ashamed to look at the robot; she looked at her peers and asked them about the tone of answer with her body language. Student G thought long for other sentences, but he was watching the robot as he thought.

The students with more active performance had better interactions with the robot, and the team atmosphere would affect the interaction between human and machine. In the future, relevant experiments can be designed to evaluate this.

6.6.2 Interaction Between Students

As it is a group practice exercise, in addition to listening to the robot's guidance and questions, students also need to pay attention to the previous person's answer. Sometimes the other students in the group also used body language to remind the questioned student of the proper pronunciation. On the social side, the group approach allows for interpersonal collaboration in language learning and peer support. When someone's answer was quickly recognized by the robot, other students clapped or cheered. After a student failed to pronounce correctly twice, his peers told him the correct pronunciation. When the answer was failed to be received by the robot consistently, his peers blamed the robot. However, as can be observed from the recording, some of the issue was actually due to the students' inaccurate pronunciation.

6.6.3 Student Answering Process and Automatic Speech Recognition

The first group spent 10 min and 25 s to finish the full test, while the second group spent more than 15 min. In the second group, students were unable to speak or understand the questions or read the words in each of the three tests, so they kept quiet to think. The longest silent thinking time was 43 s, and the robot teacher could not do anything because he did not hear any voice and had to wait in place. There were two questions that students gave up on and let the next person answer.

The above situation should be improved in the further design. Students can ask to skip the answer by saying "我不知道" (wǒ bù zhī dào, I don't know) or "下一题" (xià yī tí, next question) in response so that the process can run smoothly without

getting stuck on a certain question. This way, everyone has the opportunity to speak, even those who want to give up.

In terms of speech recognition, the first group of students answered 43 times, of which 17 times the robot did not hear the response. For 26 responses, the robot could hear and recognize the input through STT, and in 13 of these responses the text was the same as the correct answer. In two instances the students did not speak and the robot recognized the background noise.

We also calculated the probability of the robot being unable to receive the sound from the recording data. According to the oral output of student, the failure rate of sound reception was 54.8% for monosyllables (such as 1, 2, 3) and 32.1% for more than two syllables. When monosyllabic words were received, the results of STT were different from the students' expectation 53.8% of the time. We made a preliminary analysis of students' pronunciation problems: for "一" (yī, one) the pitch was not high enough; for "二" (èr, two) the students did not show the pitch changing quickly from the highest to the lowest, but only pronounced a short low-pitch sound; and several students' "三" (sān) sounded like "sāng."

6.6.4 Student Answering Strategies

In the first part, the students all answered with a vocabulary word or phrase, and no one answered with a complete sentence although the class training is that students need to answer complete sentence instead of simple one. When the robot could not receive the students' response, they used different strategies for the second speech output: (1) getting closer to the robot (microphone) (2) correcting the sentence, changing the wrong answer ("一人" plus the quantifier to "一个人") (3) correcting their own pronunciation, such as by saying their response louder, lengthening the sound, adjusting the pitch, or lowering the three tones even lower (4) using gestures to help them create the right tone of voice (5) using gestures to help themselves pronounce the right tone.

6.7 Discussion

From the results of questionnaire in Fig. 6.5, we found that 80% students think the robot could be used as a tutor and guide for a test of looking at the picture and answering the question, and over 80% students agree or strongly agree that they would like to learn language with a robot. To answer the research questions in this study according to the above analysis, we think it is possible for the robot to act as a tutor and automatically guide freshmen to conduct a group test.

Just like student's comment "the robot was strict with the answer,", we expect robots to judge students' answers fairly. This is also the advantage of RALL. In the past, when human teachers conducted oral tests, they sometimes let students pass the

assessment with a looser standard. In addition, human teachers cannot maintain a certain concentration, objectivity and fairly for a long time, and robots can easily do it. However current RALL exists a main problem. We can find in the questionnaires and observations that the robot was not sensitive to students' monosyllabic answers. In fact, sometimes the students had to try several times before the robot could receive the sound and recognize it. Although some monosyllabic words were heard by the robot, the STT results were not as expected because of the pronunciation problems. Since the pronunciation of numbers is very basic, this can be a blow to students. In the first case, Japanese students' pronunciation of Chinese numbers will affect the correct answer rate on the test. From the perspective of language teachers also the user of robot, we cannot change the current technical problems of ASR. We suggest that when using a robot to conduct the oral test, the robot need to hold a practice of Chinese number pronunciation before conducting formal test. It also could give the students the opportunity to pronounce before the test. Besides, the teacher could modify the way that students answer questions (e.g., by answering with whole sentences instead of just numbers) to make up for the robot's lack of recognition of monosyllables. A further test can be conducted by native speakers to compare the reception of sound to find out if this situation is mainly due to the pronunciation of foreign language learners or the experimental environment. Also about the design of the test, the robot can say the correct answer after each question to let the students know the correct answer or pronunciation immediately. Go further, we can save the STT results of students. It will be used to discover pronunciation problems of Japanese native speakers.

We assessed students' practical experience using video recordings and some interactions between human and robot were obvious. We saw students personify the robot, waving, greeting, thanking, and saying goodbye to it. They also felt nervous when answering the robot's questions, shy when getting the questions wrong, and happy, sad, fulfilled, or regretful when the robot judged their answer and responded. It may be because of the influence of peer pressure or that students really considered robot as a teacher. In this experiment, we also saw the students adjust their pronunciation so that the robot could understand what they were saying. Whether these emotions of interaction can be a motivation for language learning depends on future discussion. Besides, according to the exciting reactions from students, we suggest that the robot could do more conversations like asking the name with individual student and asking daily life questions to conduct various kinds of oral test.

Human–robot interaction also enhanced peer–peer interaction. When someone answered right, the peers cheered, and when the pronounced wrong, they blamed the robot's STT system together. Through their peers' affirmation, students can improve self-confidence or reduce the sense of distrust of their own pronunciation. In addition, in group learning students can learn important lessons from the answers made by other students. In the analysis, we also see that students corrected sentences from the mistakes of the previous person. It is also worth noting that the processes and atmosphere of the two groups were different. One group had a smooth process and a good atmosphere, and everyone kept smiling. The other group had a negative atmosphere, and it took a long time to finish the test. The atmosphere sometimes was

due to the interaction of humans and the robot. In the further work, we can investigate the relationship between user personality and RALL to find out the necessity of using Robot to assist language learning.

6.8 Conclusions and Future Work

This paper proposes using a robot as a tutor to guide a dialogue-based language test automatically. The students look at the pictures and answer the questions asked by the robot. Students need to use listening, reading, and speaking skills at the same time. We have described the test design and setup and have conducted a preliminary experiment. We reported an analysis from observations of video data and from the students' comments. From the analysis, we think a robot as a tutor and oral test proctor is possible. However, the robot was not sensitive to L2 students' monosyllabic answers. We also found that the student treated the robot as a human and perhaps even as a teacher. Following this experiment, we will improve the existing design according to the suggestions of the preliminary experimental students and the problems found in the observations. Going further, we hope to save the STT results of students. It will be used to discover pronunciation problems of Japanese native speakers.

In the near future, we will compare the differences between the test guided by a robot tutor and a human native-speaking tutor. In the past, oral ability tests in universities were often conducted face-to-face by a teacher with one or more students. We hope to be able to use robots to guide the test so that teachers can switch roles and sit around to observe and evaluate the students' comprehensive ability and flip the way the conversation test is conducted.

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Chapter 7
The Relationship Between Self-Determination and English Language Acquisition: A Case Study of Human Determination, Self-Efficacy, & Success

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Abstract Although technology can overcome decontextualized practices of language learning, learners' success in independent language learning using the available technology depends on their motivation to carry out self-study. The Self-Determination Theory (SDT) suggests that some humans can remain zealous, motivated, and goal-oriented even when faced with challenges because of belief in their innate abilities. SDT explains such an individual's confidence in their inherent growth tendencies and innate skills allows them to recognize, pursue, and grasp opportunities that help them meet their psychological needs for competence, connections, and autonomy. SDT extends to consider the mediating and moderating factors, such as educational, family, and community supports that can help individuals develop the levels of self-determination necessary to move beyond their current circumstances and improve their lives regardless of the obstacle they face along the way. Self-efficacy theory (SET) clarifies one's beliefs of primary motivation to achieve an explicit goal. Within the roles of behavioral perspectives, self-determination, and motivation, educational psychology draws the relationships between cognition and mental physiology that contribute to human educational development. The purpose of this case study was to observe and describe the lived experiences of a Pakistani trash scavenger who rose to fame as an educator and world-famous motivational public speaker because of his personal beliefs and intrinsic motivation to become fluent in English. The study was relevant because it documents correlations between

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the psychological and sources of personal motivation and self-determination in the language acquisition process.

Keywords Self-efficacy theory · Self-determination theory · Motivation · Language acquisition · Educational technology

7.1 Literature Review

Metacognition plays a role in the development of self-regulating behaviors such as feelings of self-determination and self-motivation (Lau, 2015; Reif, 2008; Stolp & Zabrucky, 2017). Edmondson and Artis (2013) conducted a meta-analytic review that studied self-directed learning, self-efficacy and motivation research over 30 years and across five countries. They found a statistically significant positive correlations between self-determination and self-efficacy ($r = .41$, $p < .001$), self-determination and motivation ($r = .26$, $p < .001$), and self-determination and outcome of the performance ($r = .26$, $p < .001$). A similar meta-analysis by Huang (2016) found comparable strong positive correlations between these mediators and moderators by using multiple self-efficacy scales and the effects on the relationship between self-efficacy and performance goals. The results showed a statistically significant moderate to strong correlation between task mastery and self-efficacy ($p < 0.01$). But, questions and neuromyths remain concerning what drives an individual's intense desire for self-efficacy and motivation (McCullagh, 2005).

7.2 Psychological Self-Determination and Motivation Moderators and Mediators

Bandura (1978) was among the first to map the connection between self-motivation, self-efficacy, and expected intrinsic rewards, which may explain why his Self-efficacy theory (SET) has been examined in cognitive, social, educational, and psychological studies for decades because of its implications regarding the psychological aspects of human self-determination and personal motivation. Bandura theorized that one's reactions to life's challenges are dependent upon one's beliefs in one's own ability to positively complete courses of action. He further suggests individuals react to obstacles in accordance with their beliefs about their ability to achieve the desired outcomes. Harter (1978) studied the intrinsic nature of factors that drive an individual's internal and preconditioned responses and desires to achieve success and the expectations and rewards associated with positive outcomes. Harter opines that perhaps no single phenomenon reflects the positive potential of human nature than intrinsic motivation, which he defined as the inherent instigator that drives an individual's tendency to seek out novelty and challenges, to extend and exercise one's capacities, to explore, and to learn. Specifically, Harter wrote, "Developmentalists

acknowledge that from the time of birth, children, in their healthiest states, are active, inquisitive, curious, and playful, even in the absence of specific rewards" (Harter, 1978, p. 176), which infers his belief that intrinsic moderators derive the strength of self-determination while internal mediators explain the motivations.

By contrast, Ryan, Kuhl, and Deci's (1997) Self-Determination Theory (SDT) maps a connection between human self-determination and extrinsic mediators such as the inherent and innate psychological need for recognition, financial benefits, and awards. These theorists suggest humans naturally pursue three goals in life: competence, relatedness, and autonomy (p. 60), which shapes their personality development and behavioral self-regulation (Ryan et al. 1997). Other research suggests an individual's intrinsic motivation for success may be driven more by self-confidence in their abilities, well-determined control on their performance, and internal self-motivation enhanced by frequent reinforcements from supportive caregivers (Eisenberger, Pierce, & Cameron, 1999). Such assumptions have driven other researchers to argue that an individual's extrinsic motivation drives the person toward working harder and outperforming competitors to collect a reward (Stecher & Rosse, 2007).

Other research attempts to bridge the gap between theories by noting the role external moderators such as levels of education, self-efficacy, and environmental supports play as individuals develop feelings of reciprocal determination (Bandura, 1978), behavioral capacity (Allport, 1987), behavioral reinforcements (Nevin, Mandell, & Atak, 1983), and behavioral expectancy (Kirsch, Tennen, Wickless, & Cody, 1983). For instance, studies have found that an individual's self-drive is often the consequence of both intrinsic and extrinsic motivations, which result in internal satisfaction, pride, and external rewards (Wilson, n.d.). Other studies have found that the struggles experienced while advancing toward one's goals can bring a person down unless that individual has supportive family members, teachers, friends, and classmates willing to encourage them during the pursuit of goals and provide the reassurance and reinforcements needed to overcome obstacles (Dombestine, Norheim, & Husebo, 2019). Moreover, Krashen (1982) claimed that negative affective and cognitive feedback from teachers could directly influence the successful or unsuccessful acquisition of a second language. Synthesized research infers, whether internal intrinsic or extrinsic rewards drive self-determination, individuals need medicating caring and assertive psychological support systems to moderate and strengthen their feelings of self-determination and motivation (Bandura, 1989; McEwan & Downie, n.d.).

7.3 The Affective Filter in Language Acquisition

A combination of both objective and affective factors influences an individual's motivation to learn a second language. These affective filters function as forms of psychological obstacles that can block the amount of comprehensible input that enters the learner's brain (Du, 2009; Ni, 2012). Thus, individuals with a high affective filter have lower input, while those with a low affective filter have higher comprehensible

input. Krashen posited four factors concerning the function of the affective filter during second language acquisition. First, a raised filter can block input from reaching the language acquisition device. Second, a lower filter allows input to strike deeper and be acquired by the learner. Third, the affective filter helps to explain differences and individual variations in motivation, self-esteem, and success during the language learning process. Finally, the affective filter is not an issue in children as they acquire their first language. In the case of Ali, the subject of this research paper, he was subject only to the affective filter as he sought to acquire a second language.

7.4 Method

The purpose of this study is to answer the question: What mediators and moderators affect an individual's feeling of self-determination, self-motivation, and determination to succeed regardless of current circumstances? The case of this paper has been constructed by reviewing televised and published interviews, YouTube videos, the subject's website, and other social media resources. The story of Ali, as recalled by him in his televised interview, follows the life experiences of a trash scavenger child who was brought up in a very poor family living in a slum area of Lahore, Pakistan. He rose above and beyond anyone's expectations against all the odds, educated himself and his siblings, and is now is a successful educator and motivational speaker whose passionate story has improved the living conditions of others that reside within the slum areas in Pakistan he once called home. Despite being subject to negativity from educators and cultural expectations, Ali maintained a low affective filter that enabled him to successfully learn English. The life history of Ali provides a perfect example of how the word "self-determination," defined as the "free choice of" one's acts or states without external compulsion (Merriam-Webster's Collegiate Dictionary, 2007), can make a difference in a person's life. A case study approach was appropriate to answer the question because this research approach can provide a thorough quantitative analysis of a rare phenomenon and the development of a hypothesis based on the struggles and obstacles Muhammed Ali (name changed to protect the identity of the subject) faced as he rose from a Pakistani trash picker to a renown motivational speaker and descriptions of the intrinsic and extrinsic moderators and mediators that supported his accomplishment and achievements (Mariotto, Zanni, & De Morales, 2014).

From the tender age of five, Ali would rise before dawn to eat half a portion of pita bread with tea before picking up a large trash bag and leaving home for the streets of Lahore to gather scrap paper, aluminum cans, plastic bottles, and any other items of perceived value that he could bring home to help support his family. At the day's end, Ali would present his collection of other people's castaway items to his parents to filter for items to sell, or that could be used by himself or his siblings. Younger siblings often joined him during trash pickings whom he would sit on his shoulders after they tired from the heavy workload and while carrying his heavy trash bags. Ali remembers the open sores he would get on the soles of his feet because of holes

in his worn shoes. Ali's memories of such hardships are not bitter because of his feelings that such hardships were his role in life and as he grew older, Ali adjusted to his daily routine.

While picking through trash, Ali remembers watching school children on their ways to and from school and dreaming that, one day, he would be one of them. But attending school was well beyond his reach because his parents could not afford to send their children to school. Ali remembers once asking his father to allow him to go to school, but only getting a harsh scolding in return. His father explained that Ali and his family belonged to an underclass and that rich people would not like him or their children having to sit next to him at school because of his filthy clothing and bare feet. Undeterred, Ali held on to his desire to one day go to school and get an education. His dreams remained burned in his heart, and he supported them by reading torn pieces of scraped books and newspapers he gathered during trash pickings.

Ali remembers one delight during his hardships, a vendor that sold used books and newspapers whose stand was on his trash-picking footpath. Ali recalls asking the vendor if he could read captions for pictures in some books and the headlines from some of the newspaper to him. Recognizing his ambition, the vendor began teaching Ali, first the alphabets, then slowly to spell and read. By the time he turned 10-years-old, Ali remembers he could read the newspapers on his own even though he still could not afford to buy one. The vendor eventually introduced Ali to a retired primary school teacher who had a tutoring center in his home. The teacher had a passion for teaching street children and felt Ali was the perfect example. Soon, Ali began collecting trash from seven in the morning until three in the afternoon, then rushing to the schoolmaster's home-based school to learn afterward. Ali's determination to become educated drove his ability to advance from illiteracy to reading and writing at the fourth-grade level within two years. But, Ali also recalls noticing his parents' anguish at how education was changing him as they were very distressed by this change in him and how they began to discourage him by repeatedly saying, no matter what happened, he would never be able to achieve the levels of the rich people he watched. "We belong to the lowest class of society. Let's stay where we are." Ali's father would tell him. Nevertheless, Ali was determined to change his life and his ambitions grew.

His tutor prepared Ali to take the fifth-grade entrance exam and persuaded him to try. On the day of the exam, Ali was downhearted because he did not have proper clothes to wear on testing day and would probably be dirty when he got to the exam site because he would have to pick up trash before going and carry his trash bag with him to the school. Regardless, Ali's dogged determination refused to let anything stop him from taking the exam, which he passed. Ali remembers his parents were furious when they learned he had passed the exam because of their fear he would abandon his family, and they would lose him as a primary source of income. But Ali promised his parents he would continue his trash pickings at the same levels and volumes daily if they would allow him to go to school. After starting school, Ali remembers his mornings began two hours earlier so that he could pick trash each day. After picking up trash, Ali would leave his load of trash bags at his old school

teacher's house before heading off to his new school. He soon found his parents were right. None of the other children liked sitting next to him because he was dirty, wore dirty clothes, and smelled unpleasant.

But, even discouragement and prejudice could not stop Ali from pursuing an education. Lacking support from parents, Ali would share his concerns and problems with the used book vendor and his old schoolteacher who could afford to help him financially but were great sources of both encouragement and motivation. Ali remembers studying under the streetlights after dark and selling bottled water after school so his parents would let him keep going to school. **"Childhood for me was not comfortable,"** Ali recalled with a sadness in his eyes (The Dawn, 2012).

As he became more educated, Ali's biggest challenge was that he felt he could not learn to speak and read English. His determination propelled him to read English aggressively and subconsciously chip away at the affective filter that had formed until, one day, he realized the text was beginning to make sense to him. From that point, Ali restricted himself to reading in English only and soon learn to begin speaking the language as well. Ali's hard-won ability to speak English earned him respect in the eyes of his wealthy customers and resulted in increased sales at the market. "My early encounter with reading shaped my imagination and had a very strong impact on me," he said in his interview. Ali was further encouraged to improve his English reading and speaking skills after reading Charles Dickens' *Great Expectations.* Ali further remembers "Pip," Dicken's fictional main character, as an orphan who struggled in his childhood but was able to succeed in the end. From that point, his ability to read and speak English opened a new world for Ali, and the inspired teenager soon found himself reading everything from Karl Marx to Virginia Woolf to translations of Russian literature. He was encouraged by the book vendor who would lend him books he knew would enlighten Ali's imagination. Before long, Ali remembers turning himself into a bookworm that tutored his rich classmates to earn extra income for the family. Ali recalls his skills also began building his self-esteem and his feelings of self-determination, eagerness to learn, and successes in school eventually even earned the respect of his parents. Ali used his new income-earning potential to demonstrate to his parents the value of education, then convinced them to allow him to begin educating his siblings as well and he began teaching his sisters and brothers at home after school.

Despite never-ending discrimination and discouragement, Ali remained undeterred in his pursuit of education and eventually earned a Master's degree with honors from the Institute of Management and Accountants of Pakistan. Today, Ali is considered to be a highly educated person and is greatly respected and esteemed. But, he says he will never forget his past. Ali currently uses the stories of his struggles and experiences to change the lives of impoverished Pakistani children. Ali is the founder of "The Slumabad" a term used to refer to residents of the slums, an organization he uses to provide education, healthcare, and community development to whom he considers as his country's forgotten people. For his honorable efforts, Ali has been recognized at national and international forums and was chosen to become a member of the elite fellowship of the "Emerging Leaders of Pakistan." His fellowship led to

Ali being chosen to go to the United States of America to further continue his education and receive advanced training. "It was a defining moment in my life," Ali says. "I was thinking to myself that: 'Oh wow! I have made something of myself." Ali had also been selected to become a member of several other international fellowships, like the Acumen Fund, which provides training and funds to Non-Governmental Organizations involved in the betterment of the underprivileged.

Reading the story of Ali's life provides inspiration and hope for other people of the slum, the poor and unprivileged, and other disadvantaged individuals who lack the courage and self-determination to suffer as he did to improve his life. Ali's story stands as a testament that, with hard work, persistence, determination, perseverance, and strong self-drive, a person can alter his life, overcome adversity and discouragement, and harsh environmental conditions and influences, and transform them into successful educated individuals. One's cultural background the caste system they are forced into does not limit one's ability to learn a new language if their self-determination is high enough. Ali's case study has also provided a framework for positive influences and interventions that can lead to successful outcomes—despite the obstacles and barriers a subject might face (Jabeen, 2019).

7.5 Discussion

A gap in the literature was observed regarding the types and levels of mediators and moderators that affect an individual's feeling of self-determination, self-motivation, and determination to succeed and learn a second language regardless of current circumstances. Ali's case study shows that, despite all the unfavorable conditions, a human's inherent and innate desire for intrinsic and extrinsic rewards. Ali's research suggests self-determination is driven by both internal intrinsic (Bandura, 1989; Harter, 1978; McEwan & Downie, n.d.), external supports (Dombestine et al. 2019; Eisenberger et al. 1999; Stecher & Rosse, 2007), and extrinsic expectations of rewards (Ryan et al. 1997). The inference supports other research that suggests manipulation of the intrinsic and extrinsic moderators that strengthen self-determination will result in an increased understanding of the mediator associated with personal motivations.

The mediator, a variable that specifies how or why a particular effect occurs, in this case is the dynamic property of the individual that created the relationship between the desire to learn and the achievement of obtaining a formal education. Ali observed his condition and the conditions of others and sets a goal. In order to achieve that goal, Ali realized he needed to be able to read, speak, and write English. His dynamic property was that nothing deterred him from achieving his goal. No amount of hardship, sores on his feet, lack of support, or unacceptance of others suppressed the relationship between his desire to learn and obtaining and education. Ali's dynamic property was his belief in himself; this belief is why the effect occurred between his desire and the formal education achievements.

The moderator, the variable that changes the strength of the effect between two variables, in this case was the strong desire that Ali felt. In the face of challenges such

as this parent's lack of support and the disdain of the rich children for his physical appearance and aroma, Ali continued on his journey to excel and learn to speak and read English through formal and informal learning. The relationship between support for education, in this case lack of support by his parents at first, and the mastery of a second language was moderated by Ali's strong desire to achieve the skills necessary to speak, read, and write English. The success Ali experienced through using English to conduct business further moderated the relationships between the level of support and the gains in English communication skills.

7.6 Limitations

The primary limitation of this study, as in the case with case studies, is that the results cannot be generalized over a population since it is not possible to replicate it. This study was limited to the achievements of only one person, and the results were derived from it. It is recommended that more research be done and compared with this case study. However, it can recommend new areas of research and further elaborate outcomes of an existing investigation (Loba, Moeyaert, Cunha, & Babik, 2017).

7.7 Future Research

This study can help the cognitive, behavioral specialists, educational psychologists as well as neurologists to further research the topic and recommend treatments for under-developed patients through medications and or counseling.

7.8 Conclusion

The purpose of this descriptive case study was to address this gap by answering the question: What mediators and moderators affect an individual's feeling of self-determination, self-motivation, and determination to succeed regardless of current circumstances? More specifically, the study was concerned with how these mediators and moderators influence an individual's ability to learn a second language. The study describes the lived experiences of a Pakistani man whose self-determination, self-motivation, and external supports inspired his rise from trash scavenger to educator and world-famous motivational speaker and the factors that facilitated his rise. Ali overcame the limitations imposed by a caste system and was able to learn English independently. For many people, the cultural circumstances would have caused an affective filter to rise then impeded their ability to learn. The case study design was

appropriate because it highlights particular aspects of these moderators and mediators by analyzing one particular situation.

The findings of this case study further elaborate through psychological and physiological discussions on what mediators and moderators are associated with and individual's feelings of self-determination and motivations. The inferences are that a combination of both intrinsic and extrinsic motivations is needed to support what interventions intended to improve a person's feeling of self-determination and personal motivations.

The study is relevant and significant because it documents correlations between the psychological and physiological influences that often motivate individuals to succeed. Based on the case studied, future research should examine the role moderators and mediators play regarding an individual's pursuit of their psychological needs for competence, connections, and anatomy and how these play in promoting feelings of self-determination, motivation, and elation among test subjects.

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Chapter 8
Designing HAYA! ABC: Utilizing Transmedia Storytelling to Teach English to K-12 Online Arab ELLs—A Framework for Encouraging Online and Offline L2 Participation

Lauren M. Belaid

Abstract Learning English is valued across the globe and storytelling is an engaging and motivating tool educators can use to inspire language acquisition through the fun and amusing use of the English language (Kirsch, in Language Learning Journal 44(1): 33–51, 2016). In addition, though K-12 online learners are an understudied population, K-12 online learning has increased immensely all around the world due to the COVID-19 pandemic. This study focuses on the design of the online English language program, HAYA! ABC. In addition, through a review of the current literature, this study seeks to offer support for a new pedagogical method of engaging ELLs through the online and offline affordances granted to the learner via transmedia storytelling. The literature review for this design focuses on nations around the Arabian Peninsula who are utilizing the ancient tradition of storytelling to learn the English language. A method for choosing the sources for this review is presented and findings are discussed. Finally, examples of HAYA! ABC's transmedia storyline and its participatory language affordances are explored as they relate to Paul Nation's "four strands" and the three categories of language curriculum design (Nation & Macalister in *Language curriculum design.* Routledge, London, 2010). Future empirical studies will be conducted to gauge the effectiveness of the curriculum design proposed in this paper. The focus of this paper is on the research and design of this novel online curriculum.

Keywords Arab ELLs · Transmedia storytelling · STEM curriculum · Comprehensible input · Online language learning · K-12 online learners

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8.1 Introduction

The effectiveness of storytelling in language learning has been documented for decades. Whether the focus is on vocabulary acquisition (Abasi & Soori, 2014) or on communication skills (Ma et al., 2017), storytelling is an effective way to learn, and more specifically, to learn second languages (L2). Much of the research in this field focuses on the benefits of traditional storytelling for young learners. Traditional storytelling is an effective teaching method for reaching students of all ages. In addition, digital storytelling, a modern way to express and share one's stories, has been studied in both K-12 and Higher Ed populations. Digital storytelling fosters young English Language Learners' (ELLs) interest in learning (Fig & McCartney, 2010).

It is important for educators to deliver language learning content that is meaningful. The design of such content should be engaging, effective, and efficient (Merrill, 2002). More specifically, and with a focus on this study's population, educators and instructional designers should design and deliver content that is culturally responsive and relevant. The research conducted for this study focuses on elementary Arabic-speaking ELLs.

The design for this language-focused curriculum is based on the work of Paul Nation and John Macalister (2010). Nation and Macalister's design was chosen because their twenty curriculum design principals are all backed by either first language learning research, second language learning research, or general education research and theory. "(The principles) could equally well apply to the teaching of mathematics or motorcycle maintenance" (p. 38). For this reason, this all-encompassing design for second language acquisition is also appropriate for STEM-based content delivery.

The guiding questions for this literature review are:

1. Would transmedia storytelling be an effective, engaging, efficient, and culturally responsive way to design an online English language program for Arabic-speaking children?
2. If so, what does the research convey about designing a curriculum which would incorporate transmedia storytelling for young ELLs?

Though research on our online K-12 learner population is scarce, research on the effectiveness of storytelling in language learning is plentiful. Through this journey of discovery, we draw conclusions about effective language acquisition design incorporated within a STEM-based English curriculum. We also encourage the educational community to consider conducting further research in the field of transmedia storytelling and language acquisition.

In an effort to design an engaging online language curriculum for HAYA! ABC, which affords learners opportunities to communicate online in their second language, this paper first takes readers on a journey through the work of world-renowned linguist Stephen Krashen and his Comprehensible Input Hypothesis (Krashen, 2009). From there, we explore the use of traditional storytelling in language learning and the relevance of the storytelling methodology in the Arab culture (Eissa, 2019). We

then explore the participatory nature of transmedia storytelling and the engagement found within this relatively new mode of story expression (Jenkins, 2003). Finally, we explore the use of engaging transmedia storytelling to facilitate English language learning. From the research, we navigate our way through the development of HAYA! ABC's curriculum which utilizes the engaging participatory nature of transmedia storytelling to teach the English language online to our young Arab population.

8.2 Method

8.2.1 Descriptors

The scope of this review encompassed a range of key terms aimed at delivering the most relevant sources for this review. Terms such as "Arab English Language Learner", "storytelling and English", "transmedia storytelling and EFLs", "digital storytelling and language learning", "K-12 ELLs", "online K-12 ELLs", and "Arabic-speaking ELLs" were all terms used to gather sources for this study.

8.2.2 Rationale

This review focuses on a specific understudied population. K-12 Online ELLs whose primary language is Arabic is not the most common population one can study. The rationale for the use of many of the descriptors was an attempt at trying to capture as many studies which fulfilled as many of our "population checkboxes" as possible. Oftentimes, the literature was lacking in key population characteristics entirely relevant to this study. For example, articles on adult online Arab ELL populations would be found or K-12 Arab offline ELL populations would be found, but it was very difficult to find a single study that met all the population criteria for this review.

In addition, it was important to search articles which focused on the effectiveness of storytelling in second language (L2) acquisition. Part of the rationale for researching various forms of storytelling as a pedagogical tool was to draw an invisible evolutionary line highlighting the effectiveness of traditional storytelling in language learning to the effectiveness of digitized storytelling in online learning environments. The importance of this connection is to provide support for HAYA! ABC's online pedagogical use of transmedia storytelling to teach the English language.

8.2.3 Procedures

Prior to using key terms on e-journal database sites, basic research was conducted through YouTube videos and expert websites. Interviews with Stephen Krashen were viewed to obtain initial background information while sources from Paul Nation's personal website were reviewed and his and Macalister's (2010) language curriculum design book was further explored. EBSCO and ERIC were e-journal databases that were used to search for relevant articles. One question was asked in the search for the most applicable sources: *Does the source offer background in any of the following areas?*

1. *Arab cultural background*
2. *Impact of storytelling on language learning*
3. *Best pedagogical practices for ELLs*
4. *Second language acquisition theoretical constructs*
5. *Transmedia storytelling and language learning*

8.2.4 Criteria

With the exceptions of Vygotsky's, Krashen's, and Jenkin's works, all other sources were purposefully excluded if they were not published in the last decade. In addition, Persian studies on ELLs were included because of their similarities in cultural norms to the Arab culture. Also, references to adult Arab ELLs were permitted in lieu of available research on K-12 Arab ELLs. One of the aims of this study is to identify gaps in the research and possible future suggestions on studies that might help to fill these gaps. One obvious gap in this regard is the lack of research on K-12 Arab Online ELLs.

8.3 Literature Review

8.3.1 Comprehensible Input Hypothesis

World renowned linguist, Stephen Krashen, developed his Second Language Acquisition Theory by laying the foundations of five different hypotheses (Krashen, 2009). This paper focuses on the Comprehensible Input Hypothesis. In addition, design and lesson delivery considerations for second language (L2) curriculum are presented in order to better illustrate the underlying constructs and foundations of the HAYA! ABC curriculum.

According to Krashen (2009), "noise" is considered incomprehensible and is defined as input which learners simply do not understand. Krashen (2009) also mentions that children do not acquire language by simply watching and listening

to TV and radio shows if the input is not comprehensible. However, children do acquire language if the language is "directed at the child, in other words, whether an attempt is made to make the language comprehensible" (p. 64).

In defining ways teachers can provide their students with comprehensible input, Krashen (2009) noted that just talking or "free talk" is not language teaching. Being a native speaker or being a teacher with extensive grammatical knowledge does not make one a language teacher either. According to Krashen's research, a good teacher is one who can make input comprehensible for the student (Krashen, 2009).

From a pedagogical perspective, Krashen (2009) states that there are two ways we can make language comprehensible. The first way is based on linguistics. Slower speaking rates and offering students more processing time can provide students with comprehensible input. In addition, more use of high frequency vocabulary, shorter sentences, and less slang can also help students understand what their teacher is conveying.

The second way is non-linguistic. Non-linguistic methods include showing pictures and realia. In addition, teachers must also operate and focus their discussions based on their students' knowledge of the world.

Very importantly, input must be interesting and relevant. "The best input is so interesting and relevant that the acquirer may even 'forget' that the message is encoded in a foreign language" (p. 66).

In addition to listing the best practices for language teachers, Krashen (2009) identified very common strategies we use today but have been found ineffective in language acquisition. Pattern drill and dialogue exercises are perceived to be uninteresting. Also, uninteresting reading assignments do not contribute to comprehensible input. If most ELLs would not read the material in their native language, they would probably show the same disinterest in a second language.

Krashen (2009) argues that there is no need to sequence the grammar and have a "grammar focus" that lasts momentarily and is not revisited in the curriculum until the next year. It is very important to spiral the grammar throughout the course for regular input to occur naturally. This is also a recommendation of Nation and Macalister (2010). As a side note, however, direct language instruction is needed for children. If they are not taught directly and given sufficient comprehensible input early on, they will undergo what Krashen described as "silent period" which could last for six months. This "silent period" is a result of overexposure to incomprehensible input.

8.3.2 Traditional Storytelling and Language Learning

Safe and encouraging learning environments coupled with engaging and motivational learning material help optimize L2 acquisition. Krashen is certainly an advocate of storytelling as an L2 instructional method. Storytelling increases interest and allows for more streams of comprehensible input. Storytelling, therefore, keeps learners engaged and interested. Wasik and Bond (2001) mention that stories can

make language more comprehensible (as cited in Abasi & Soori, 2014). Stories, whether real or fictitious, engage through the connection of the human experience. With language learning, storytelling is one of the most effective methods of engaging and motivating learners to read, write, speak, and listen in a foreign language. Several studies have been conducted validating the significance and effectiveness of storytelling on language learning.

Abasi and Soori (2014) focused their study on 20 Iranian kindergarten boys and girls as they studied the effectiveness of storytelling on improving vocabulary. They found that storytelling was quite effective in increasing the kindergartners' vocabulary acquisition.

Kirsch (2016) also conducted a study on the impact of storytelling in the primary classroom. Kirsch (2016) found that young primary students in London recalled a considerable number of words and sentences through storytelling. In addition, storytelling allowed for more explicit and incidental learning while it encouraged meaningful language use. Heathfield (2011) suggested various ways for making language input more comprehensible (as cited in Kirsch, 2016). The first 3 suggestions compliment Krashen's (2009) references to Asher's Total Physical Response (TPR) strategy as a way to communicate through gestures and actions to help make language more comprehensible to EFL learners:

1. Use actions
2. Use mime and gestures
3. Display character expressions
4. Have empathy for the characters
5. Repeat key phrases
6. Modulate one's tone of voice
7. Make good use of props
8. Interact with the audience

Westlund et al. (2017) conducted a study which accentuated the importance of modulating one's tone of voice in order to provide more comprehensible input for EFL learners. In their study, half the primary students learned through a story read by a "flat" sounding robot and the other half learned through an "expressive" sounding robot. Children who learned through the "expressive" robot responded with more engaged facial expressions and they were able to recall the story in more detail as well as identify more target vocabulary words.

Educators utilize the power of storytelling in language acquisition to build academic vocabulary and help immigrant youth express themselves more completely. In one anecdotal study, an ESL teacher utilized storytelling for all subjects with her ELLs. She used pictures in science class and created corresponding stories to help develop her students listening and comprehension skills as they acquired new science-related vocabulary. In another study, Geres (2016) found that storytelling in an EFL classroom provides opportunities for "newcomer youth" to express themselves in the face of adversity.

In addition, other studies concerning storytelling and language acquisition have focused on the importance of social learning and interaction through leveled storytelling within a group. Ma et al. (2017) found that collaborative group work could be an effective instructional method for fostering ELLs communication skills through the use of storytelling. Likewise, Tsou (2012) found that storytelling elicits increased student interaction. The storytelling group in their study achieved statistically significantly higher scores in reading comprehension and in employing story conventions in writing.

8.3.3 Storytelling as an Ancient Staple of Arabic Culture

This paper seeks to determine the best design strategy for teaching English to English Language Learners (ELLs) in Arab nations. The focus of storytelling was chosen because storytelling has been a staple in Arabic culture for thousands of years. "Arab culture is an originally oral culture in which the spoken word occupies a central position" (Herzog, 2011, p. 631). Herzog (2011) goes on to explain that all important foundational texts of Arab culture are orally performed and transmitted. Poetry played a central role in the lives of early nomadic Arabs. Bushnaq (as cited in Brind, 1986), noted that memorization has always been an important tool for learning and literature preservation. Nearly all nomadic tribes or clans on the Arabian Peninsula had their own sha'fir, or extremely gifted poet who used their power of speech to speak on behalf of their own tribes or clans (Herzog, 2011).

In the rural Middle East, storytelling is still an important form of entertainment (Brind, 1986). "Interactive storytelling is a new and challenging successor to traditional storytelling" (Alsumait & Al-Musawi, 2013). The following are studies conducted on Arabic or Persian children living in nations around the Arabian Peninsula.

Alsumait and Al-Musawi (2013) conducted a study on several elementary school children from Kuwait and found that interesting stories in interactive media is an engaging way to support learning.

In addition, Eissa (2019) conducted an experiment on Saudi EFL college students and found that the addition of digital storytelling to traditional teaching methods contributed to student improvement in their speaking skills by mastering stress, tone, and intonation.

Interestingly, Khodabandeh (2018) studied 30 young Iranian EFL learners and found that learning through storytelling online was much more effective in advancing spoken English skills than learning through offline software. Samantaray (2014) found that using storytelling to teach English was one of the most enjoyable methods used to develop EFL learners' English fluency (as cited in Khodabandeh, 2018).

As we move into the next section of this paper, it is important to note the repeated mention of learner engagement and interactivity in the texts reviewed. Interactivity through digital and transmedia storytelling is a critical component of modern digitized storytelling.

8.3.4 Transmedia Storytelling and Engagement

Transmedia storytelling offers learners a participatory role in advancing complex narratives through a single-story world. "Transmedia learning combines the capabilities of ubiquitous technologies, real life experiences, and learner-focused pedagogy drawn from a rich ecology of content and media" (Fleming, 2013, p. 371). Losh and Jenkins (2012) eluded to the idea that social learning and experimenting with new digital media practices online are exciting and engaging ways for students to learn. "In the ideal form of transmedia storytelling, each medium does what it does best-so that a story might be introduced in a film, expanded through television, novels, and comics, and its world might be explored and experienced through game play" (Jenkins, 2003, p. 1). Jenkins went on to note that with transmedia storytelling, every channel can be a point of entry into the storyline. One does not need to be aware of all of the elements of a storyline in order to explore it through various forms and channels.

Ciancia (2015) designed a framework for transmedia storytelling and equates it with "learning by engaging" (p. 142). Ya-Ting Yang and Wan-Chi Wu (2011) reported several studies which found digital storytelling as a catalyst for student interest and motivation.

Jenkins (2003) draws on the perspective that a good character might develop great storylines and even a Hollywood franchise, whereas a good story world could accommodate numerous characters, their own narratives and successfully launch a transmedia franchise. The story world in a transmedia project is what sets it apart from other cross-media or multi-media projects. The story world offers infinite opportunities for readers/learners to participate in the development of the storyline. This level of storytelling participation through various media channels is what Jenkins calls *participatory culture* (Jenkins, 2014).

Participatory culture defines a culture of people. In the case of HAYA! ABC, our young ELLs are expected to work individually and collectively to find STEM-based solutions to real-world or futuristic problems. In addition, they design various storyline-based innovations. Learners design their own role in the story world and work to advance the storyline itself through democratically driven voting opportunities and, very importantly, by expressing their own ideas in the English language.

8.3.5 Transmedia Storytelling and Language Learning

Figg and McCartney (2010) reported digital storytelling as an effective method of fostering young EFL learners' interest in learning (as cited in Huang, Liu, Wang, Tsai, & Lin, 2017). Digital stories give opportunities for learners to produce and share oral, written, and visual messages. In addition, digital stories have been shown to have "remarkable positive effects on fostering students' language skills" (Huang

et al., 2016, p. 4). Liu, Tai, and Liu (2018) found that students' motivation in language learning was closely related to the creativity of their stories.

Rahimi and Samaneh (2017) conducted an experiment on 42 EFL learners and found that those who produced their stories in an online environment improved significantly in their literacy skills compared to those who produced their stories in offline software. The interactive and participatory nature of digital storytelling engages reluctant learners and makes every learner do their best before presenting their story in front of an audience (Razmi, Pourali, & Nozad, 2014).

Two of the greatest pioneers, Rodrigues and Bidarra (2016), in the utilization of transmedia storytelling for English language learning have developed a prototype of a transmedia learning environment especially for English Language Learners (ELLs). "The story world is constructed to allow the expansion and dynamic personalization of its elements while enhancing the development of communication and media literacy skills" (p. 57). Through the exploration of the story world Connecting Cat, students participate in opinion-generating activities. They express themselves in multi-modal outputs. Knowledge is socially constricted in transmedia learning environments. Rodrigues and Bidarra (2014) found that story worlds could be used for online learning spaces where students could participate, exchange ideas, and build their language fluency.

8.3.6 Nation and Macalister's (2010) Language Curriculum Design

In the previous sections of this paper, we navigated our way through the relevance and use of storytelling for ELLs. Rodrigues and Bidarra (2014) utilized the affordances of transmedia storytelling to teach adult learners, so how might we utilize transmedia storytelling in an online ESL or EFL environment for children?

The curriculum for HAYA! ABC is STEM-based and as such, requires a thorough design not only for reading, writing, listening, and speaking language objectives, but also for STEM-based knowledge objectives in the L2 (English) language as well. Nation and Macalister (2010) offer a comprehensive approach to language curriculum design. As seen in Fig. 8.1, this approach incorporates content and sequencing, format and presentation, and monitoring and assessing. In addition, they offer twenty principles within these categories that guide language curriculum designers into creating a comprehensive language curriculum.

Paul Nation's "four strands" are a principle described in the format and presentation category for language curriculum design (Nation & Macalister, 2010). These four strands are:

1. meaning-focused input
2. meaning-focused output
3. language-focused learning
4. fluency development

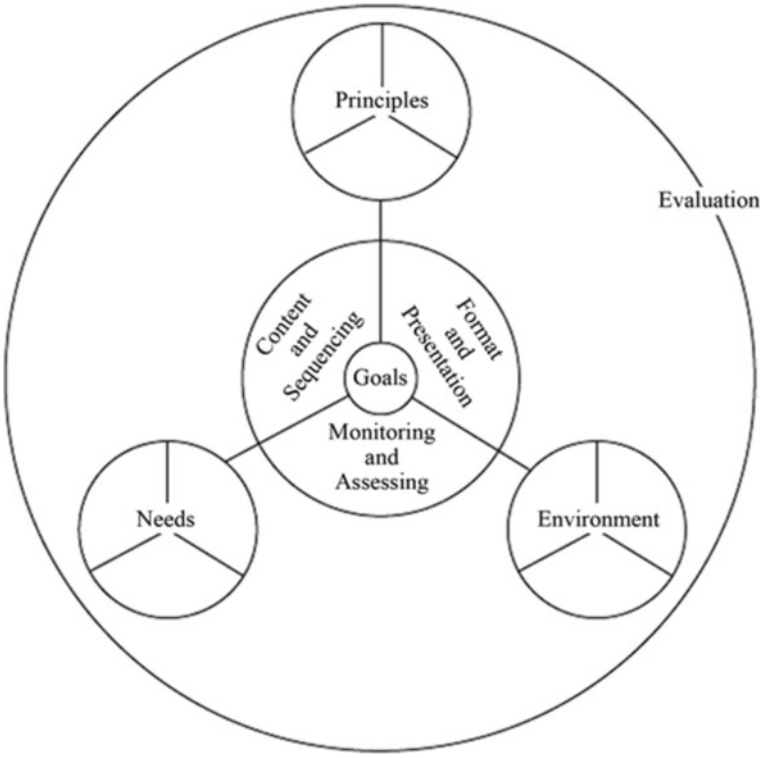

Fig. 8.1 Nation and Macalister's (2010) curriculum design diagram

According to Paul Nation, meaning-focused input for an L2 learner is giving them the opportunity to learn from listening and speaking (Nation & Macalister, 2010). As mentioned earlier, Stephen Krashen would call meaning-focused input "comprehensible input". "In language courses, the most important way of providing a large amount of comprehensible input is to have an extensive reading program" (Nation & Macalister, 2010, p. 90).

HAYA! ABC is developing an extensive reading program through its exclusive STEM Stories and ongoing transmedia storyline delivered in every lesson. In addition, HAYA! ABC offers several leveled e-readers which provide even more exposure to target vocabulary.

Another strand in Nation's "four strands" is meaning-focused output. Meaning-focused output is concerned with speaking and writing and should be incorporated in such a way that it encompasses about a quarter of the class time. During this time, learners should be involved in conversation. The conversation can be social or informational (Nation & Macalister, 2010).

HAYA! ABC is an individualized e-learning program which not only offers several online listening activities through its courses (meaning-focused input), but it also

encourages social interactivity with friends and family members. As this is a transmedia, highly interactive program, learners are considered valuable "employees" with very important jobs in the "WTE company". They always have a practice script, but we encourage them to continue to expand their discussions as much as possible; even if they are beginners. Every lesson offers multi-contextual word exposure, semantically "de-clustered" vocabulary, and phonics-based vocabulary exposure to help build their conversational word banks.

Learners receive speaking practice online, and then they utilize what they have learned by speaking with a friend, fellow classmate from their brick and mortar school or a family member. For example, brand new beginners in the program just learning their alphabet, phonics, and basic small talk exchanges may practice this dialogue with a friend on their phone via Face Time, on a short range walkie talkie, or on a personally designed play-device which the learner has invented themselves (which we always encourage in our program).

Learner: Hello.
Friend: Hi.
Learner: What's your name/call sign?
Friend: My name is Red Ant. And you?
Learner: My name is Bad Bug.
Friend: How are you?
Learner: I'm fine/sad/tired/happy.
(switch roles)

HAYA! ABC regularly assigns learners two types of stories. One type of story, which we call a STEM Story, is based on science, technology, engineering, or math content (or a combination of all four domains) and is designed for the purpose of providing the learner with either non-fiction information, or real-world problem-solving scenarios. The other type of story we call a WTE Story (after the main characters' business name). This is part of the transmedia storyline that is constantly evolving based on the new information they learn through their lesson and STEM stories.

Consider the differences in presentation style below. In Fig. 8.2, STEM stories follow Mayer's Cognitive Theory of Multimedia learning and includes an audio/text video with Arabic translations of key vocabulary, whereas the WTE storyline in Fig. 8.3, though certainly educational in that learners apply new knowledge to the storyline, is also more entertaining in its design. In short, the WTE storyline is purposefully designed to be more engaging and entertaining while it aims to elicit the learner's newly learned STEM knowledge through reading, writing, speaking, and listening in English.

Language-focused learning is another one of Paul Nation's essential "four strands" in designing language learning curricula. With language-focused learning, learners spend a quarter of the time on pronunciation, grammar, and language conventions. HAYA! ABC incorporates focused phonics video exercises into the curriculum. Learners are expected to engage in pronunciation practice regularly.

Very importantly, the fourth strand, fluency development, is a crucial element to language curriculum design. Nation notes that fluency development does not deal

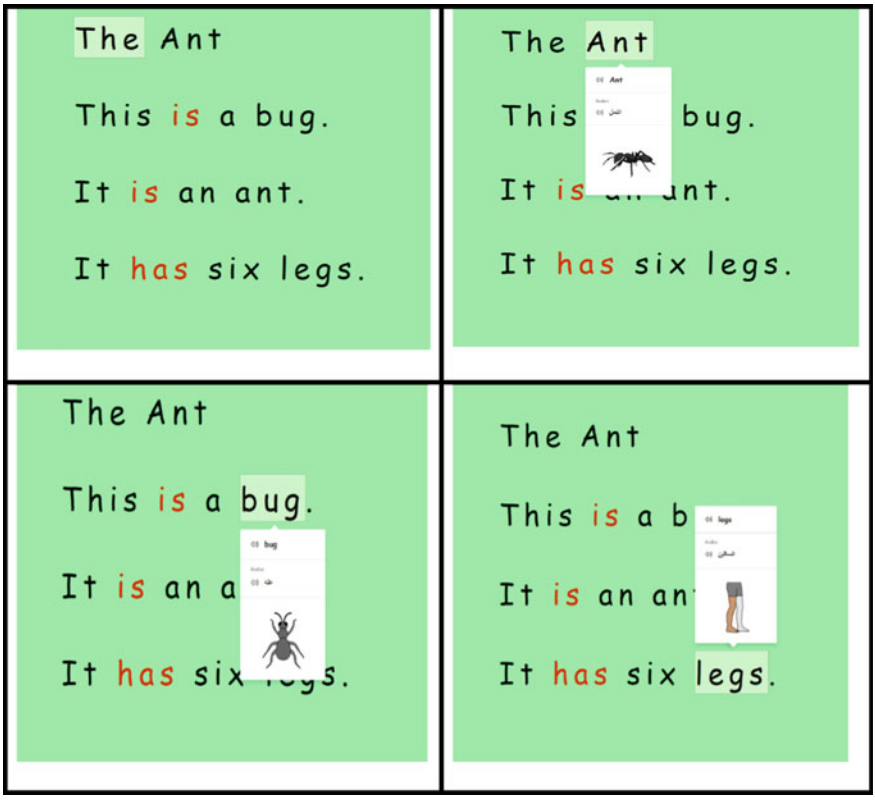

Fig. 8.2 STEM story video designed for reading practice with L2 learning aids

with new knowledge, rather, it utilizes previously learned knowledge and offers plenty of opportunities for output production (Nation & Macalister, 2010). There are four conditions for fluency development:

1. Material should be easy and familiar.
2. There should be a focus on communication messages.
3. There should be some pressure to perform at a faster speed.
4. There should be plenty of opportunities for communication and fluency practice through reading, writing, listening, and speaking.

As learners/employees progress through HAYA! ABC, they will find more opportunities to participate and hone their English skills. In some instances, they will be asked to write a letter, post an "announcement", and design *and* explain their inventions to help the main characters throughout the storyline. As they progress, the role-playing scripts they used in the beginning will become more advanced. In addition to the scripts, the learners will receive prompts from Izzy, the robot shih tzu who is in charge of guiding Gabby, Gabe and the learner through all of the dimensions that make up the vast transmedia story world (Fig. 8.4).

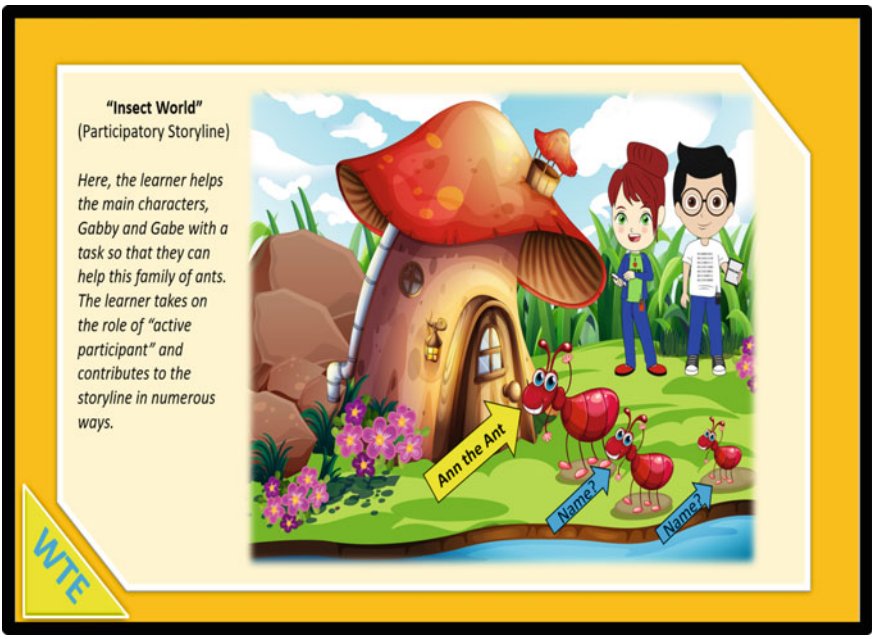

Fig. 8.3 WTE transmedia story designed for applying STEM knowledge and engaging learner with various reading, writing, speaking, and listening affordances in the participatory storyline

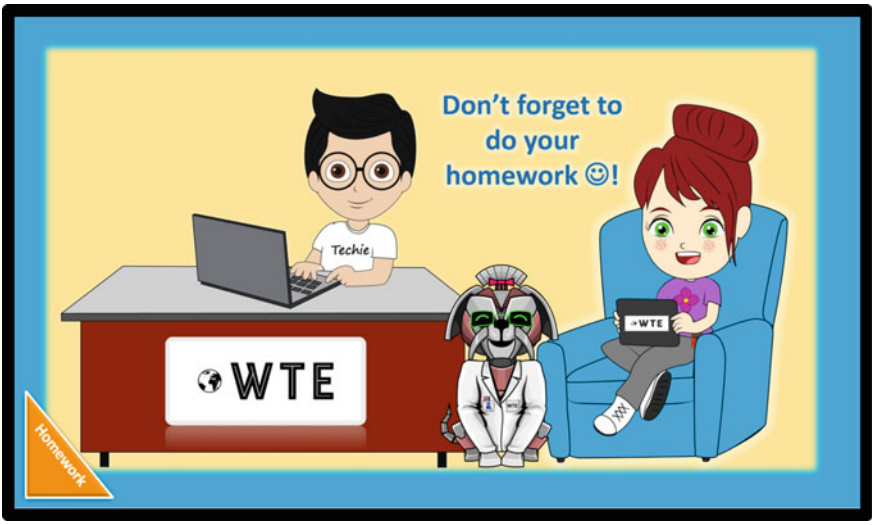

Fig. 8.4 Transmedia story world homework reminder from "WTE Headquarters"

So far, we have discussed Nation and Macalister's (2010) language curriculum design as it pertains to an online learning environment immersed in a transmedia storyline. In addition to Nation's "four strands", as mentioned earlier, there are three major categories to their approach: content and sequencing, format and presentation, and monitoring and assessing.

With regard to content and sequencing, the HAYA! ABC program has taken immense effort in designing this L2 curriculum in a way that operates within the learner's Zone of Proximal Development (ZPD) (Vygotsky, 1962). Content is in no way linear, rather, it is spiraled in order to give the learners more opportunities to utilize new language vocabulary and processes. For example, the alphabet itself is taught out of sequence. We teach the most common letters first so that we can motivate our learners to start isolating, segmenting, and blending new words and sounds as soon as possible.

As for format and presentation, "the four strands" are certainly a principle of this category, as is the principle of motivation (Nation & Macalister, 2010). All of our lessons are designed through e-courseware. The interactive nature of the design is a tool used to motivate learners to explore the English language through multiple online and offline channels. The presentation of the lessons can be sampled throughout the LMS itself, social media sites, Google sites, content websites, the fictitious WTE business website, learners' tangible language journals, HTML 5 games, and 3D Augmented Reality images. As a participant in the storyline itself, "employees" also experience language through the presentation and sharing of the innovative artifacts they create for the storyline.

In addition, the transmedia storyline is seen through the entire design, and this includes monitoring and assessing. Assessments take on the theme of the unit and are gamified in a way that keeps the learner engaged and focused (Fig. 8.5). In addition, self-regulation is a very important skill that can be taught in the elementary years. It is a form of self-monitoring through self-reflection. Every learner/employee has a "Goal Sheet" for the work they accomplish within each unit. It is essentially a check list of sorts to help keep students organized and self-aware of "problem areas". It includes a "self-reflection" section and the entire sheet is designed as if it were a very important "WTE work document". Essentially, the progress monitoring/self-reflection sheet is also a part of the transmedia storyline.

Moreover, social learning and participation are also very important components of the HAYA! ABC program. Interaction through language is a social experience (Vygotsky, 1962). We encourage learner families to get involved and reach out to each other (in English) online through the main characters' social media sites. It's our goal that over time, learners in the HAYA! ABC program will have built a network of fellow ELLs who are just as eager to participate and interact in the storyline. In addition, the transmedia storyline, rich with participatory online and offline English language processing activities, encourages each learner/employee to find a role that suits them in the "company". They will "apply for the job" through an online form and create their own "business card" by choosing their own STEM-based title such as:

Fig. 8.5 Gamified unit assessment introductory slide (6 levels)

1. Problem Solving Expert
2. STEM Specialist
3. World Peace Ambassador.

All of these titles were chosen for their strength and power. A major goal of the program is to inspire interest in STEM fields through the use of the English language, especially for young girls.

Finally, and very importantly, another area for the design of this curriculum that is important to explore is the target population's culture. Cultural responsiveness in curriculum design for a targeted population is essential. As this curriculum is designed through a storyline itself, it is important that our learners relate to the characters. The way we did this was by having our characters relate to the learner. As the design of this program caters to learners from countries in North Africa and all around the Arabian Peninsula, it is very important to design with sensitivity to the majority population's belief system and common cultural practices.

HAYA! ABC is a culturally responsive program which promotes the learner's cultural identity through the behavior and traditional dress of the main characters, their family, and their friends. Learners need to relate to the main characters, Gabby and Gabe, on a personal level if they are to feel motivated to participate in the transmedia storyline. As the storyline progresses, the learner understands that Gabby and Gabe are siblings from a beautiful multicultural family. Not only do they play a main role in the storyline, but they also act as pedagogical agents (Schroeder & Adesope, 2014) with a high level of motivational support throughout the lessons (Figs. 8.6, 8.7, and 8.8).

Fig. 8.6 Gabby and Gabe in traditional dress after learner completes a lesson

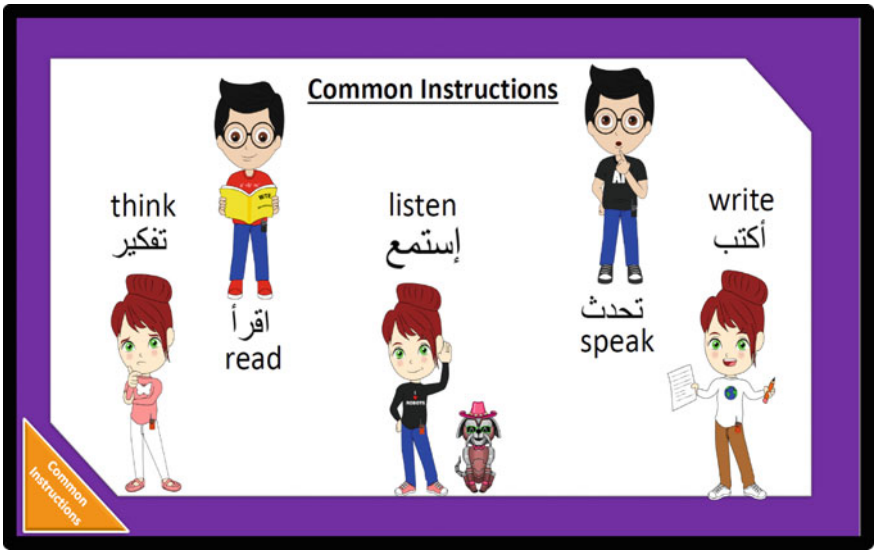

Fig. 8.7 Gabby and Gabe acting as pedagogical agents by using signaling

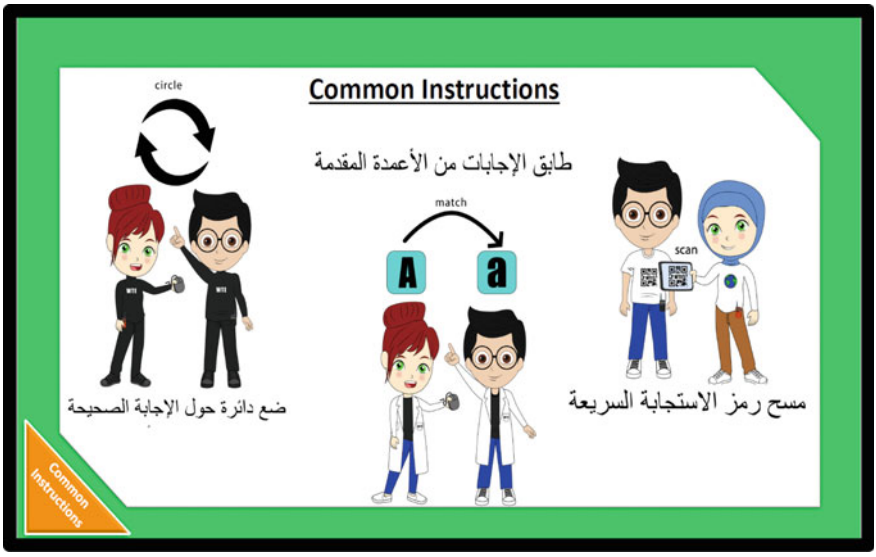

Fig. 8.8 Gabby and Gabe acting as pedagogical agents signaling essential digital instructions for an online learning environment

8.4 Discussion

This paper reviewed the Comprehensible Input Hypothesis and applied it to the design of the HAYA! ABC online English program (Krashen, 2009). The Comprehensible Input Hypothesis adamantly encourages comprehensible input in the form of engaging and exciting L2 reading material.

In addition, this paper sought a pathway to answer two questions:

1. Would transmedia storytelling be an effective, engaging, efficient, and culturally responsive way to design an online English language program for Arabic-speaking children?
2. If so, what does the research convey about designing a curriculum which would incorporate transmedia storytelling for young ELLs?

In response to question one, Rodrigues and Bidarra (2014) demonstrated that transmedia storytelling can be used as a pedagogical method for language acquisition. With transmedia storytelling, the learner takes on an important and relevant role in the storyline. There is no beginning or end, there is just fluid movement through a transmedia story. From the research noted above, transmedia storytelling has an ability to captivate English Language Learners in a way that Krashen (2009) would describe as having the learner "forget" they are even learning a second language. With transmedia storytelling, the English Language Learner is very important and is needed to progress the storyline. By nature, this construct gives the learner and their effort a sense of relevance and purpose.

In addition, HAYA! ABC's culturally responsive design ensures a high level of cultural respect and relevance to its target audience in the Arabian Peninsula and North Africa.

In response to question two, we recommend incorporating the methods of Nation and Macalister (2010) in order to design a thorough curriculum which can certainly be catered toward transmedia story worlds and online learning environments. Very importantly, the designer must design with the "four strands" in mind, as well as the three principled clusters (content and sequencing, format and presentation, and monitoring and assessment).

8.5 Conclusion

Altogether, the review of the literature herein points toward an effective pedagogical strategy for English curriculum designers, ESL teachers, and young Arab ELLs.

Like many ancient cultures, Arab culture has a history of embracing and valuing storytelling as a way to entertain and teach societal lessons. The second language acquisition work of Dr. Stephen Krashen seems to support utilizing transmedia storytelling as a method of teaching English Language Learners (ELLs) in the most effective, efficient, and engaging way possible. By building on the comprehensible input one finds in engaging reading material and by utilizing the interactive participatory elements which make transmedia storytelling so compelling, ELLs have the potential to build their second language fluency more efficiently than other commonly practiced methods such as regular rote grammatical memorization.

In an effort to design an engaging online learning environment for young Arab ELLs, research was analyzed pertaining to second language learning theory, the impact of storytelling on second language acquisition, and second language curriculum design. This study shared research findings and several design ideas for implementing a culturally responsive transmedia storyline into an online ESL or EFL STEM-based curriculum.

There are so many areas of potential research involving transmedia storytelling and language acquisition. Future research and qualitative data should include the study of Arab student and teacher initial perspectives of transmedia storytelling as an engaging and effective online method to learn English. In addition, experimental data should be collected on the effectiveness of utilizing an online transmedia storytelling curriculum to facilitate English language acquisition. Elementary students should be studied as well as Higher Ed students. It would be interesting to determine the level of progress within a given duration of time from both the younger and older ELL populations. An extensive evaluation pertaining to the effectiveness of the HAYA! ABC program will be conducted in the future. Data from the evaluation will be shared in future studies.

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In her free time, she enjoys being in nature and visiting waterfalls with her husband. She also enjoys immersing herself in the beauty and intrigue of humanity through the diverse and colorful cultures of the world. Those who travel understand that there is much more that unites us than divides us.

And elephants. She absolutely loves elephants. She spends her free time watching documentaries on elephants…..yes, elephants.

Chapter 9
A Preliminary Study of Pre-Service Teachers' Development and Reflections on Online Teaching

Chih-hua Hsu, Yu-Ju Lan, and Miao-fen Tseng

Abstract The development of internet technology has gradually changed the way of language learning. Online synchronous lessons further promote learning without geographical restrictions. Due to its difference from classroom teaching, teachers face many issues: operation of teaching platform, change in teacher–student interaction, and change in teaching context. Therefore, training for online synchronous teaching is necessary. This research observes both in-class courses of the "2018 Web-Based Chinese Language Teaching Practice" of National Taiwan Normal University, and online teaching collaboration with "Pre-Advanced Chinese Course" at the University of Virginia. The online teaching practical internship was over the course of 14 weeks in the Fall Semester of 2018. During this training: theoretical courses, practical teaching, reflection and discussion are repeated. The questionnaire survey method was used to collect the reflections of 37 pre-service teachers. The performance of pre-service teachers' self-growth, action strategies, and collaborative learning were then analyzed. When the course was concluded, we interviewed six graduates who became online teachers, analyzed their feedback, and discussed what benefits had derived from the training for their online teaching needs. In this study, pre-service teachers learn foundational teaching theories, engage in reflective discussion, and participate in peer-to-peer collaborative learning. Mutual assistance and support are emphasized in group work. What kind of progress can result through this training course? What difficulties are encountered by these participants in the training? How do we come up with strategic solution? These are the questions we are investigating in this study. We wanted to explore the deficiencies in the training and various areas that requires further reinforcement and strengthening. Comprehensive questionnaires and reflections from pre-service teachers, and interviews with current teachers after training, put forth the items that need to be explored in the future training online. This is to serve as reference for planning training courses of the same nature.

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Keywords Distance education · Online synchronous teaching · Teacher training · Pre-service teacher

9.1 Introduction

A new way of language learning has evolved, due to commonplace usage of the internet. Learning is no longer restricted to traditional classroom spaces. Online distance courses have also become one of the mainstream trends in language education. Lan, Chang, and Chen (2012) pointed out: the present language teaching mode needs teachers who are capable of utilizing online media in their online teaching. Also, a second language acquisition theory was proposed by Krashen (1981) and Long (1996). They mentioned that successful language learning requires real social interaction. Chinese language learners, however, live in non-Chinese speaking areas. They lack a natural environment for using the language. Language teachers must respond to this dilemma and find a way to meet students' needs. Using long-distance synchronous interaction can provide learners with a natural Chinese language environment and provide natural learning simulation.

Kentnor (2015) also suggested that with the development of educational technology, methods of online teaching will also further develop. We need to investigate and understand the progress of educational technology and various methods to provide resources in improving the quality of education today. In addition, Chao (2015) pointed out that technology in the classroom cannot replace the role of a live teacher; the training focus of technology-assisted language learning is to enable teachers to adapt to the ever-changing technology. At the same time, to apply these technologies to the new teaching environment appropriately is a great task and challenge for any teacher training institution. How to cultivate pre-service online teachers with these essential teaching capabilities is an on-going question.

Teacher training and teacher quality are integral components of the education system. Therefore, new training programs for these teachers are needed to acquire new knowledge and skills, and to support their professional development (Akalin & Sucuoglu, 2015).

What kind of growth can teachers obtain after this new mode of teacher training? What difficulties will they encounter in this online teaching process? What could be some of the possible solutions to their challenges? What type of help can educational institutions continue to offer in their post teacher training? What are some of the beneficial, yet missing elements that can be implemented into the current course?

We hope, in analyzing questionnaires and reflections from pre-service teachers, to track their growth and to record the challenges they encounter in real-time teaching. It also tracks the teachers after training, and obtains their constructive feedback via interviews. In understanding the helpfulness and deficiencies of the existing training, we can use these gained knowledge to build a better and more relevant curriculum.

9.2 Research Methods

9.2.1 Participants

The participants are 37 pre-service teachers who took the course "2018 Web-Based Chinese Language Teaching Practice" at the Department of Chinese as a Second Language, National Taiwan Normal University. Their age ranged from 19 to 25 (average age is 21.5 years-old).

In order to provide real-time online teaching opportunities, 11 students from the "Pre-Advanced Chinese Course for Fall Semester" at the University of Virginia were selected as teaching subjects. This group of Chinese learning students include nine American-born Chinese students and two Korean students.

After their training course, 6 of 37 teachers eventually took off their online Chinese teaching career. Interviews were conducted 4 months after their employment (7 months after the course).

9.2.2 Research Design

This study divided 37 pre-service teachers into 11 teams, each team of 3 to 4 people, and was assigned a student as their teaching subject. The training curriculum is divided into two parts.

In the first part, pre-service teachers participate in a three-hour training class every week. The first week is on the introduction to online teaching and teaching subjects. Then, from the 2nd to 11th week of the training continued on with the learning of teaching theory, and sharing practical teaching experience with discussion.

The second part is the online teaching practicum. Pre-service teachers and the teaching subjects (11 students who took Chinese Course at the University of Virginia) agreed upon 40–60 minutes per weekly online session. One online teaching practicum mostly occurs between two training classes.

The theoretical course content includes: elements of Chinese language teaching materials design, teaching strategies, teaching activity design, online Chinese teaching management and curriculum planning, and introduction to technical operation of various online platforms.

Practical teaching content is provided by the University of Virginia (UVA). An 11-week Chinese course with UVA's "Pre-Advanced Chinese Course Syllabus for Fall." The pre-service teachers are the teaching assistants, who helped UVA students to complete OORIC (Online One-on-one Real-time Immersive Communication) on the zoom platform (Fig 9.1).

This arrangement provides real-time teaching opportunities after the theoretical course ended. Pre-service teachers who have successfully completed the training may apply to become formal online Chinese teachers. Four months after their teaching (7 months after the end of the course), we interviewed these online Chinese teachers.

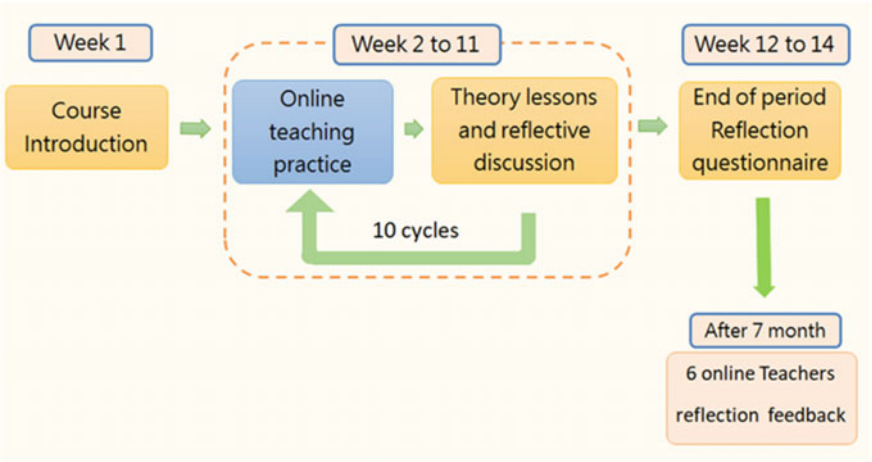

Fig. 9.1 Teacher training course and the research timeline

9.2.3 Questionnaire and Data Collection

The data sources for this study are three parts: the end-of-term questionnaire, the end-of-term reflection, and the interview of online teachers who successfully entered into the teaching field.

The end-of-term questionnaire investigated 5 areas: the motivation for taking online pre-service courses, the benefits of the course, the difficulties encountered during the course, the knowledge/skills/and emotional help from online teaching practicum, and the assessment of self-progress.

The end-of-term reflections of 37 pre-service teachers are analyzed. The coding results of these teachers' responses include: 1. The growth brought by the curriculum; 2. Strategies derived from difficulties encountered in the teaching process.

Lastly, 7 months after the end of the course, interviews were conducted with those who became online teachers. Results of the interviews are also analyzed by the coding.

9.3 Results

9.3.1 Growth from Training Courses

Based on the answers of pre-service teachers, to analyze the coding results of the responses of each growth area and details are shown in Table 9.1 below. The data shows that pre-service teachers think that their teaching skills have been greatly improved (58.67%). It is certain that sufficient practical teaching experience can

Table 9.1 Growth from this course (Mentions N = 75)

Category	Mentions (%)	Detail
Growth in Teaching Skills	44 (58.67)	Design courses that are more suitable for students; adjust the class methods (including lesson preparation and content level) according to student requirements; practical teaching experience; better understanding of online teaching; use of Chinese teaching knowledge and teaching skills; time management (including lesson preparation time, teaching time), knowing how to correct mistakes; ability to react instantly in class
Improvement of Chinese language professional concepts	18 (24.00)	Better understand self-deficit, self-evaluation, and seek progress; feel self-improvement; truly experience the difficulty of teaching; be clearer about your teaching goals and direction
Recognize the importance of cooperation, interaction, and peer reflection for self-growth	13 (17.33)	Teamwork; mutual experience sharing (reflection) and learning among students and group members; reflection in the classroom (how to improve teaching); understanding the importance of teacher-student relations and interaction

effectively help these teachers. In addition, some also reported improvement in the knowledge of Chinese language teaching concept (24.00%), and realized the importance of cooperation, interaction, and peer reflection on self-growth (17.33%).

9.3.2 Difficulties in the Training Process for Pre-service Teachers

In terms of online practical teaching, difficulties are encountered before, during, and after training. The results of the questionnaire are shown in Tables 9.2, 9.3, and 9.4.

9.3.3 Difficulties and Solutions During Class

In the end-of-term reflection, we can also see the difficulties of different forms. The occurrence time and solution strategy are shown in Table 9.5.

2. Interview Analysis of Online Teachers

Table 9.2 Difficulties in online practice teaching (before class) ($N = 37$)

Difficulties	Mentions (%)
Uncertain of student level	30 (81.08)
Uncertain of student learning expectations	29 (78.38)
Don't know how to design teaching activities	19 (51.35)
Don't know how to adjust the difficulty of the textbook	15 (40.54)
Don't know how to design teaching materials	13 (35.14)
Language learning students were late or failed to hand in assignments, which affects the week's teaching (e.g., photos, subject materials, etc.)	12 (32.43)
Difficulty connecting with students (e.g., no response, or slow response)	10 (27.03)
Coordinating class time with students was not smooth	7 (18.92)
Coordination among team members is not smooth	3 (8.11)

Table 9.3 Difficulties in online practice teaching (during class) ($N = 37$)

Difficulties	Mentions (%)
Poor control of teaching time (teaching overtime or too short)	23(62.16)
Students' answers and reactions unexpected	17 (45.95)
Don't know how to correct	17 (45.95)
Pronunciation is not standard enough	16 (43.24)
Don't know how to answer when students ask questions	16 (43.24)
Students come to class without any preparation	14 (37.84)
Poorly controlled teaching process	14 (37.84)
Teaching did not produce the expected results	13 (35.14)
Students are not energetic	12 (32.43)
Problems with teaching hardware or connection (zoom platform, webcam, internet connection, etc.)	12 (32.43)
Restricted teaching activities/cannot be diversified	10 (27.03)
Students are late or absent for no reason	8 (21.62)
Low student willingness to learn	5 (13.51)
Failure to complete UVA-designated learning content and activities	2 (5.41)

Table 9.4 Difficulties in online practice teaching (after class) ($N = 37$)

Difficulties	Mentions (%)
Uncertain self-teaching performance and how to improve	26 (70.27)
Unable to know if the student has completed a review or preview	23 (62.16)
Unaware of students' class evaluation	13 (35.14)
Students' delayed responses outside of class time (e.g., do not respond to message or email)	6 (16.22)

Table 9.5 Difficulties in online practice teaching (after class) ($N = 37$)

Type	Time of occurrence	Mentions (%)	Resolution strategy
Teacher's difficulty: Unable to grasp the student's level; how to guide the student (e.g., the student has always used known vocabulary); how to improve the motivation of the student; unable to answer students' questions	Before class /during class	14 (37.84)	Mutual support and cooperation among team members Pre-class teaching preparation; adjusting teaching content, process, or method; review and discussion after class; refer to or ask other people's teaching experience; give students supplements after class
Time control	during class	6 (16.22)	
Poorly designed teaching content and teaching process	Before class /during class	5 (13.51)	
Student problem: The student did not prepare in advance; the student did not know how to answer; the student lacked attention, or lacked interest	during class	5 (13.51)	Adjust course content, teaching process or method; require students to prepare before class
Hardware: Network connection or hardware device problem	during class	4 (10.81)	Reconnect; mutual support and cooperation between team members; improve equipment
Timing of correcting mistakes: Don't know when to correct or to what exten**t**	during class	3 (8.11)	Mutual support and cooperation among team members Pre-class teaching preparation; adjusting teaching content, process, or method; review and discussion after class; refer to or ask other people's teaching experience; give students supplements after class

Interview with those who have become online Chinese teachers after the training course. We want to know: What are the benefits of the training course in real Chinese teaching, what real difficulties will be faced after becoming an online Chinese teacher, and the teaching items that should be provided for the training course? Then, we also asked them to give suggestions for the training course. Six teachers give feedback, the interviews are analyzed by the coding. The results are as follows (Table 9.6).

Table 9.6 The benefit of training courses for present teaching ($N = 6$)

	Mentions (%)
Online course arrangement, teaching process arrangement, teaching content, activity design and planning	6 (100.00)
Understand the use of online tools (Zoom operation, presentation production)	4 (66.67)
Planning a review activities or games	4 (66.67)
Awareness of student status (causes student interest, concentration)	3 (50.00)
Ability to notice prior connections (cautions, time difference)	3 (50.00)
Efficient and organized planning courses	1 (16.67)
Meaningful questions for students	1 (16.67)

9.3.4 Benefits of Training Courses

Online teachers think that the training courses are helpful for the arrangement of online courses, teaching process, teaching content, activity design, and planning. 66.67% of teachers think that the training courses make them more familiar with the use of online tools and planning review activities or games. 50% of the teachers think that they can pay more attention to the condition of students in teaching, including arousing students' interest and concentration. 50% of the teachers mentioned the past training experience allow them to notice the problems of pre-connection and jet lag with students. Teachers also mentioned that training courses help them know how to plan lessons efficiently (16.67%) and how to make meaningful questions to students (16.67%) (Table 9.7).

Teachers responded that the training courses were helpful on their teaching. Four of the teachers mentioned practical teaching activities help them learn how to arrange courses and teaching processes (66.67%). The teaching theory and usage of the online activities/games introduction helped them understand what students interested in online class (33.33%); In addition, they also mention the training course help them how to make a good teaching material, ask meaningful questions or give students

Table 9.7 What kind of help in your present online teaching? (N = 6)

	Mentions (%)
Learn how to adjust and arrange courses and teaching processes in the experience of practical teaching activities	4 (66.67)
teaching theory and introduction of online teaching platform/games helps to understand what students like	2 (33.33)
Presentation production-brief and focused, animated games for presentations	1 (16.67)
Use meaningful chats and give students a chance to speak	1 (16.67)
Self-confidence in online teaching	1 (16.67)

Table 9.8 Differences in the age of the subject ($N = 6$)

	Mentions (%)
Proportion, stimulation, competition, and novelty of classroom activities (games)	5 (83.33)
Comprehension, different knowledge, and practice	5 (83.33)
Learning motivation, interest	4 (66.67)
Attention and control of classroom	3 (50.00)
Course content	3 (50.00)

chances to speak, and increase their own self-confidence in online teaching (16.67%) (Table 9.7).

9.3.5 Differences Between Training Courses and Current Positions

According to the different ages and numbers of teaching objects, the teachers need to have different arrangements (include different kinds of games and activities) for class activities (83.33%). The younger students are not as good at understanding as adults, so the teaching methods are different (83.33%).

Because of different ages, students' learning motivation and interest in the class are different (66.67%). Children have less concentration especially in an online learning environment, teachers need to pay more attention to the classroom management (50%). The course content for the single age of the students (university students) was different from the age of the students(children/teenagers) whom they are teaching now (50%).

In the response of the interview, teachers also pointed out some difficult points that were not mentioned in the training process. Four teachers (66.67%) believe that teaching models or methods, teaching activities, teaching techniques and timing of activities for different age groups are currently issues that need to be discussed in training courses. Half of them thought that they needed to learn teaching skills on how to keep students interested and focused.

Students' differences in language levels, personality, and preferences within the same class can raise teaching challenges. This is an issue not encountered by the way this practicum is set up (3–4 teachers to 1 student). Different age levels of students also raise different sets of challenges or lack of challenges. For example, while a teacher needs to deal with the emotional aspects of elementary and middle school, it is less of an issue when teaching adults. In addition, teachers-in-training also raised the need for learning ice-breaking techniques, which is much needed in a group teaching setting of more than two students.

9.3.6 *Suggestion from In-service Online Teachers on Training Courses*

Interview with these online teachers who made the following suggestions for online teaching training courses: Half of the teachers mentioned that they would like to observe the excellent teaching of other groups, such as sharing presentations (online teaching materials), teaching videos, sharing effective teaching, and review activities (50.00%). They hope the training course include sharing online teaching activities, games, and useful websites (33.33%). In addition, some teachers mentioned that in the training course, there should be bilateral evaluations instead of unilateral evaluations (16.67%); and lesson plan writing (16.67%).

In addition, in-service online teachers suggest that the training courses should include the following teaching content: Source of online materials and websites, online teaching applications, and how to design online teaching games (33.33%). Activity skills (including review activities) of online teaching in different ages (33.33%) and classroom management (include student emotion management skills) (33.33%) should be also referred into the training program. How to design and organize lessons and presentations for different level students (33.33%). Processing skills for all kinds of unexpected situations (16.67%) and opportunities to observe each other teaching (16.67%).

9.4 Discussion and Conclusion

9.4.1 *Discussion*

Through this research, the teacher training courses are conducted interactively between teaching theory and practical teaching. It is evident that this approach allows pre-service teachers to gain practical experience, and to grow in teaching skills. Pre-service teachers can experience real-time difficulties and dilemmas in context, reflect on their own teaching methods, and seek ways to improve. Team teaching not only allows members to discuss and prepare lessons together, but also for peer support and peer teaching. Through this approach, they can then modify their teaching direction as well. Echoing Lan et al. (2012) and Jamil and Hamre (2018) proposal that through reflection and peer feedback, pre-service teachers can realize how to better and to amend their approach.

It's not likely for novice teacher to have in-depth, unbiased observation of their current behavior. Plešec Gasparič and Pečar (2016) proposes to introduce peer cooperation into reflective activities: to help each other discuss in depth, to encourage and guide participants to reflect and cooperate with each other. Participation in reflection, discussion, and cooperation can also help improve the quality of learning and better understand one's own progress.

In the reflection and questionnaire at the end of the training, the pre-service teachers also raised various difficulties encountered before, during, and after the class. There are three factors that can be summarized in each difficulty:

1. Teacher factors: Difficulties of designing teaching activities or teaching processes, time control, pronunciation, without improving methods.
2. Student factors: Low learning willingness, without preview or review.
3. Communication factors: teaching platform or connection problem, teaching methods are limited by the platform, poor communication between teachers and students.

The teacher's factors can be attributed to insufficient preparation and skills of the teaching content. Preparation and skills can be complemented by practical theory courses. But pre-service teachers also need to have sufficient practical teaching experience. Pre-service teachers also need the opportunity to reflect to learn how to solve problems.

Interviewing in-service online teachers, they expressed different orientations and perspectives. They recognize the important experience and help that training courses bring. However, it is also proposed that the internship object of the training process should not be limited to the same age or the same type (such as one-to-one or one-to-many). Because of different teaching techniques are used for students of different ages, and also different management methods are used for different types of online classrooms. So that in the training process, we should also pay attention to mention the diversity of teaching objects.

The in-service teachers also suggested that in addition to the peer learning in the group, if we could increase observation among groups during the training, for example: 1. Watch teaching videos of different groups; 2. Share excellent briefings and online teaching materials; 3. Discuss effective teaching activities and websites of each group's practical internships, so that they can not only learn more about the problems and experiences of different groups in the teaching objects but also bring substantial help for the current in-service teaching.

9.5 Conclusions

Based on the Comprehensive questionnaires, reflections from pre-service teachers, and the interviews with employed teachers after training, we have made several discoveries. Online Chinese teacher training course should include the following components:

1. Online teaching ability:

It consists of two aspects: One is the basic online teaching theory. The second is the teaching practice in order to implement and consolidate teaching theory. The practical internship includes real teaching situations (including internship objects of different ages, group cooperation and discussion, reflection and sharing, teaching videos and briefings).

2. The ability to use teaching tools:

Except the usage of the teaching platform, how to find and use online teaching tools and resources effectively should be included in the curriculum.

3. Online classroom management and emotional processing ability:

Online classroom management is also very important for online teaching, especially the online teaching for more than one student. Such as emotional processing skills for students of different ages, and classroom management skills with different class sizes. The training course must also include solutions and discussions of various emergencies.

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Part II
Critical Thinking

Chapter 10
Effective Feedback Strategies that Promote Critical Thinking Skills in Online Learning Environments: An Online Assessment Learning Perspective

Sharon Ndolo

Abstract This paper presents a thematic analysis of how higher education instructors can effectively provide feedback in the online learning environment, in such a way that, it promotes critical and creative thinking skills in the students. Feedback has been a great point of interest to many researchers. However, previous research has mainly focused on analyzing student perception toward the feedback they receive in the learning environment but, little focus is being put on how effective feedback should be delivered to the students, in such a way that sparks their thinking to greater heights improving the learning process. This comprehensive review of literature will explore various interactive feedback strategies such as, those recommended by prominent researchers (Narciss, 2008) that instructors can utilize. The paper will provide dominant themes within several research literature on feedback, with an aim of enhancing the quality of feedback in the online learning environment.

Keywords Feedback · Assessment · Higher education · Course signals · Technology · Online learning

10.1 Introduction

10.1.1 Definition of Feedback

Feedback is the most important element in the learning process. Cookson (2017) defines feedback as the "lifeblood" of learning. Carless (2002) believe that feedback is the most powerful element in learning and has the most powerful influence on student achievement. Higher educational institutions are embracing a culture of online learning where majority of the courses are now offered through online learning management systems. Thomas, West, and Borup (2017) and Wolsey (2008)

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stated that this could be as a result of the student–teacher interaction that is available in the electronic environment, that is achieved through feedback, the building block of teacher–student relationship in online learning environment. In addition, Kuo, Walker, Schroder and Belland (2014) stated that the difference between online courses and traditional face to face courses is the interactions between the students and the teachers.

Hunt and Pelligrino (2002) and Evans (2013) found that the electronic environments give a lot of opportunities to track student performance, frequent self-testing as compared to face to face meetings. In addition, Gaytan and McEwen (2007) found that, a high percentage of students now prefer online learning due to convenience of learning anywhere and is further supported by, Hast and Healy (2016) who stated that, "our students now want to learn anywhere at anyplace".

Therefore, as recommended by Gaytan and McEwen (2007) an increased awareness about online assessment is crucial, especially in this era where majority of higher educational institutions are incorporating technology into their learning environment. Thus, this paper will focus on providing effective feedback strategies that instructors can utilize in their online courses by analyzing effective feedback strategies that have been rated the best by students in various research.

10.1.2 Technology Affordances and Feedback

Technology has improved the assessment process in online learning environments. Interaction is what makes students satisfied in the learning environment and its mostly promoted using technology. Johnson, Steelmarck, and Barthel (2018) stated that electronic feedback assists instructors in providing effective feedback which is also supported by Nagel and Kotze (2010), who stated that technology has provided more opportunities for interactions among students and the instructors with ease. Nevertheless, teaching in an online environment should not just be about books behind the glass with minimal interaction because it will not make a difference in the learning process. This is evident by, Wolsey and Hunt and Pelligrino (2002) who stated that despite the affordances of assessment offered by the advancement of technology, instructors must be able to use it well, to track student progress and give quality feedback to their students. This is also supported by Kuo et al. (2014), who stated that self-efficacy and Internet-self-efficacy are crucial in online learning. When instructors are technologically competent, chances are that they will encounter quality interactions with their students. Effective use of technology enhances interactions between students, instructors, and content.

Gaytan and McEwen (2007) conducted a qualitative study to find out the perceptions of online teachers and students about online assessment techniques. The authors found that, online instruction and assessment must balance the requirements of technology and learning outcomes. The authors, emphasized the need for using a variety of assessment techniques in providing meaningful and timely feedback which can be

achieved by coming up with good rubrics, using email messages, discussion forums, chat room conversations as venues for providing feedback.

In addition, Johnson et al. (2018), conducted a qualitative study and evaluated students' assignments for an introductory research methods class. The authors found that, the margins in the Microsoft and Google drive editing tools allowed the instructor to give more comments within the students work and the students could clearly point to where they were wrong. A similar qualitative study was conducted by Wolsey (2008) where he used interviews to determine the types and forms of feedback on assignments with 25 graduate students. Wolsey found that all 25 students agreed that feedback embedded within the students work, showed areas of improvement and at the same time gave the students justification of why they missed their points. The authors thus advocate for instructors to give feedback within students work using editing tools as opposed to giving a summary at the end of their assignments.

The use of Adaptive technology in the assessment area has been beneficial to educators. This is evident in an experimental research conducted by Matthews, He, and Patterson (2012) to understand how "auto grading" with an adaptive learning component might affect the quality, quantity, and speed of feedback. The authors found that, in the pre-implementation control set, more than 30% of students did not get any feedback and in the post-implementation set, majority of the students received feedback with only less than 1% not receiving any feedback. Matthews, He and Patterson findings show that the use of AGLS (Adaptive Grading /Learning Systems) will increase quantity of feedback, and decrease time taken for assignments to be graded but does not affect the quality.

MacWilliam and Malan (2013) sought to address the issue of the quality of feedback that was missing in Matthews et al. (2012) findings. MacWilliam and Malan (2013) study aimed at, decreasing the amount of time needed for grading assignments and improving the quality of feedback. The authors used the CS50 submit that tracks the time graders speed and length of feedback they give to the students. The CS50 was a useful assessment tool as it not only notifies the students when their assignments are graded, but also records how many students viewed the feedback allowing the instructors to know if the feedback was utilized and how useful it was to the student.

Social media has also provided platforms where instructors can provide feedback in online learning environment. For example, Mccarthy (2017) conducted a qualitative study where he/she analyzed feedback that was received online via Café, an e-learning application hosted by Facebook. Participants were 118 students of whom 19 were international students. Student experience was evaluated using online surveys using Likert-type scale statements and open-ended questions. Mccarthy found that, the feedback was more in-depth as evident by, 132 posts to the pinboard, text comments, links to external websites, videos, and images showing that all the participants visited the Café forums frequently.

One main factor to remember is that, despite the online platform giving avenues such as chat rooms, discussion forums, emails, social media platforms for interaction, it is important that instructors maintain their presence as instructor feedback in the online environment plays an important role in student individual assignments.

10.1.3 Language of Feedback

Gigante, Dell, and Sharkey (2011) stated that learners tend to associate no feedback with approval that they did the right thing. Hence feedback should be given using the right language. Depending on the tone that is used, feedback can be either referential, directive, or expressive (Adel, 2017). Duijnhouwer, Prins, and Stokking (2012) stated that the more receptive you are to the feedback, the more it will improve the learning process. Therefore, to make students receptive to feedback, instructors should ensure that they give feedback in the most appropriate language. Adel (2017) discourages instructors from using directive feedback such as, 'you have to, "you must" as it tends to negatively influence student's motivation to learn. Instead, Adel, encourages instructors to use facilitative instructions for facilitative instructions such as,' you might want to consider' which has a positive tone hence promote learning.

Instructors can also be cautious of the language they use in providing feedback by avoiding being too critical as it may affect the student's ability to put in more effort in the future as it makes them feel labeled as failures. Instructors are prone to offer feedback quickly and end up being judgmental (Wolsey, 2008). Instead, instructors should notice student's effort and acknowledge good work they have done before judging the students work. Bergh, Ros, and Beijaard (2014) refers to this as "optimal feedback'.

In addition, the language used when interacting with the students affects the level of student satisfaction in the classroom. For example, in a qualitative study done by, Kuo et al. (2014), the impact of learner-instructor interaction on student satisfaction depends on how the students papers are evaluated, thus if they are evaluated with a negative language, student satisfaction will decrease leading to high dropout rates and poor academic achievement. This is evident by Nagel and Kotze (2010) who found an association of high dropout rates of students due to limited feedback from the instructor.

Gigante et al. (2011) advocated for instructors to use the "feedback sandwich model" when giving feedback by starting with a positive note, then points out the area that needs improvement and finally another positive note that ends the feedback on a good note. Gigante et al. (2011) "sandwich model" is like Adel (2017) "expressive feedback model" where instructors use praise, then criticism and finally give their opinion.

Therefore, instructors should always aim to acknowledge the student's effort even though it does not meet their expectation. Wolsey (2008) identified one of the effective feedback strategies as the identification of the positive aspect of the students work. In addition, Bailey (2010) found that for students to improve, teachers felt that the written feedback should be worded positively. Thus, instructors need to organize their comments well in a way that reveals their presence as being supportive (Adel, 2017).

10.1.3.1 Feedback Specificity

Vague feedback may sometimes make the students struggle to identify their own strengths and weakness. Carless (2006) stated that sometimes instructors offer feedback that may be difficult for the students to interpret thus having a negative impact on student's self-perception and confidence. Especially in this era where our educational institutions are diverse with people from different countries, international students are prone to misunderstand feedback due to language barriers Mccarthy (2017).

Cookson (2017) stated that the gap that exists between what teachers expect and what students do, is the leading cause of student dissatisfaction and teacher frustrations. Chanock (2002) found that it is sometimes difficult for instructors to give feedback that the students will understand what they mean (difficult for someone else to read your mind). To close this gap, the authors advocates for, instructors to be more precise and ensure that the students understand feedback they give by using more information and not assuming that the student will know what you mean. However, Wolsey (2008) contradicts Chanock (2002) by stating that, too much specificity on feedback is not good as it discourages the learners from exploring their thinking in depth.

In addition, Mallonee and Breihan (1985) stated that instructors should avoid abusing editing tools where they cover the entire students work with too much corrections from the very minor issue to the major. Mallonee and Breihan (1985) referred to this as, covering students work with "blood-red rivers of ink". Too much corrections make the students feel overwhelmed making it difficult for the student to know what is really important. Instead, instructors should use the margins well to give thoughtful feedback. This is supported by Wilkinson, Couldry, Philiphs, and Buck (2013) who stated that feedback should be provided in small doses. Findings from previous research show that there are differing perceptions on the amount of feedback that should be delivered.

10.1.3.2 Summative Vs Formative Feedback

One of the major setbacks of online learning is that student–teacher interaction is mostly limited to feedback about their assignments hence it is prone to have some degree of evaluation (Cox, Black, Heney, & Keith, 2015). Promoting teacher presence: Strategies for effective 401 and efficient feedback to student 2015). Gigante et al. (2011) and Cox et al. (2015) view evaluation as summative, the final judgement of the learner's performance for determining grades and graduation decisions. The author's stated that, instructors should refrain from giving feedback that is too general but offer formative feedback that is specific aiming at improving future performance. This is further supported by Coll et al. (2013) who stated that, feedback should have specific pointers on areas of improvement such as, providing references, making suggestions, fostering reflection, and formulating questions.

According to Wilkinson et al. (2013) feedback is an ongoing process, a formative one that helps the learner improve their learning. This goes hand in hand with Gigante

et al. (2011) who stated that, feedback should be about improving future performance and instructors should refrain from encouragements such as, "Good Job" because it is supportive, but does not do nothing to improve learner skills. In a qualitative study conducted by Chanock (2002), 232 students were asked about their perceptions of the function of feedback. All the students stated that feedback should be informative on how they could improve other than feedback that categorized their assignments as good or bad. One hundred and eighty-four students felt that the function of feedback is not to judge a student's ability but to help them improve their learning. This is supported by, Wilkinson et al. (2013) and Cox et al. (2015) who found that, feedback conveys information and evaluation coffers judgment which makes students insecure causing them to see the instructor as harsh or dismissive. Thus, instructors should ensure they mold their presence well by creating an identity that makes students feel acknowledged, guided, and well cared for.

Therefore, as Hunt and Pelligrino (2002) stated, current assessment practices that are summative are not well aligned with improving student learning. Instructors need to come up with different approaches that stem from cognitive theories of knowledge to be implemented in the classroom.

10.1.3.3 Assignment Structure

Teacher presence should be laid out in the course design and organization. Instructors should come up with instructional activities that makes the students think deeply about concepts presented to them and at the same time the instructors should be able to know what to do next to advance the students to the next stage of understanding. The instructor should act as the generative guide, facilitator, reflective guide, mediator, or role play (Nagel & Kotze, 2010).

Instructors have the responsibility to ensure that they structure their assignments in a way that will allow them to give detailed feedback to their students work. Carless (2002) stated that assessment promotes learning when the assignment is structured in a way that contains many opportunities for the learners to receive detailed, positive, and timely feedback.

In an active research conducted by Carless (2002), groups of three students were given an assignment to collect a portfolio of assessment tools and write the importance of the tool. The students submitted their work using the "mini-viva" and got opportunity to justify their work and received feedback from the instructor. Carless found that, all students liked how the assignments were structured as it enabled them to get an opportunity to get feedback that improved their overall projects.

Another way to promote feedback in students writing is through the utilization of peer reviews. According to Abdullah, Hussin, and Shakir (2018), instructors can structure their assignments in a way that allows for the social interactions such as, collaborative writing projects, where students interact and write papers collaboratively might help students gain self-confidence in their writing and reduce their anxiety when they see their work corrected as a group. In addition, Gibbs and Simpson (2004) and Duijnhouwer et al. (2012) emphasized the need for instructors to design

their assignments in a way that will allow the students discuss with their peers and evaluate each other's work to see areas of improvements.

For feedback to promote learning, Hummel (2006) advocated for assignments to be structured using driving questions in a way that will have the student think and reflect when coming up with their answers. Hummel (2006) then suggested for instructors to use questions when giving feedback, as it helps understand why the student gave the response they did and thus, easy to point out the specific step that the student needs to change. This is also supported by Langer (2011) who stated that instructors should use probing questions during their assignments as it will allow the students to put in their effort, which in turn facilitates good delivery of feedback as the instructor can monitor the student work step by step.

10.1.3.4 Immediate Vs. Delayed Feedback

The time at which instructors offer feedback to the student is an important area of consideration. Dating back from Behaviorist theorist such as the Skinner's operant learning theory, feedback is seen to be effective when it is provided immediately. However, Spector, Merrill, van Merriënboer, and Driscoll (2008) found that, early researchers such as, Anderson and Kulhavy (1972) came up with the concept of *delay retention effect* which meant that giving immediate feedback might hinder the acquisition of the correct response. Spector et al. (2008) stated that when feedback is delayed, the incorrect response is forgotten, thus students will embrace the feedback well. Therefore, when instructors want students to realize their mistakes and offer correction, it is best for the feedback not to be offered immediately because it will not foster the acquisition of the new skill. However, Spector et al. (2008) found that, when instructors offer feedback that is aimed at offering new knowledge of the result together with knowledge about the mistake made in a multi-try process that needs students to look into their errors and to identify error correction steps, then the feedback can be provided immediately.

10.1.3.5 Single Try Vs Multiple Try Feedback

Spector et al. (2008) found out that prominent researchers in the field of feedback such as, Narciss (2008) found that, majority of online classroom environments feedback is offered in the form of single try that is, learners do what is requested by their instructor then they are provided with feedback and do not have the opportunity to respond again to the same item. Narciss (2008) conducted a review of literature on feedback and found that majority of researchers recommended for the use of Multi-try form of feedback delivery which is best achieved by a concept known as Answer Until Correct (AUC) feedback which is more effective for promoting high order thinking skills among students.

Narciss (2008) found that majority of instructors utilize the simultaneous approach of delivering feedback all at once. While other instructors use complex elaborated

feedback, which is presented step by step. However, other researchers view that, due to the cognitive load of delivering feedback all at once it is better to deliver it in a sequential step by step manner. Sequential presentation of feedback will require the instructor to have multiple tries, this might be the reason as to why most instructors offer feedback using the simultaneous approach with the single try approach.

10.1.3.6 Discussion (Implications)

According to Narciss (2008) the time taken for the learner to understand feedback given to them depends on the learner's characteristics, quality of the feedback provided, the complexity of the tasks, and the type of error that the learner had made. High skilled learners may only need first response but for low skill learners' informative feedback alone might not be enough to meet their needs. How feedback is provided, depends on how the learners process and interpret information provided which is influenced by so many factors such as prior knowledge, motivation levels, and learning goals (Narciss, 2008).

Therefore, higher education institutions should consider incorporating course signals (CS) in all the courses that are offered online. Learning analytics provides a good opportunity to identify struggling students and provide intervention early to increase their chances of being successful in their studies. Instructors can use course signals to know more about various factors that might affect the student's success in the class such as grades, effort, previous academic history, and student demographics. Majority of instructors and teacher assistants fall victim of providing feedback without putting these factors into consideration hence making the feedback process difficult for both the instructor and the student. Thus, incorporating course signals will enable instructors provide effective feedback as they will be aware of their students more. However, one main issue of concern with course signals is that, the workload for instructors and TA's will increase as evident by, Arnold and Pistilli (2012) who found that, students posted a lot of questions before due dates. However, this appears to be an issue that can be resolved if the school administration is willing to invest in more teacher assistants to help the instructor. Also, as a passionate instructor this should not be a concern because the aim of all instructors is to improve the students learning outcomes, which can be achieved by sacrificing time to ensure availability to respond to students' questions.

In addition, higher educational institutions should consider investing in training their teachers to know what good teaching means and ensure that teaching expectations are well laid out in rubrics (Lenihan, 2016). As mentioned earlier, it is the responsibility of the instructor to set the climate of the classroom. Teacher presence should be felt in all aspects of the learning, that is, online courses should be designed well, instructions should be easy to follow, and the assignments should be structured in a way that allows for the instructor to deliver feedback well.

A simple layout composed of a combination of various strategies for effective feedback is important because, if instructors have a clear way in which they can provide effective feedback, it will make the learning environment more interactive and improve student's mastery of concepts learned.

10.2 Conclusion

Several major themes emerged after reviewing literature on effective feedback strategies that instructors can utilize in the online learning environment. A major common theme was, the language that instructors use when giving feedback. Previous research shows that majority of instructors fall victim of giving feedback quickly before thinking how it will affect their student. Instead, instructors should always operate with the mindset that, 'what is common sense to them may not be common sense to the students.' Instructors should be cautious not to be too critical of students work as it may hinder their learning process. Previous research shows us that, students' self-confidence is important in the learning process. Hence instructors should be careful with the "tone" that they offer their feedback as it may affect the student's self-esteem which in turn affects their ability to perform well. In addition, there is an increased diversity of students in higher educational institutions today, thus, it is important that instructor also consider language barriers and cultural differences when relating with international students. That is, what might appear as polite language in the United States might not be polite in Africa.

Another major theme was the specificity of feedback. It is evident that there are differing perceptions on the amount of feedback that is enough for the students. Some authors recommend for giving more information on feedback while others view too much information overwhelming to the student. This is an area that needs more attention as students are different, others might be grateful for the corrections while others might see it as somewhat overwhelming and intimidating when the instructors cover their entire work with corrections.

Utilizing technology affordances was another major theme that was mostly discussed in previous research. Technology is the key enabler of online education in higher education today. Despite technology creating more avenues such as chat rooms, discussion forums, emails where feedback can be delivered in an online learning environment, previous research has emphasized the importance of instructors having the skills to know how to use technology for the feedback to be effective. In addition, technology has also enabled instructors to be able to provide as detailed feedback as possible using editing tools that allow the instructors to add, modify, or delete information within the students work. Nevertheless, this has brought about a lot of debate between various researchers as it is not clear, what amount of feedback is enough. Previous research has shown that feedback should be as specific as possible while other researchers found that too much specificity causes the students to be overwhelmed. This is an area that needs more research. In addition, with the advancements of technology, feedback can be presented in various forms including but not limited

to text. graphics, animations. Therefore, future research should investigate how and when to apply multimodal feedback.

The structure of assignments was something critical too**.** It is evident from previous research that the basis of giving effective feedback starts with how well the assignments are structured. Instructors have to ensure that they design their course work well, in a way that will allow them to offer feedback to the students. Some of the ways that have been suggested in previous research include the use of constructivist approach in teaching where students are required to explore on topics step by step which facilitates the feedback process as the instructor is able to identify the specific step that the student missed. Group work activities was also a major finding in various research, as it avoids instances when a student feels that they were the only one who did not get it right because correcting a team reduces the level of anxiety as opposed correcting one person.

Finally, formative and summative feedback was a major issue of concern to many researchers. All researchers in my study agreed that feedback should be about improving the learning process as opposed to assigning grades to students and judging them based on their grades. Previous literature shows how grades do not matter but what counts is what the students learned from the feedback. This is evident by students who utilized the "mini viva" and got an opportunity to explain their findings then revised their work based on the feedback given to them before the final grade was assigned to their projects.

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Chapter 11
Is Computational Thinking Critical Thinking?

Julie M. Smith

Abstract Jeannette Wing popularized the idea of computational thinking, which is the set of approaches typically used in computer science in order to solve a problem. In recent years, nationwide educational reform efforts have focused on expanding students' exposure to and proficiency in computational thinking. It has even been argued that computational thinking is critical thinking. This paper assesses the relationship between critical thinking and computational thinking by examining different definitions of and frameworks for critical thinking, assessing the various definitions and manifestations of computational thinking, and then analyzing the extent to which computational thinking can be considered critical thinking, concluding by noting important gaps between computational thinking as frequently practiced and critical thinking as ideally constituted. The social implications of the lacunae in computational thinking will be briefly explored.

Keywords Computational thinking · Critical thinking · Computer Science Education

11.1 Introduction

The idea that the habits of mind used in computer programming could be applicable to other situations has existed since the 1950s (Tedre & Denning, 2016), but it was popularized in the twenty-first century as "computational thinking" (hereafter compT) by a highly influential editorial by Wing (2006). Since that time, there has been a flood of scholarly work, educational standards, and curricular products focused on computational thinking. More recently, a discussion in both academic and popular circles has begun about the relationship between critical thinking (hereafter critT) and compT (Kules, 2016), but this relationship requires more exploration (Voskoglou & Buckley, 2012). A thorough and rigorous articulation of the relationship between the two is essential, given the ever-increasing role of computational technology in

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virtually all facets of modern life. It is the goal of this paper to contribute to the clarification of that relationship, with an eye toward improving the practice of both compT and critT.

This paper will establish working definitions of compT and critT and show how the application of critT to the practice of compT can help compT avoid some serious pitfalls.

11.2 Defining CompT and CritT

One trait that both compT and critT have in common is that there is widespread agreement about their basic definition but no consensus regarding a more specific definition.

The general definition of critT is that it is thinking that involves the use of higher-order thinking skills. Here, there is agreement (Ennis, 2016). But, in terms of the specific definition, there is less agreement, with the following items appearing on some but not all definitions of critT: reasoning, using logic, using metacognition, reflecting, questioning, evaluating, being fair/objective, being purposeful, being goal-oriented, making judgements, synthesizing information, making inferences, interpreting, analyzing, and being flexible/open (Ennis, 2016). However, as both Halpern (2007) and Ennis (2016) point out, the general agreement about the definition is sufficient, and most definitions of critT have enough in common so that the differences are not unduly problematic for researchers or practitioners and therefore need not be reconciled.

Similarly, there is a consensus for the general definition of compT; it involves thinking like a computer scientist (Wing, 2006). Some definitions of compT include specific elements that others do not, including abstraction, simulation, iteration, encapsulation, automation, data analysis, modeling, pattern recognition, recursion, debugging, algorithmic thinking, and decomposition (Smith, 2019). But, as with critT, the similarities between these definitions are sufficient so that work in the field can proceed without becoming mired in debates over which particular elements must or must not be included (Nardelli, 2019).

11.3 The Relationship Between CompT and CritT

The excitement over compT is such that some popular outlets are claiming that compT is critT (Lee, 2019; Noonoo, 2019). But comparing compT with a few of the standard frameworks for thinking and learning illustrates the differences between compT and critT.

In terms of Bloom's revised taxonomy (Krathwohl, 2002), many compT experiences will involve the creation of artifacts and thus involve practices at the very top of Bloom's pyramid. But compT is missing the evaluation level in most of its

iterations. To the extent that evaluation might be involved in compT, it is generally limited to evaluation based solely on efficiency and efficacy—not on social, cultural, or moral implications. Similarly, there is little analysis in most versions of compT, leaving the lower levels of the taxonomy (remember, understand, and apply) overrepresented. And some of the skills associated with understanding, such as interpreting and inferring, are missing from compT.

Similar gaps are observed when considering Webb's (2002) depth of knowledge taxonomy: the two lower levels are well-represented by compT, but the two higher levels are not since compT does not generally involve activities such as using evidence to justify conclusions or making connections between concepts. The same lacunae appear when applying Marzano and Kendall's taxonomy (2006) to compT: three of the four highest levels (analysis, metacognition, and self system thinking) are missing from most conceptions of compT.

Thus, comparing compT and critT in light of the most commonly used thinking frameworks shows that there are gaps in compT that prevent it from being considered to be the same as—let alone superior to—critT. Most importantly, a key aspect of critT is the evaluation of ideas in order to render judgment on them (Mulnix, 2012). CompT lacks the tools to judge the quality of ideas. Rather, compT is best understood as a set of strategies that might be useful for solving a problem but, crucially, lack the ability to critique a solution to a problem. Further, the basis of compT is the idea of applying algorithmic thinking to a problem; by definition, critT requires non-algorithmic thinking (Voskoglou & Buckley, 2012). For example, critT often involves judging the reliability of a source of information (Ennis, 2016, p. 2), but compT supplies no tools for making reliability assessments. Similarly, critT is "self-rectifying" (Facione, 1990) because it contains the tools to uncover and correct mistakes; the same cannot be said of compT.

The case for thinking that compT and critT are not the same can marshal quantitative evidence as well as logical evidence. A study by Walden, Doyle, Garns, and Hart (2013) of students in an informatics class showed that it was possible to significantly improve compT performance without impacting critT performance. While the quantitative evidence about the relationship between critT and compT is limited, it is nonetheless the case that both theoretical and empirical evidence show that compT is missing several essential elements of critT and thus should not be considered as (a form of) critT.

This is not to say that compT is not useful. Rather, Denning and Tedre (2019) make the case that the traditional bifurcation of science into theoretical work (which has ancient roots) and experimental work (rooted in the Enlightenment) is now obsolete: science now contains a third form, new to the twenty-first century. Now, all of the traditional fields of science (chemistry, biology, geosciences, etc.) each have a computational branch. While theoretical science requires the mastery of logic and reasoning and experimental science requires mastery of scientific thinking, computational science will require the use of computational thinking.

If compT is not critT but is nonetheless essential to a new branch of scientific inquiry, how, then, should the relationship between compT and critT be understood? This paper proposes that compT should be considered as a set of tools that can aid

critT but that cannot function well without constant interaction with critT skills. CompT is a set of problem-solving skills, but critT needs to be applied before, during, and after the use of compT in order to ensure that compT is being properly deployed. Framing compT as an essential set of tools to a new, third branch of science implies a lot about the role of compT: it isn't critT, it isn't a substitute for critT, and it isn't universally applicable any more than scientific thinking is applicable to all situations. Rather, compT is a tool set that is useful, when combined with critT, for computational problems in a variety of disciplines.

11.4 The Application of CritT to the Practice of CompT

Because, as the previous section demonstrated, compT lacks some of the essential elements of critT, it is necessary for critT to supplement compT at every stage of practice. This section will catalog the limitations of compT and show how critT can be used to balance those limitations.

11.4.1 Technological Solutionism

A major shortcoming of compT as a system of thinking is that the problem statement is generally accepted uncritically (Easterbrook, 2014); application of critT insists that the all aspects of the problem are critically interrogated before, during, and after compT is used. (This implies that, in some situations, compT principles will be deemed inappropriate for the task.) To do otherwise runs the risk of eliding crucial perspectives on the problem (Kules, 2016), but critT involves holistically evaluating the larger context of the situation (Ennis, 2016). Further, compT assumes that every situation is (1) a problem that (2) has a computational solution. Easterbrook (2014) terms this approach technological solutionism; this framework should be interrogated. First, not every situation should automatically be assumed to be a problem; it may be more productive to frame it as a situation with a variety of trade-offs (Rittel & Webber, 1973).

Second, as early as the 1950s, there were warnings about the "treachery" (Forsythe, 1959, p. 655) of computing, with the reminder that algorithms must not be used "blindly" (p. 656). And, yet, over half of a century later, compT (or, at least, many common iterations of it) do not emphasize the careful interrogation of algorithmic thinking. This approach can have one of two detrimental results: either problems that do not have computational solutions are ignored, or inappropriate solutions are applied to the problem. Easterbrook (2014) mentions social changes, questions of values, and ethical quandaries as examples of situations that usually do not have computational solutions. It has been recognized for decades—since Alan Turing's work on the Halting Problem (Denning & Tedre, 2019)–that not every problem has a computational solution.

Further, even when a technological solution is appropriate, it cannot be assumed that it will be a compT solution. Tedre and Denning (2016) point out that other kinds of thinking—such as engineering thinking, design thinking, network thing, and systems thinking—are also possible. And where technological solutions are not the most appropriate, other disciplinary-based forms of thinking, such as historical thinking or artistic thinking, might be most appropriate.

It is perhaps not coincidental that there is a social movement around compT and not, say, artistic thinking. Current fears about increased economic inequality have led to a veneration of STEM careers, particularly computer science. To the extent that this kind of thinking motivates the uncritical application of compT, it should be challenged. Rather, Tedre and Denning (2016) summarize Papert's conclusion that "true computer literacy is knowing when it is appropriate to make use of computers and computational ideas while continuing to be open for alternative ways of knowing" (p. 125).

Another danger of technological solutionism is the reification of the current model of computation as the sole basis for compT (Tedre & Denning, 2016). But there are different models of computation, and there likely will be new models in the future. For example, machine learning will result in computational models that are opaque to human interpreters; what, then might compT be based on in a world where computing was dominated by machine learning? As the modern history of computers indicates, foregrounded values can change from concerns such as efficient memory usage (a key issue in the 1950s and 1960s) to marketability (1990s) to usability (2010s). Each of these values implies something different for what is defined as compT and what its best practices would be.

An additional danger of uncritical compT is that it narrowly circumscribes human thinking. Many definitions of compT emphasize the idea that it involves thought processes used to "formulat[e] problems and their solutions so that the solutions are represented in a form that can be effectively carried out by an information-processing agent" (Cuny, Snyder, & Wing, 2010). Note that this implies that when compT is applied to any endeavor—even non-computer-related ones—it means that the only problems considered and the only solutions offered are those that are capable of being carried out by a computer. This requires that humans then limit their problem-recognition and problem-solving abilities to match a computer's. Papert (1980) warned in the context of computer aided instruction that the computer might be programming the student when what one would hope is that the student would program the computer. Uncritical applications of compT can, unfortunately, have the effect of limiting the student to the capability of the computer. It is a strong argument against the universal applicability of compT: why should human thinking be limited to computer capabilities when there are "many problems that cannot be solved at all with computation" (Denning & Tedre, 2019)? This includes even some very basic problems: while a human driver would never have been fooled by a slightly altered speed limit sign, an automated car recently accelerated to 85mph in a 35mph zone (Heilweil, 2020).

In sum, the conceptualization of and use of compT will be improved when critT is used to examine compT approaches through the lens of technological solutionism in

order to ensure that compT is not misapplied. In addition to this critique of the applicability of compT in general, critT can be used to interrogate the various components of compT.

11.4.2 Encapsulation and Information Hiding

Two principles often included in the practice of compT are information hiding and encapsulation (Denning & Tedre, 2019). Both of these concepts are essential to object-oriented computer programming, where they function to isolate the user from some data and functions in order to ensure that these things are not misused. However, applying these principles to broader contexts can lead to significant problems. And, regardless of the field, hiding information and processes from others make it harder for them to engage in a critical evaluation of the process at work—an essential component of critT. Thus, when compT is applied to other fields, care has to be taken so that encapsulation and information hiding do not obscure the work that has been done in a way that makes future critT analyses of that work more difficult.

11.4.3 Optimization

A core principle of compT is the desire to optimize performance of a task. However, optimization is usually defined very narrowly—solely in terms of efficiency and robustness. In other words, the larger context—including social and environmental concerns—is often ignored (Easterbrook, 2014). Recent debacles in the tech world—from chatbots that quickly learned to be racist to photo tagging software that identified some people as animals (Smith, 2019)—are reminders that *more*—not less—attention to the social context of computing is needed. Undergirding compT with critT ensures that broader concerns are not ignored.

11.4.4 Abstraction

CompT emphasizes the idea of abstraction as a problem-solving technique. But abstraction means losing "any local, contingent knowledge about the problem situation" (Easterbrook, 2014, p. 237). Not only can this lead to the kinds of undesirable social impacts mentioned above, but it can also, ironically enough, make optimizing a solution to local conditions more difficult. An abstracted approach creates an inaccurate perception of universality "that is not founded in any real or human phenomenon" (Blackwell, Church, & Green, 2008, p. 7).

Further, an abstraction-heavy approach may be harmful to certain student populations. As Hu (2011) indicated, Piaget's theory of the stages of cognitive development implies that abstraction is not accessible to younger students, calling into question the practice of teaching compT in the early years. The possibility that an abstraction-heavy approach to an activity will alienate minoritized students must also be considered: female representation in computer science programs is a perennial challenge, and those schools that have made the most gains have emphasized not abstraction but rather increasing community, instilling confidence, and developing curricular breadth (Alvarado & Dodds, 2010).

Judicious application of critT can help avoid the inappropriate application of abstraction as a problem-solving principle in situations where it is not the best fit.

11.4.5 Quantification

Because compT brackets any situation that cannot be understood by a computer, it necessarily brackets anything that cannot be quantified. Blackwell et al. (2008) considered the example of the photo of the Sharbat Gula, the Afghan refugee girl on the famous *National Geographic* magazine cover: do terms such as "girl" and "portrait" capture the full power of this image? They conclude that the "value of this image … is in its computationally inaccessible, socially constructed properties" (Blackwell et al., 2008, p. 6). This implies that, when compT is allowed to elide qualitative realities, it loses something—a process that critT can help it avoid.

11.4.6 Iteration

A core principle of compT is the idea of iterating until an acceptable solution is found, an approach perhaps most famously encapsulated in Mark Zuckerberg's early motto "move fast and break things." As should have been obvious from this formulation, "breaking things" is one of the dangers of iterating through solutions. The recent history of tech-enabled problems such as unjust criminal sentencing algorithms (Huq, 2019) and racially biased medical wearables (Monea, 2019) show the potential for an iterative approach—where software or hardware might be released and used without being fully vetted—to be detrimental. CritT applied to compT would interrogate the possible ramifications of new technologies *before* they are widely used.

11.5 The Lessons of CritT for the Discipline of CompT

In the previous section, we explored how, on the level of practice, compT can be improved by the application of critT to the problem-solving process. In this section, we will consider what the *discipline* of compT can learn from the much older discipline of critT.

11.5.1 Questions of Generalizability

There is extensive debate and even doubt about the extent to which critT skills can be generalized or transferred to other contexts (Monteiro, Sherbino, Sibbald, & Norman, 2020; Moore, 2015). The advocacy of compT needs to heed these debates: the practice of compT should be able to show evidence of the transferability of its skills. Earlier efforts at compT did not show evidence of transferability (Tedre & Denning, 2016). Thus, the same debate over whether limited instructional time is better spent on teaching generalizable skills (such as critT and compT) or subject matter content is an important one to have, especially in light of Halpern's (2007) observation that critT is impossible without content knowledge.

Research has shown that what is most effective for teaching critT is "extensive deliberate practice" (Mulnix, 2012). Is this also the case with compT? It is likely to be, given that many definitions of compT define it as competencies developed from practicing computer science (Hu, 2011; Nardelli, 2019). Given this, does it make sense to attempt to extract something called "computational thinking" from computer science instruction and teach it separately, which is likely to require extensive practice in computer science (-like) activities to develop it, instead of just simply teaching computer science? In other words, is compT an effort to find a shortcut to developing the habits of mind of a computer scientist, one that is likely to be ineffective? Hu (2011) wonders if it would be more effective to simply promote "computational doing" (p. 226) instead of computational thinking.

One danger is that cash-strapped schools facing a shortage of qualified computer science teachers will turn to compT as a less expensive, easier to implement substitute for computer science, under the mistaken impression that compT will meet the overwhelming desire—more than 9 out of 10 parents want computer science instruction in their child's school (English, 2015)–for computer science instruction.

11.5.2 The Need for Empirical Research

CompT could benefit from attention to how empirical research has been used to refine approaches to teaching critT. One issue with assessment in both fields is ensuring that it is authentic, which can be a problem with abstract, general skills. Ironically,

given its (over)emphasis on quantification, there is little empirical research about the benefits of compT. While extensive research has been performed on various critT programs and approaches in order to improve the state of the field, the same cannot be said of compT. Further, critT has had to face the difference between what is "easily measured" and what constitutes the "fullness" (Facione, 1990, p. 16) of critT. Similarly, compT assessments need to be carefully designed in order to avoid this problem.

11.6 Conclusions

This paper has attempted to elucidate a productive relationship between compT and critT and explore how the discipline of compT can learn from critT. But further research is needed in several areas.

First, computational sciences can accrue an "intellectual debt" (Zittrain, 2019) because they offer solutions to problems without explaining the mechanism by which the solution works. For example, artificial intelligence used to discover new medicines will not describe the mechanism by which these medicines work, leading to an intellectual debt manifested in the inability to predict how and when these medicines might adversely interact with other drugs or conditions. Thus, procedures for reducing the intellectual debt of compT solutions will need to be explored.

Second, compT is currently theory heavy but lacks a complementary level of practical implementation. In other words, compT has advanced farther in position papers and curriculum standards than it has in evidence-based activities and lessons. (One interesting exception to this is the work of Seoane-Pardo [2016] to apply Boolean logic to the ethical issues raised by decision-making in autonomous vehicles). Further work should focus on practical ways to implement critT-grounded compT activities.

Third, as early as the 1950s, the suggestion was made that, while a student may *think* that they know something, they can only *know* that they know it when they can teach a computer to do it (Forsythe, 1959). This observation leads to the notion of using compT as an assessment device. Most compT research focuses on compT as a set of thinking skills, but more focus could be devoted to using compT artifacts as a means of assessment. For example, students could show their mastery of the process of multiplying fractions not by solving a set of problems but rather by creating an algorithm to solve problems. One intriguing aspect of this approach is that it might solve the perennial problem of creating quality assessments that can be graded at large scale, including on standardized tests.

Fourth, there is more work to be done in terms of determining the boundaries of compT. Halpern (2007) articulates the difference between critT and its opposite (namely, rote memorization and other kinds of low-level thinking skills). What would an articulation of the opposite of compT include? Perhaps imprecision might be suggested as one of the opposites of compT; if so, what would this observation imply for student thinking? Is imprecision ever valuable? Additionally, the relationship between compT and creativity deserves more exploration.

Escalating promises about the potential for compT to transform learning may eventually lead to disappointment if compT fails to deliver (Denning & Tedre, 2019; Yasar, 2018). This paper has argued that the rightful place of compT is not as an alternative for or an equivalent to critT, but rather as a set of problem-solving tools, which need to be accompanied by critT, appropriate to computational branches of science.

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Chapter 12
Using Holistic Design and Technology to Stimulate Critical Thinking in Mathematical Modeling

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Abstract Critical thinking can be defined as reflection, based on deep content knowledge, which informs the thinker about how best to apply his knowledge in a given situation. With the increasing demand for higher education to produce graduates that are not only well educated in their field of study but who can also think critically within it, one instructional model that promotes critical thinking is holistic design. Holistic design provides strategies for complex learning by presenting students with authentic, real-world tasks. In my junior-level mathematical modeling course at Baylor University, one such task my students investigate is building a schedule to repay an automobile loan. This project requires that students account for all financial aspects of the car buying process. In order to accomplish this, they must engage inductive and deductive reasoning skills while leveraging their knowledge of exponential growth and recursive relationships to construct a mathematical model. As they build their models, students use Excel to explore the consequences of their assumptions and gauge the reasonableness of their calculations. In the final phase, students use the internet to find an online car payment calculator. They must compare it to their model, describe similarities and differences, and reconcile any inconsistencies. Once their model is completed, students must then write a paper describing their model, its ingredients, and how it works. Requiring that students reflect on and articulate their solution has shown to be particularly effective at engaging the students' cognitive analysis, synthesis, and evaluation processes which fuel critical thinking.

Keywords Mathematical modeling · Critical thinking · Holistic design · Authentic tasks · Problem solving with technology

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12.1 Introduction: Critical Thinking Defined

Teaching students to think critically has been an important theme in education for decades. Therefore, it is useful to examine just what the phrase "critical thinking" implies. According to Halpern and Sternberg (2020), critical thinking is "the use of skills or strategies that increase the probability of a desirable outcome. It includes thinking skills, the disposition to apply these skills, and a deep knowledge of the content area" (p. 17). Schafersman (1991) defines critical thinking as "reasonable, reflective, responsible, and skillful thinking that is focused on deciding what to believe or do" (p. 3). Seizing on the mention of 'thinking reflectively' evokes the words of John Dewey (1909), reminding us that reflection is "turning a topic over in various aspects and in various lights so that nothing significant about it shall be overlooked" (p. 30). Synthesizing these definitions for the purposes of this paper, I propose that critical thinking is reflection, based on deep content knowledge, which informs the thinker about how best to apply his knowledge in a given situation.

12.2 A Rationale for Critical Thinking

So, why is it important to impart this type of thinking to our students? The most famous answer to this question may be the 1983 report of the National Commission on Excellence in Education, entitled "A Nation at Risk." The report opened with the announcement that individuals in the United States who do not possess a sufficiently high level of skill, literacy, and training will be disenfranchised from material rewards and full participation in national life (National Commission on Excellence in Education, 1983). Later the report elaborated on the type of "skill" to which they were referring and how many American students may be "disenfranchised." Unfortunately, they reported that

> many 17-year-olds do not possess the 'higher order' intellectual skills we should expect of them. Nearly 40 percent cannot draw inferences from written material; only one-fifth can write a persuasive essay; only one-third can solve a mathematics problem requiring several steps (National Commission on Excellence in Education, 1983, p. 115).

Other researchers have asserted that critical thinking skills are vital because they are required to "successfully negotiate the complexities of contemporary life" (Bransford, Brown, & Cocking, 2000, p. 4) or be successful in the world (Schafersman, 1991). Although, a more practical reason to teach critical thinking skills may be that in every survey of *Employers and Economic Trends* conducted by Hart Research Associates 'critical thinking skills' has emerged as one of the "most desired" traits that employers are seeking in their prospective employees (2018, 2015, 2014, 2010, 2008, 2007, & 2006). So, whether our learners are being educated to fully participate in national life, to successfully negotiate life's complexities, or to be desirable job candidates, they should practice critical thinking skills as an essential part of a responsible education.

12.3 Using Holistic Design to Promote Critical Thinking in Mathematics Modeling

What is holistic design? Holistic design is an approach to designing instruction for complex learning without losing sight of the relationships between separate elements (Milrad, Spector, & Davidsen, 2003; Van Merriënboer, 2007). Complex learning integrates knowledge, skills, and attitudes into a focus on real-life authentic tasks for teaching and learning (Van Merriënboer & Kirschner, 2018). Therefore, holistic design models for complex learning present a fusion of declarative, procedural, and affective learning in order to "facilitate the development of an integrated knowledge base that increases the chance that transfer of learning occurs" (Van Merriënboer & Kirschner, 2018, pp. 5–6). Instructional design for complex learning can be organized into a four-component blueprint that includes learning tasks, supportive information, procedural information, and part-task practice (Van Merriënboer & Kirschner, 2018). Over the last thirteen years, holistic design has been used to promote critical thinking in engineering course design (Vanasupa, Stolk, & Herter, 2009), mathematical understanding (Buchbinder & Zaslavsky, 2013), and the design of course examinations and evaluations (Chen, Cheng, Xu, & Wen, 2017).

In my junior level mathematical modeling course at Baylor University, students advance their critical thinking skills by working in groups of four to model the real-world task of creating a payment schedule for a car loan. In this sense, creating a mathematical model means describing "a particular phenomenon mathematically (by means of a function or equation, for instance)" (Giordano, Weir, & Fox, 2003, p. 1). Through modeling, students learn about a content domain more deeply, improve their ability to transfer their learning, and develop stronger problem-solving skills (Alessi, 2000). In the specific case of modeling the payment schedule for a car loan, students must leverage their knowledge of compound interest and dynamic systems. For my class, a dynamic system is a potentially infinite set of algebraic equations which describe change over discrete periods of time (Giordano et al., 2003), and my students apply a version of the Systems Dynamics approach, advanced by Forrester (1961), to create mathematical models. That is, they use computing technology, computer simulation, strategic decision-making, and the role of feedback in complex systems (Richardson, 2011) to test and refine their mathematical models. The four-component blueprint for this project contains a mix of instructor-controlled, learner-controlled, and shared instruction and is presented below.

Learning Task	Instructor Controlled	I assign students the task of authentically mathematically modeling the payment schedule for a car loan.
Supportive Information	Learner Controlled	After some initial direction, the students research the process of buying a car and taking out a car loan. They define their own variables and values.

(continued)

(continued)

Learning Task	Instructor Controlled	I assign students the task of authentically mathematically modeling the payment schedule for a car loan.
Procedural Information	Shared	We discuss examples of modeling a dynamic system in class. It is up to the students to apply these examples to their own projects.
Part-Task Practice	Shared	Class discussions and homework assignments give students opportunities to model dynamic systems. For the project, it is up to the students to integrate that practice into the model of their car loan payment schedules.

Examples of necessary supportive information to model a car loan payment schedule are sale price, taxes and fees, down payment, trade-in value (if applicable), loan fees, monthly interest, and monthly payments. Procedural information and part-task practice would involve combining the formula for compound interest (see below) with dynamic systems to formulate a proposed mathematical model.

12.4 Compound Interest Formula

The balance, B, in an account is a function of the Principal, P, initially invested, the annual interest rate, r, the compound frequency, n, and the time elapsed, t, in years.

$$B = P(1 + \frac{r}{n})^{n\,t}$$

For instance, say that after the sale price, taxes and fees, trade-in value, and down payment have been accounted for, the students apply for a $10,000 loan with an annual interest rate of 5% compounded monthly. If they agree to pay $500 per month, their dynamic systems model for each month would be as shown below.

$$\begin{aligned} B_0 &= 10,000 \\ B_1 &= 10,000(1 + \frac{0.05}{12})^{12\,\frac{1}{12}} - 500 \\ B_2 &= B_1(1 + \frac{0.05}{12})^{12\,\frac{1}{12}} - 500 \\ B_{n+1} &= B_n(1 + \frac{0.05}{12})^{12\,\frac{1}{12}} - 500 \end{aligned}$$

The question resulting from this model would be: will a payment of $500 per month succeed in paying off this loan? If not, how should the payment amount be adjusted?

If so, how long will it take to pay off? How can the variables in the model be adjusted to accommodate constraints on a given loan duration, payment amount, interest rate, or loan amount? It is technology that allows students to investigate the problem from here.

12.5 Combining Holistic Design with Technology to Stimulate Critical Thinking in Mathematics Modeling

"One of the main pedagogic benefits computers play in mathematics teaching and learning is the enhancement of conceptual development" (Abramovich, 2018, p. 13). For my students to enhance and refine the conceptual development of their initial mathematical model, they first employ the computing power of Microsoft Excel. In Excel, they are able to examine the long-run consequences of their recursively defined dynamic systems model to determine if it is working and giving reasonable answers. In this process, they use Forrester's (1961) standard that "a model is sound and defendable if it accomplishes what is expected of it" (p. 115). Then, once the students have refined their models, they can explore the consequences of changing one initial variable while the others stay constant. By running these variations on their simulation, they are able to answer questions about how a change in one variable affects the other variables or the borrower's ability to pay back the loan. After this phase, the students then locate an online loan schedule calculator, enter the values of their variables, and compare the online output to their answer in Excel. For example, if a student wants to pay off a $10,000 loan, which is accruing interest at 5% annual interest compounded monthly, in 48 months, what would the monthly payment be? Through this process, students will make note of the similarities and differences between their model and the online loan schedule. In addition, they describe whether/how the schedule they found online caused them to go back and further tweak their model. Ultimately, each group of four students must write a paper describing their model, its ingredients, and how it works.

Requiring that students reflect on and articulate their solution has shown to be particularly effective in engaging the students' cognitive analysis, synthesis, and evaluation processes which fuel critical thinking. Though the process of building this mathematical model may sound somewhat daunting as one of four projects for one class in a full-time student schedule, the cognitive load is distributed across the four members working together in each group. When students work in small groups, this collaborative learning experience has proven to be an essential component of simulation building problems. The model benefits from a wider array of skills, the students provide their own scaffolding and metacognitive support, and the overall process moves at a faster pace (Alessi, 2000). In addition, research has shown a positive correlation between group projects with writing assignments that receive

instructor feedback and the development of critical thinking skills (Tsui, 1999). Indeed, Halpern and Sternberg (2020) assert that

> the best way to teach critical thinking is to require that students write. Writing forces students to organize their thoughts, contemplate their topic, evaluate their data in a logical fashion, and present their conclusions in a persuasive manner. Good writing is the epitome of good critical thinking. (p. 7)

I have found this to be especially true in this mathematical modeling project.

12.6 Conclusion

This project represents one of my favorite pedagogical avenues for stimulating students' critical thinking skills. By investigating the real-life process of buying a car and taking out a car loan, students must engage their inductive and deductive reasoning skills, while leveraging their knowledge of exponential growth and dynamic systems to construct a mathematical model. They then use technology to validate their model, check their assumptions, and refine their process. Once they arrive at a final mathematical model, students compare it to an online loan payment schedule and write a paper describing their model, how it works, and how it compares. Throughout the entire project, they are always aware of the overarching problem they are trying to solve. After all, "central to any design process is an understanding of the whole project, in other words, a view of the project in conceptual, theoretical, and contextual terms" (Hokanson & Miller, 2009, p. 25). All the while, the students are broadening and deepening their critical thinking, which "is more than a set of skills; it also includes the propensity to use those skills. The dispositions for critical thinking include the willingness to engage in and persist at a complex task" (Halpern & Sternberg, 2020, p. 13). For this project, I use holistic design to channel this persistence in my students and encourage them to harness it for this real-world task, to formulate a mathematical model of this problem, and to engage with technology to evaluate the reasonableness of their solution. Ultimately, it is the feedback from the technology, combined with the reflective exercise of explaining and articulating their process, that presents the real evidence of their critical thinking.

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Chapter 13
Multimedia in Teacher-Directed and Student-Centered Mathematics Classrooms

Brittany A. Lankford

Abstract Teacher-directed classrooms are defined as traditional classrooms in which the teacher is the main source for students' gain of knowledge. Student-centered classrooms are centered on learner needs that direct learning. Multimedia is a tool used in classrooms to support students in the learning process. With the rise in need for developing critical thinking skills and mathematics language learning, it is important to investigate multimedia in teacher-directed and student-centered classrooms. The literature review serves as the purpose to promote teachers' knowledge on developing mathematics lessons that incorporate multimedia. With the use of multimedia in mathematics lessons, learner needs can be supported when developing mathematics language and critical thinking skills. A literature search was conducted to examine multimedia in teacher-directed and student-centered mathematics classrooms. Theories were addressed to serve as the foundation for teacher-directed and student-centered instruction. Furthermore, theories were addressed to support the use of multimedia in mathematics classrooms. Literature were examined through multiple databases for teacher-directed and student-centered instruction. Furthermore, literature was examined on the use of multimedia for learning in mathematics classrooms. Strategies are discussed for integrating multimedia into mathematics classrooms to develop mathematics language and critical thinking skills. Future research should examine multimedia with different instructional practices in mathematics classrooms. Furthermore, future research can indicate how these instructional practices can conjointly lead to student achievement. Problems to overcome with future studies on the use of multimedia with instructional practices are discussed. Recommendations are made for expanding teacher knowledge and skills on use of multimedia to develop students' mathematics language and critical thinking skills.

Keywords Multimedia · Teacher-directed · Student-centered · Personalized learning · Learning contexts · Instructional practices · Critical thinking

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13.1 Introduction

Two practices that have been examined in education are teacher-directed and student-centered instruction. Deriving from theoretical perspectives, both practices can serve the value for student learning. The likelihood that educators are strictly teacher-directed or student-centered is slim (Garrett, 2008). Teachers implement multiple strategies and techniques in their classroom practice based on students' needs. Even if a classroom is dominantly teacher-directed or dominantly student-centered, teachers incorporate components from both practices (Garrett, 2008).

Teachers are under pressure to increase students' academic language and critical thinking skills. With the demands of twenty-first century skills, teachers are required to design lessons that develop students' skills to meet those demands. Technology has given teachers' capabilities to design lessons that use different learning tools and strategies to increase student learning. With the prevalence of technology in education, teachers have access to design rich lessons that use technology to develop students' critical thinking skills and academic language.

Multimedia is a learning tool that can be incorporated with instruction. With the use of technology, teachers are able to have access to multimedia and can use the creation of multimedia for personalizing learning to adapt to students' needs. With the need to develop students' critical thinking skills and mathematics language, multimedia should be examined in different learning contexts in mathematics classrooms. The purpose of the literature review is to promote knowledge for developing mathematics lessons that incorporate multimedia. The literature review serves the purpose of promoting knowledge for incorporating multimedia to develop students' academic language and critical thinking skills.

Several studies exist on the use of multimedia, teacher-directed classrooms, and student-centered classrooms. Furthermore, several studies exist on language learning and critical thinking. However, few studies exist on teachers' use of multimedia for developing students' critical thinking skills and academic language. Therefore, future research is needed to examine the use of multimedia in mathematics classrooms to enhance students' critical thinking skills and academic language. Future research is needed to determine the use of multimedia in different learning contexts in mathematics classrooms, including teacher-directed and student-centered classrooms. Teachers' understanding on how to effectively use multimedia in teacher-directed and student-centered classrooms can collectively reinforce students' mathematics language and critical thinking skills.

13.2 Methods

For the literature review, a search was completed in multiple databases. The databases included: Academic Search Complete, Google Scholar, Education Source, Online Articles, and Eric, and reference lists of related studies. The literature used during the

search was published and peer reviewed, as well as some scholarly works. More than 100 were reviewed, and 44 were selected for the literature review. The keywords that were used in the literature search included, but not limited to: instructional practices, teacher-directed and student-centered mathematics classrooms, multimedia in mathematics classroom, multimedia for learning, developing students' critical thinking skills, and developing mathematics language. The articles selected and the attention of the literature review were geared toward teachers and students in K-12 classrooms.

13.3 Instructional Practices and Multimedia Defined

Classroom instruction is the result of teachers taking curriculum and transferring it to students. Instructional practices are the techniques in which teachers transfer curriculum to students that result in learning (Lubienski, 2006). Pinpointing the instructional practices that best result in student achievement is a common focus among educators (Lubienski, 2006). Based on research, instructional practices should be a balanced approach, incorporating different components that support learning in the classroom (Minter, 2011). The literature review will focus on two categories for instructional practices, teacher-directed, and student-centered.

13.3.1 Teacher-Directed Instruction

The framework for teacher-directed learning involves the teacher being the primary source for students gaining knowledge. The teacher is the primary voice in learning, asking most of the questions, providing most of the information (Schuh, 2004). The structure of the classroom environment is typically whole group instruction. Furthermore, the primary source of information originates from textbooks, media, and other sources containing information (Schuh, 2004). Mathematics teachers in teacher-directed classrooms use mathematics textbooks, which has influenced how students learn mathematics (Remillard, 2005). Therefore, using textbooks for mathematics instruction has developed many teacher-directed mathematics classrooms. Instruction in teacher-directed classrooms consists of practices such as lectures, demonstration, guided discussions (Garrett, 2008). Furthermore, the attention in teacher-directed instruction is placed on the teacher, while students listen (Minter, 2011). Teacher-directed instruction involves teachers transmitting content to the students, while the students' respond by listening and asking questions (Schuh, 2004).

13.3.2 Student-Centered Instruction

The framework around student-centered learning has developed through research, and researchers are aware that effective teachers apprehend the components for student-centered instruction (McCombs, Daniels, & Perry, 2008). In a student-centered classroom, constructivists believe students' construct their own knowledge built from prior knowledge and experiences (Schuh, 2003). Student-centered classrooms involve collaboration between students and teachers in the development of new knowledge (Schuh, 2003). The idea for instructional practices in student-centered learning is to concentrate on learners' needs (McCombs, 2003). Therefore, teachers serve as the facilitator and guide learners into deriving their own meaning of new context (Kafai, Ching, & Marshall, 1997; McCombs, 2003). Teachers guide learners in building knowledge from their own personal experiences (Richter, Scheiter, & Eitel, 2017). Student-centered classrooms are built around the idea that learning happens best when learners are involved in creation, constructing their knowledge throughout the process (Kafai et al., 1997). Traditionally, teachers guide students in learning mathematical concepts through sequencing that aligns with the textbook (Hwang, Chen, & Hsu, 2006). However, Hwang et al. (2006) emphasize the belief for mathematics education is to support an environment where students are searching for mathematical solutions. Student-centered instruction involves students with learning activities that consist of engaging, challenging, and real-life tasks with the use of technology to communicate and collaborate with other students (Brush & Saye, 2000).

13.3.3 Multimedia

Multimedia is a collection of text, images, audio, and video. Multimedia can include a combination of text, images, audio, and video that produce other forms of multimedia, such as graphics and animations (Chiu & Churchill, 2015). Multimedia is used in multiple variations to deliver content in learning environments. Furthermore, multimedia is produced using a variety of technologies including, but not limited to, cameras, video recorders, audio recorders, computers, printers and copiers for reproduction, and software and websites for multimedia production and distribution. The implementation of multimedia in learning environments has contributed to assisting teachers and learners in learning processes (Nusir, Alsmadi, Al-Kabi, & Sharadgah, 2012).

13.4 Theoretical Framework

The purpose of the literature review will be the determining factor for the theoretical framework. The support for using multimedia in mathematics lessons is derived from the National Council of Teachers of Mathematics (NCTM). The NCTM have a set of standards that technology is a tool that is an affordance to mathematics students (NCTM, 2000). As multimedia is created through the use of technology, it can be determined that multimedia serves a purpose in the classroom.

13.4.1 Learning Framework

With the focus of the literature review being placed on teacher-directed and student-centered classrooms, multimedia, as well as mathematics language learning and critical thinking, several theories and ideas behind learning will serve as the foundation for the theoretical framework.

13.4.2 Teacher-Directed and Student-Centered Framework

The framework behind teacher-directed learning is explained by Polly, Margerison, and Piel (2014). Teacher-directed learning is classified as the teacher being the determinant of the content that students learn through structure and order, while developing students' memorization skills (Polly et al., 2014). Furthermore, teachers in a teacher-directed classroom ensure that students gain essential knowledge in all of the core areas within the subject (Polly et al., 2014). Student-centered classrooms are developed around learner needs. The framework behind student-centered classrooms is framed around the idea that learning happens best when learners are involved in creation, constructing their knowledge throughout the process (Kafai et al., 1997). Furthermore, the teacher is the facilitator of student learning (McCombs, 2003) while students construct their own knowledge of the content (Kafai et al., 1997).

The twenty-first-century skills were identified as skills needed in order to enter the workforce in the twenty-first century (van Laar, van Deursen, van Dijk, & de Haan, 2017). Student-centered classrooms should integrate twenty-first-century skills as these skills are needed once learners reach the workforce. The twenty-first-century skills include collaboration, communication, digital literacy, citizenship, problem solving and critical thinking, creativity and productivity (Voogt & Roblin, 2012). Therefore, student-centered mathematics classrooms should design lessons that teach students twenty-first-century skills.

13.4.3 Multimedia Theories

The first theory that can support the use of multimedia is the Cognitive Theory of Multimedia. The Cognitive Theory of Multimedia was developed by Mayer (2002). The Cognitive Load Theory demonstrates how multimedia assists with the transfer of knowledge from sensory memory to working memory to long-term memory (Mayer, 2002). The process of the Cognitive Load Theory starts with a multimedia presentation which moves the content into students' sensory memory. Then, as students process the information from the multimedia presentation, the information moves into students' working memory (Mayer, 2002). Finally, students' prior knowledge and the information stored into students' working memory are integrated and stored into students' long-term memory (Mayer, 2002). The second theory that will support the use of multimedia is the Theory of Multimedia Learning. In addition to the Cognitive Load Theory, Mayer (2002) developed the Theory of Multimedia Learning. The Theory of Multimedia Learning demonstrates learning experiences and students' learning abilities are influenced by the use of multimedia (Mayer, 2002). The third theory that will support the use of multimedia is Connectivism. Connectivism demonstrates the collection of information across a digital platform to influence learning (Dunaway, 2011). As multimedia is produced and distributed using technology, Connectivism will support learning through the use of multimedia in a digital platform.

13.4.4 Language Learning and Critical Thinking Theories

Language Learning is defined as learning how to mean (Halliday, 1999). In academics, students should develop a language for the content being learned. The main theory behind the development of academic language was developed by Halliday (1999). Systemic Functional Linguistics consist of six steps that students move to take when developing academic language. These steps include the movement from interpersonal to ideational orientation, dialogic to monologic mode, self-centered to other-centered focus, concrete to abstract experience, simple to complex taxonomies, and movement from generalization to prediction, reasoning, and explanation (Neal, 2015).

Critical thinking is identified as a person's ability to ask questions reason, when to ask questions and reason, and knowing which reasoning methods to use (Palinussa, 2013). The theory behind twenty-first-century skills will support the use of

multimedia for critical thinking. One of the skills that was included in the list of twenty-first-century skills is critical thinking. Therefore, instructional practices in student-centered classrooms will develop around the use of multimedia for developing students' critical thinking skills. In addition to twenty-first-century skills, connectivism will also support critical thinking. Student's critical thinking skills will develop as students make connection with the use of multimedia and the content that is collected over the digital platform.

13.5 Use of Multimedia

With the growth of multimedia in classrooms, there has been a general understanding of multimedia's affordances in learning. When used effectively with instructional practices, multimedia has the opportunity to create quality learning environments (Nusir et al., 2012). Furthermore, multimedia brings more realistic learning in the context through different uses (Nusir et al., 2012). Multimedia is constructed of multiple components such as video, audio, graphics, etc. Multimedia can be interactive and has been widely used in education (Nusir et al., 2012).

The curriculum that most mathematics teachers follow has been mandated by state standards, and in return, students are required to learn all the same mathematical concepts (Maloy, Razzaq, & Edwards, 2014). However, giving students choices for how they learn the mathematical concepts can influence the learning outcomes (Maloy et al., 2014). During a study conducted by Maloy et al. (2014), students were allowed to make choices while using multimedia. The results from the study indicated that all students showed progress between a pretest and posttest after making choices while using multimedia (Maloy et al., 2014). The use of multimedia can be influential to student success when developing language learning and critical thinking skills in mathematics classrooms. Proper use of multimedia in mathematics instruction develops students' mathematics proficiency and overall understanding of mathematics concepts (Liu, 2013).

As stated previously, the purpose of the literature review is to promote knowledge for developing mathematics lessons that use multimedia in teacher-directed and student-centered classrooms in order to enhance students' mathematics language and critical thinking skills. Therefore, the types of multimedia should be examined for the purpose of the literature review.

13.5.1 Types of Multimedia

The design and implementation of multimedia tools are influential to student learning, should be used to target the cognitive processes of learners, and should adapt to how students learn (Chiu & Churchill, 2015). For the purpose of the literature review,

multimedia will be examined in two instructional contexts: Teacher-directed classrooms and student-centered classrooms. Examining multimedia in teacher-directed and student-centered classrooms can assist teachers in determining the best methods to use multimedia in learning to enhance students' mathematics language and critical thinking skills. Studies have been conducted that show the use of multimedia with teacher-directed instruction and student-centered instruction, both with favorable outcomes.

13.5.2 Multimedia with Teacher-Directed Instruction

Referring previously to the framework behind teacher-directed instruction, multimedia in teacher-directed mathematics classrooms will be examined. Teachers in teacher-directed classrooms determine the content that the student is learning, how students learn the content, provide students with opportunities to develop memorization skills, and provide a structured and organized environment for learning in the classroom (Polly et al., 2014). Eskicioglu and Kopec (2003) discuss that multimedia assists students in learning, while emphasizing that learners remember 80% of what they see, hear, and interact with (Dale, 1969). As multimedia is text, images, audio, and video, multimedia can serve the purpose of providing students' the means to see, hear, and interact with content. Therefore, using multimedia in mathematics classroom can assist students in remembering and learning 80% of what they see, hear, and interact with. Teachers can use multimedia in teacher-directed mathematics classrooms to assist students in memorizing content. In a study conducted by Liu (2013), a project was implemented into mathematics classrooms. Mathematics teachers were expected to design and develop a multimedia mathematics lesson, and then implement the lesson into their classrooms. The design, development, and implementation of the multimedia was evaluated with a rubric, and students were evaluated with a pretest and posttest. Liu (2013) found that students were focused on the multimedia mathematics lessons, which resulted in higher posttest scores than the group that did not receive the multimedia mathematics lessons. Therefore, it can be determined that multimedia is effective when teaching students new concepts.

Multimedia as learning aids gives additional support in the form of video, audio, and graphics (Ruf & Ploetzner, 2014). In teacher-directed classrooms, multimedia can be used to demonstrate concepts, as demonstrated by a study conducted by Rackaway (2012). Rackaway (2012) conducted a study to examine multimedia pedagogy. The researcher observed multimedia used in with different learning tasks to establish the outcomes from each task. The results from Rackaway's (2012) study concluded that multimedia should be used with textbooks as it meets the needs of learners, and multimedia provides different visuals for the concepts being presented through textbooks. Based on the theory of Connectivism (Dunaway, 2011), students can make connections between multiple platforms to result in learning.

In a study conducted by Nusir et al. (2012), multimedia was used to cover the main topics of a lesson, students were allowed to interact with the multimedia, and different

types of multimedia were used to provide students with information of new concepts. The researchers determined that multimedia in teacher-directed instruction did show improvements in student learning. The Cognitive Load of Multimedia (Mayer, 2002) supports the idea that multimedia assists with moving new concepts from sensory memory, to working memory, to long-term memory. Furthermore, multimedia can support student learning by providing students access to new information. Based on the Theory of Multimedia Learning (Mayer, 2002), learning is supported through the use of multimedia. When students have access to multimedia for learning, students can use the multimedia for support instead of waiting for the teacher's help.

13.5.3 Developing Mathematics Language

Multimedia is used to supplement learning based on student needs (Nusir et al., 2012). Considering how multimedia in teacher-directed mathematics classrooms results in student learning, the development of mathematics language should be examined. According to Bailey, Butler, Stevens, and Lord (2007), being language proficient in the academic register is defined "as knowing and being able to 'use general and content-specific vocabulary, specialized or complex grammatical structures, and multifarious language functions and discourse structures—all for the purpose of acquiring new knowledge and skills, interacting about a topic, or imparting information to others'" (p. 10). As teacher-directed mathematics classrooms are designed to teach students new knowledge (Rackaway, 2012), it can be determined that developing students' mathematics language should involve a teacher-directed framework. Neal (2015) stated the six steps of Systemic Functional Linguistics that students take when developing language. Stated previously, the steps of Systemic Functional Linguistics include the movement from interpersonal to ideational orientation, dialogic to monologic mode, self-centered to other-centered focus, concrete to abstract experience, simple to complex taxonomies, and movement from generalization to prediction, reasoning, and explanation (Neal, 2015). Multimedia is combinations of text, images, audio, and video. Furthermore, the Theory of Cognitive Multimedia and the Theory of Multimedia Learning (Mayer, 2002) state that multimedia is used to move new knowledge into the long-term memory. Furthermore, multimedia can be used to provide students with learning experiences and learning abilities (Mayer, 2002). Using multimedia as visual representations can take students through creative process and allow students to explain mathematics contents through a monologic mode. Multimedia can also be used to help students move from self-centered to seeing other perspectives through visualization. Furthermore, multimedia can assist students in moving from concrete to abstract experiences, bridge students from simple to complex, and help students make predictions, reason, and explain their ideas (Neal, 2015).

13.5.4 Multimedia with Student-Centered Instruction

Stated previously, the twenty-first-century skills were identified as skills needed in order to enter the workforce in the twenty-first century (van Laar et al., 2017). Student-centered instruction is guided around learner needs, holding students responsible for their own learning, and teachers becoming the facilitator for learning in the classroom (McCombs et al., 2008). Aligning with twenty-first-century skills, student-centered instruction encourages students to be the creator of knowledge. Activities and tasks in student-centered classrooms require skills and resources for instructional practices that are different than teacher-directed classrooms (Brush & Saye, 2000). In a study conducted by Rodriguez, Frey, Dawson, Liu, and Ritzhaupt (2012), students created digital artifacts after a technology initiative. In the submitted samples of student artifacts, the researchers wanted to identify and discuss the components of multimedia in the submitted artifacts. Artifacts were examined before and after the technology initiative was implemented. Rodriguez et al. (2012) found an increase in cognitive demand from the pre-submission to post-submission of students' artifacts. However, with the increase in cognitive demand, results also indicated that most of the artifacts demonstrated low cognition skills. As the artifacts were the result of students' creation, the limitations from the study included the inability to comment on teachers' instruction or guidance in students' creation of artifacts (Rodriguez et al., 2012).

Characteristics of a student-centered classroom, according to students, include understanding the individual learner's need, engaging students in interesting learning activities, allowing students to make their own choices in learning, and collaborative learning (Daniels & Perry, 2003). Making choices and collaborative learning is supported by twenty-first-century skills, as students are problem solving, thinking critically in their choices, and collaborating (van Laar et al., 2017). In a study conducted by Maloy et al. (2014), students made choices with multimedia that was used for mathematical problem solving. Results from the study indicated higher scores on the mathematics posttest. Therefore, it can be determined that multimedia increases students' problem-solving skills.

Teachers should provide instruction to students that motivates, provides obstacles and intrigues the students (Heuser, 2000). Using multimedia as a learning tool in student-centered classrooms can achieve student motivation, challenge students, and intrigue students in learning (Heuser, 2000). Student-centered instructional practices are built on theories derived from research. Further in-depth observations and research can continue to build theories into practice (Lattimer, 2015). Therefore, examining the use of multimedia in student-centered classrooms can develop teachers' knowledge. Theories on the use of multimedia with student-centered instructional practices in mathematics classrooms can produce research-based practices.

13.5.5 Developing Critical Thinking Skills

Hwang et al. (2006) suggest that teachers need to help students understand mathematical concepts by engaging them in discussions, communication, and thinking through brainstorming mathematical concepts. Stated previously, student-centered classrooms are built around the idea that learning happens best when learners are involved in creation, constructing their knowledge throughout the process (Kafai et al., 1997). Teachers that facilitate discussions, communication, and student thinking through brainstorming create student-centered classrooms (Schuh, 2004). Furthermore, twenty-first-century skills include collaboration, communication, digital literacy, citizenship, problem solving and critical thinking, creativity and productivity (Voogt & Roblin, 2012). Mathematics activities should be developed for developing students' twenty-first-century skills in order to prepare students to enter the workforce. Multimedia, once more, is a combination of text, images, audio, and video. Students who use multimedia to collaborate, for digital literacy and citizenship, for problem solving and critical thinking, and for creativity and productivity can be prepared for the twenty-first-century workforce (Voogt & Roblin, 2012). Therefore, students can use a combination of text, images, audio, and video to develop twenty-first-century skills. Also stated previously, Connectivism demonstrates the collection of information across a digital platform to influence learning (Dunaway, 2011). Student-centered classrooms support students' construction of knowledge to develop their own meaning of the content (Kafai et al., 1997). As students are collecting information across a digital platform, students are engaged in constructing their own knowledge from the collected information (Dunaway, 2011). Therefore, students can use multimedia through a digital platform to develop problem solving and critical thinking skills in a student-centered classroom. In a study conducted by Hwang et al. (2006), the use of a multimedia whiteboard in a mathematics classroom demonstrated students' development of problem-solving skills. The multimedia whiteboard consisted of a text discussion board and a voice recorder for students to collaborate and discuss their knowledge, which supports twenty-first century skills (Hwang et al., 2006). Results from the study indicated student achievement (Hwang et al., 2006). Once more, the framework behind student-centered classrooms is framed around the idea that learning happens best when learners are involved in creation, constructing their knowledge throughout the process (Kafai et al., 1997). Furthermore, the teacher is the facilitator of student learning (McCombs, 2003) while students construct their own knowledge of the content (Kafai et al., 1997).

13.6 Strategies for Use of Multimedia

The use of multimedia with instructional practices for the purpose of developing students' mathematics language and critical thinking skills should be carefully planned. As learning varies based on students' needs, teacher knowledge is needed on

how to implement multimedia using different techniques in order to meet students' needs (Rice, Johnson, Ezell, & Pierczynski-Ward, 2008). However, teachers use multimedia on the border of instruction rather than for meaningful instructional practices (Rice et al., 2008).

13.6.1 Development of Mathematics Language

Research has supported the idea of a multimedia-based curriculum and instruction for effective alternative for textbook-based mathematics instruction (Liu, 2013). As textbooks are considered a primary source in mathematics classrooms (Remillard, 2005), it can be assumed the use of multimedia is effective for teacher-directed mathematics classrooms. From the literature review, suggestions have indicated the use of multimedia with teacher-directed instruction can influence students' mathematics language. The key to developing mathematical understanding is the shift from everyday language to specialist in mathematical language (Adoniou & Qing, 2014).

Strategies for teacher-directed multimedia should align the framework for teacher-directed instruction. Studies have shown that available multimedia, such as review videos and audio recordings, can provide students with support while waiting for help from the teacher (Kaczorowski, Hashey, & Macoro Di Cesare, 2019). Teachers in a teacher-directed classroom are the determinants for the content that students learn and ensure that students gain the essential knowledge (Polly et al., 2004). Therefore, strategies for developing mathematics language will include teachers using multimedia to supplement lessons on essential knowledge. Teachers must choose multimedia that is specific to the knowledge or skill set that students are learning (Rackaway, 2012). Student interaction with multiple forms of multimedia can increase the familiarity and knowledge for academic vocabulary (Joshi, 2012). Therefore, teachers should select and use multiple types of technology to increase students' academic language. In research conducted by Anmarkrud, Andresen, and Bråten (2019), several strategies were suggested for using multimedia for learning. One strategy mentioned is choosing multimedia that uses a mix of pictures and text. Pairing pictures and text to represent mathematical language will help students move from concrete to abstract experiences. However, Anmarkrud et al. (2019) discussed that being knowledgeable on students' learning levels is also a factor in the types of multimedia to be implemented. If students are at a higher learning level, then including redundant information in the multimedia can cause difficulties when memorizing content (Anmarkrud et al., 2019). For students learning at a higher level, teachers may want to limit multimedia that combine pictures and text to increase students' memory on mathematical language. Furthermore, teachers should consider the background knowledge of students when integrating technology to develop mathematical language. Using multimedia for signaling will trigger background knowledge of students for supporting learning in the classroom (Richter et al., 2017). Multimedia can be integrated by giving students visual representations, further

audio explanations, supplemental text to support the development of mathematical language.

13.6.2 Development of Critical Thinking Skills

Strategies for student-centered multimedia should align with the framework on student-centered instruction. Furthermore, the use of multimedia should align with twenty-first-century skills, which consists of collaboration, problem solving and critical thinking, as well as creativity and productivity (van Laar et al., 2017). Studies have shown that students could develop critical thinking skills more in realistic mathematics education compared to conventional mathematics education (Palinussa, 2013).

Multimedia can provide students with organization, guidance, and elaboration through text, audio, and video for problem solving, which supports twenty-first-century skills (van Laar et al., 2017). Furthermore, students can present their ideas and concepts with the use of multimedia. Finally, students can analyze and evaluate with the use of multimedia. For students to learn collaboration, creativity, and productivity, which are included in the twenty-first-century skills (van Laar et al., 2017), students can be the producer of multimedia. Therefore, instructional practices can be designed so that students can create and produce multimedia in order demonstrate their construction of knowledge. Allowing students to be producers of multimedia, they are able to personalize multimedia to their needs, while becoming more familiar with the content they are creating as multimedia (Kafai et al., 1997). Furthermore, students can engage in collaboration among other students while creating and producing multimedia to show the content gained in the learning process. Designing activities that involve students inductive reasoning, problem solving through dilemmas, making decisions, and debates will enrich students' critical thinking skills (Aizikovitsh-Udi & Cheng, 2015). As strategies for developing students' mathematics language and critical thinking skills were discussed, multimedia has the potential for being an effective tool for student learning in the classroom (Mayer, 2002).

13.7 Conclusion and Recommendations

A gap exists in the types of learning activities and mathematics tasks that use multimedia to develop students' mathematics language and critical thinking skills. Rackaway (2012) found that using multimedia with instructional practices is underdeveloped and under-researched. There are few studies that develop teacher knowledge on the types of multimedia that is integrated in mathematics tasks and activities. Problems to overcome with future studies on the use of multimedia with instructional practices would include the need to examine multiple mathematics classrooms and the types of multimedia that teachers have access to. Another problem to overcome would

include determining teacher experiences, knowledge, and skills on integrating multimedia into mathematics classrooms to enrich students' mathematics language and critical thinking skills. Research has suggested that low-achieving students benefited from a teacher-directed classroom (Wu & Huang, 2007). In teacher-directed classrooms, teachers provide lessons of new content, while demonstrating new content for students (Wu & Huang, 2007). Research by Wu and Huang (2007) suggested students also benefited from student-centered instruction. In the student-centered classroom, the teacher introduced key concepts, and then allowed students to manipulate the concepts to construct knowledge. Based on the background knowledge of the students, the outcomes of research have suggested that both instructional practices provided desirable outcomes for students (Wu & Huang, 2007).

Lattimer (2015) recommended the collection of practical teaching strategies and discrete approaches that align with instructional goals as well as the need of students. Teachers are expected to develop and implement materials and tools that contribute to student learning (Duh, Bratina, & Krašna, 2013). As multimedia is considered materials and tools that teachers should effectively implement with instruction, it is important that teachers understand how to implement multimedia effectively. Teacher knowledge should include how to use multimedia to develop students' mathematics language and critical thinking skills. Therefore, teacher preparation should be considered. Teachers lack the knowledge, preparation, and quality to produce and publish multimedia into instruction (Duh et al., 2013). Studies have suggested that teachers' beliefs, mathematics knowledge, and instructional practices are a determinant of student achievement (Polly et al., 2014). Therefore, teacher preparation is recommended in order to increase the knowledge of teachers on the processes for developing mathematics lessons. Teacher preparation can build knowledge for developing mathematics lessons that use multimedia to develop students' mathematics language and critical thinking skills. Teacher knowledge and skills should include strategies to use multimedia to meet learners at their level of learning. Mathematic language and critical thinking are two developmental skills students need. Learning mathematics language can potentially influence students to develop the skills needed to think critically. Therefore, future research is needed on how to effectively use multimedia into mathematics lessons in order to support and expand teacher knowledge.

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