Educational Communications and Technology Yearbook

Liping Deng
Will W. K. Ma
Cheuk Wai Rose Fong *Editors*

New Media for Educational Change

Selected Papers from HKAECT 2018 International Conference

Springer

Educational Communications and Technology Yearbook

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The Hong Kong Association for Educational Communications and Technology (HKAECT) was established in 1989. Its first conference was organized in 1990, addressing "The Role of Educational Communications and Technology in Year 2000," with speakers coming from the United States, China, and Taiwan to discuss the outlook on educational communication and technology. Throughout these years, the HKAECT has held a number of international conferences, symposiums, workshops, and talks with various themes to provide a platform to enable rich exchanges for academicians, practitioners, and professionals in the fields of communication and education to discourse about the shaping and changing issues on education, communication, and technology. This Yearbook series collect presentations from the annual international conferences held by the HKAECT. Chapters would come from the annual global call for submission, and be selected based on blind review from international review board. Subject areas include but not limited to communication, new media, news media, broadcast journalism, democracy and the media, entertainment and education, learning analytics, AI in education, game-based learning, ubiquitous learning, MOOCs, open education, instructional design, social context and learning environment, social media, risk and ethics in new media, etc.

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Preface

The HKAECT 2018 International Conference on the theme of "New Media for Educational Change: Effect on Learning and Reflection on Practice" is co-organized by the Hong Kong Association for Educational, Communications and Technology (HKAECT) and the Department of Education Studies, Hong Kong Baptist University. The conference is to be held at Hong Kong Baptist University from 25 to 27 July, 2018.

The new digital and web-based technologies, coupled with ubiquitous mobile access, have provided us with whatever information we want, whenever and wherever we want it. In spite of the fact that the world has become increasingly connected and interactive, some scholars contend that new technologies have not brought about transformative changes in the educational arena. Furthermore, the always-on lifestyle has given rise to some concerns over its negative impact on young people's cognitive development, attention, and learning. The HKAECT 2018 International Conference seeks to encourage the sharing of the experience and reflection on the theme of new media for educational change. It encourages scholarly discussion that looks beyond what new media can afford for teaching and learning and ponder over the actual effects of these media on communication and learning. In particular, we welcome the sharing of good practice and lessons learned of applying new media in a wide range of fields and critical reflection on the concerns and issues associated with emergent technologies.

The Conference has called for paper submissions from a number of areas concerning education and communication including (1) communication and new media in everyday life, (2) learning analytics and AI in education, (3) game-based learning and ubiquitous learning, (4) MOOC and open education, (5) design and application, (6) social context and learning environment, (7) social media in education, and (8) risk and ethics in using new media.

In this edited volume of conference proceedings, selected high-quality manuscripts are broadly categorized into three main themes, including Learning Attitude, Behavior, and Analysis; Learning Management Systems, Mobile Learning, and MOOCs; and Communication and New Media in Everyday Life.

It is our great honor to invite Professor Robert Branch, a Professor of Learning, Design, and Technology at the University of Georgia, as the keynote speaker of the Conference. Professor Branch is also the Head of the Department of Career and Information Studies and Past President of the Association for Educational Communications and Technology (AECT).

On behalf of the Conference Organizing Committee, we take this opportunity to express our heartfelt appreciations to all chapter contributors and reviewers. This book will not be possible without their hard work and support. We hope this proceeding will stimulate and promote fruitful exchanges among academicians, practitioners, and professionals.

We would like to extend the gratitude to our affiliated organization, partnering institutes and organizations for their incessant support and sponsorship. First and foremost, we sincerely treasure the close connection with AECT and their support over the years. Additionally, the Conference has several sponsors including Department of Education Studies of Hong Kong Baptist University, Centre for Information Technology in Education (CITE) of the University of Hong Kong, Centre for Learning, Teaching and Technology of the Education University of Hong Kong, and last but not least, the Hong Kong Pei Hua Education Foundation.

Hong Kong, China
July 2018

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Will W. K. Ma
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HKAECT

The Hong Kong Association for Educational Communications and Technology (HKAECT; http://www.hkaect.org/) was established in 1989. Its first conference was organized in 1990, addressing "The Role of Educational Communications and Technology in Year 2000," with speakers coming from the United States, China, and Taiwan to discuss the outlook on educational communications and technology. Throughout these years, the HKAECT has held a number of international conferences, symposiums, workshops, and talks with various themes to provide a platform to enable rich exchanges for academicians, practitioners, and professionals in the communication and educational fields to discourse about the shaping and changing issues on education, communications, and technology.

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1996	Innovations and Quality in Teaching and Learning
1997	Tertiary Teaching in the Use of Technology: Vision and Practice
1998	New Challenges and Innovations in Teaching and Training into the 21st Century
2001	Education Reform: Integrating Information Technology, Communication, and Curriculum
2004	Media Innovations in Education: Input and Outcome in New Society
2007	Educational Communications and Technology as Learning Experiences

2010 Multiliteracies for the 21st Century: Education, Communication, and Technology
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2017 New Ecology for Education: Communication X Learning
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Part I
Introduction

New Media for Educational Change

Robert Maribe Branch

Abstract Educational technologists should be regarded as change agents. New media should be regarded as digital tools that can be used for innovation. The contention here is that experiential learning offers an effective way for new media to affect change and can be accomplished through an experiential learning framework. A five-component strategy for organizing new media based on an experiential learning framework is presented here and includes technology-supported student activities that are active, interactive, situated, authentic, and case-based. Thus, the use of digital tools is used to increase the fidelity between the activities that occur inside the classroom and the actual performances that will be expected of students once they leave the classroom. The new media classroom will remain a common forum and will continue to be a meeting place, but the reconceptualized classroom will include a broader array of contexts. New media for educational change will likely focus on effective instructional design and development strategies.

Keywords Educational technology · Experiential learning · New media · Learning space

Educational technologists should be regarded as change agents. New media should be regarded as digital tools that can be used for innovation. According to the Association for Educational Communications and Technology (AECT), educational technology is the study and ethical application of theory, research, and best practices to advance knowledge as well as mediate and improve learning and performance through the strategic design, management, and implementation of learning and instructional processes and resources. According to the New Media Institute at the University of Georgia, new media is often interpreted as an interdisciplinary approach dedicated to exploring the essential, commercial, and creative dimensions of emerging technologies. New media investigates the constantly changing

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technology landscape, the development of skills to build commercial products, and the creation of projects that use new media solutions to address real-world problems.

These interpretations of educational technology and new media are consistent with a substantive component of the mission of the Hong Kong Association for Educational Communications and Technology (HKAECT) who seek to disseminate information with regard to current research in Hong Kong, overseas and other regions, including members' accomplishments and research projects through computer networking and printed media. According to a mediagraphy conducted by Tsheng (2018), the following are the current worldwide trends in educational technology:

1. Artificial intelligence, robotics, and electronic performance support systems
2. Computer-assisted instruction
3. Distance education
4. Educational research
5. Educational technology
6. Information science and technology
7. Instructional design and development
8. Learning sciences
9. Libraries and media centers
10. Media technologies
11. Professional development
12. Simulation, gaming, and virtual reality
13. Special education and disabilities
14. Telecommunications and networking

The contention here is that experiential learning offers an effective way for new media to affect change. Experiential learning is often denoted as involving or based on experience and observation, such as the experiential learning associated with employment. However, experiential learning, within the context of educational technology, can be regarded as the use of digital tools to increase the fidelity between the activities that occur inside the classroom and the actual performances that will be expected of students once they leave the classroom. The purpose here is to introduce a five-component strategy for organizing new media based on an experiential learning framework.

The problem is that classroom activities are often decontextualized and incongruent with life's realities. The solution is a technology-supported experiential learning environment. New media can be used to frame an experiential learning environment that promotes immediate learning transfer as well as long-term learning transfer. Further, new media for educational change should be performance-oriented and student-centered. The classroom needs to be reconceptualized as a contextualized learning space.

The new media classroom will remain a common forum and will continue to be a meeting place, but the reconceptualized classroom will include a broader array of contexts. Such a learning space will include the student, content, media, teacher,

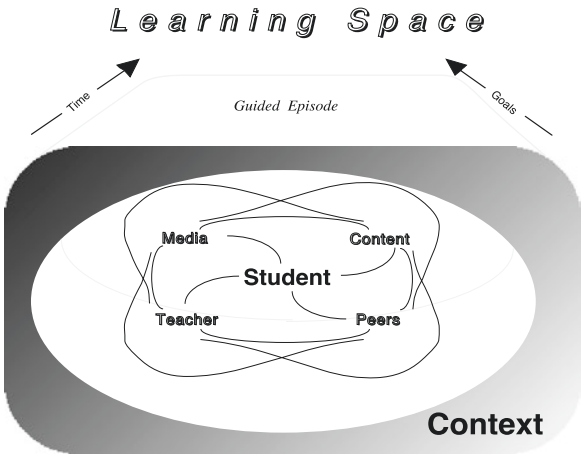

Fig. 1 Learning space paradigm

peers, context, time, and goals. It will be important to identify the knowledge and skills being brought to the learning space by the student, the content knowledge already known by the student, and expectations of the student within the experiential learning environment. It will be important to identify the type of content knowledge that is to be learned, the type of skill or knowledge that will constructed by the student, and any particular pedagogy commonly associated with the content knowledge. It will be important to anticipate the number of students who will compose a particular community of learners, the knowledge assets available within a community of learners, and the skill assets available within a community of learners. It will be important to identify the tools needed to teach the content, the tools needed to learn the content, and the tools needed to apply the new skills and knowledge. The teacher will have an extremely important role in an experiential learning framework that is supported by educational technology, especially regarding the expertise, knowledge, and skills possessed by the teacher and the teacher's ability to know times that are appropriate for the teacher to become the student. The learning goals and performance objectives should reflect the expectations of the student after he or she leaves the classroom. New media for educational change can increase the potential to maximize learning by allotting variations of time on tasks according to individual student needs. New digital and web-based technologies, coupled with ubiquitous mobile access, permit opportunities for both synchronous learning events and asynchronous learning events. The context is probably the most important factor of the new media classroom because of the technological resources required to support the learning space as well as the physical infrastructure required to support learning space. Thus, a paradigm for learning space is presented in Fig. 1.

The contention here is that new media for educational change can be accomplished through an experiential learning framework. The five-component strategy for organizing new media based on an experiential learning framework includes technology-supported student activities that are active, interactive, situated, authentic, and case-based.

1 Active Learning Strategies

Active learning strategies avoid passive techniques and promote mentally and physically stimulating activities. For example, it is important to share the professional experiences by means of meetings and conferences on subjects of general interest in educational communications and technology.

2 Interactive Learning Strategies

Interactive learning strategies avoid individualism and promote activities that require communication between the student, content, peers, students, and new media. The new digital and web-based technologies, coupled with ubiquitous mobile access, have made affordances heretofore unavailable. However, in spite of the fact that the world has become increasingly connected and interactive, there remain questions as to whether new media has instigated transformative changes in education.

3 Situated Learning Strategies

Situated learning strategies avoid activities that are unreal and unlikely to occur outside the classroom and promote activities that simulate reality and stimulate metacognition. Thus, a clarion call for research to study theories and practices that promote the construction of knowledge and skills. I believe educational technologists can provide such theory and practice through their expertise with instructional design and curriculum development.

4 Authentic Learning Strategies

Authentic learning strategies avoid low fidelity tasks and promote tasks that result in the development of genuine artifacts that are immediately usable and resemble the reality outside the classroom. Educational technologists are at the forefront of preparing students for jobs that do not exist today. This is particularly true for the areas related to instructional design and development in nonacademic settings, such as business, government agencies, and not-for-profit organizations. Rojewski and Hill's (2017) framework for twenty-first-century work preparation was developed to guide researchers and practitioners in developing training programs that continue to meet the needs of a highly complex, globalized, technology-enhanced workplace (Fig. 2).

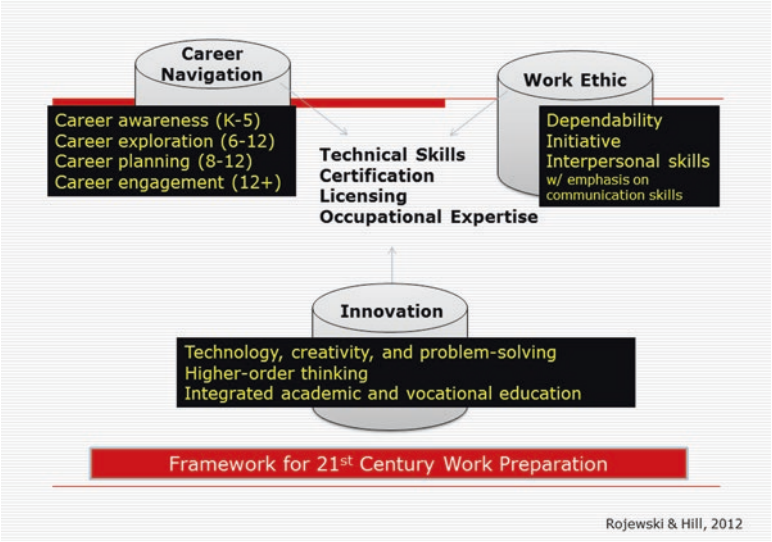

Fig. 2 Framework for twenty-first-century work preparation

5 Cased-Based Learning Strategies

Case-based learning strategies avoid classroom activities with unrelated tasks and promote tasks that provide opportunities for students to see correct sample cases, practice with incomplete cases, and apply action cases based on their own personal experiences. Instructional technology professionals interested in educational change should promote the ongoing efforts of students to find meaning and success in school and life.

6 Experiential Learning Lesson

An experiential learning lesson supported by new media and educational technology could be framed like the example presented in Fig. 3. The lesson plan format presented in Fig. 2 is adapted from Gagné, Wager, Golas, and Keller (2005).

7 Conclusion

New media for educational change will need to continue to focus on instructional design and development. Educational technologists around the world will need to conduct scholarly research and publish in top-tier refereed journals based on an innovative research program in the area of new media and human performance

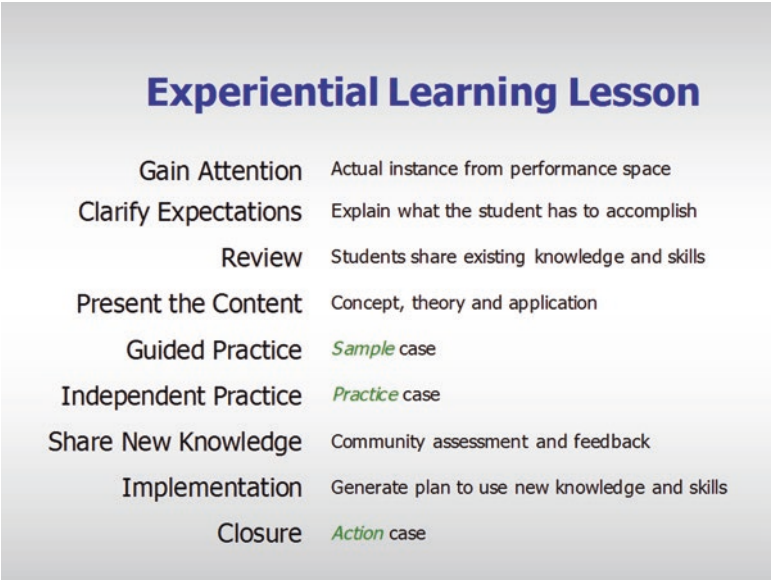

Fig. 3 An example of an experiential learning lesson plan that can have each event supported by new media and other educational technologies

improvement. We will need to foster collaborative efforts with faculty across both AECT and HKAECT on STEM-related projects. This volume seeks to encourage the sharing of the experience and reflection on the theme of new media for educational change. It encourages scholarly discussion that looks beyond what new media can afford for teaching and learning and ponders over the actual effects of these media on communication and learning. The topics of interest, such as learning analytics, game-based learning, ubiquitous learning, MOOCs, and open education, and the role of social media in education are featured herein. We hope you benefit from our sharing of good practice and lessons learned from applying new media in a wide range of fields and critical reflection on the concerns and issues associated with emergent technologies. Thus, this is an introduction to new media for educational change, its effect on learning, and reflection on practice.

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Part II
Learning Attitude, Behavior, and Analysis

Action Learning, Value Clarification, Conventional Lecture Method, and Secondary School Students' Attitude to Information and Communication Technology Concepts in Social Studies in Rural Learning Ecologies

Emmanuel O. Adu, Olugbenga A. Ige, and Kemi O. Adu

Abstract This study determined the effectiveness of action learning and value clarification instructional strategies as well as conventional lecture method on students' attitude to information and communication technology concepts in social studies in rural schools. It also determined the confounding effects of variables such as academic ability and gender on secondary school students' attitude to ICT concepts in social studies. Deploying a randomized pretest-posttest quasi-experimental paradigm using intact classes, 24 students were exposed to action learning instructional strategy, and 29 students benefited from the value clarification instructional strategy, while 93 were in the control group. The results show the rare benefits of using conventional lecture method over science-based instructional strategies to teach ICT concepts in social studies in rural learning ecologies. Further research is proposed to evaluate the sustainability of the observed effects in rural schools.

Keywords Action learning instructional strategy · Value clarification instructional strategy · Conventional lecture method · Information and communication technology concepts · Social studies · Rural learning ecologies

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1 Introduction

The information and communication technology concepts that emanated from the computer revolution have been thought to be the preserve of computer scientists. However, the realities of the Information Age have necessitated the infusion of information and communication technology (ICT) concepts in the curricula of most subjects in Nigeria. Students are given the opportunity to learn about the relevance of information and communication concepts in social studies classrooms as well as have good theoretical realities of the twenty-first-century agent of socialization that powered the fourth revolution in education (see Amosun, Ige, & Choo, 2015; Ige, 2013; Ige & Hlalele, 2017; Van Doorn & Van Doorn, 2014) called 'the Internet' which was formerly the preserve of computer science education teachers. This transdisciplinary infusion of concepts has aided the computer literacy and competency dispositions of students and provided the foundation on which different states in Nigeria founded their digital education initiatives (see pulse.ng/local/opon-imo-students-praise-osun-govt-as-distribution-of-tablets-continue-id6216638.html). Unfortunately, many teachers in the social science disciplines are at crossroads on the appropriate strategy to adopt in teaching ICT concepts consequent on its transdisciplinary nature. This indecision has led several teachers to adopt science-based teaching strategies which have led to a decline in the attitude of students to ICT concepts in social studies. It is consequent on the foregoing that this quasi-experimental study evaluated the effects of action learning and value clarification instructional strategies, as well as conventional lecture method on students' attitude to ICT concepts in secondary social studies.

1.1 Action Learning

Action learning is an experiential pedagogical MO that has risen in acceptance in the last 40 years consequent on research outcomes that it is more effectual than traditional teaching approaches (Leonard & Lang, 2010; Scott, 2017). Scholars elaborated that action learning connotes different things across disciplinary boundaries, which ranged from experiential learning to a philosophy of learning (Coghlan & Coughlan, 2015). However, O'Neil and Marsick (2007) clarified that two vital elements are at the heart of action learning; these are real school problems they encountered and progress made. Coghlan and Coughlan (2015) succinctly affirmed that beyond the two vital elements at the heart of action learning emphasized by these scholars is an important factor stated as 'distinction between different kinds of issue'. It should be known that these issues might be social, political, economic, or even pedagogical. Zuber-Skerritt (2001) declared that action learning is underpinned by fundamentals of action research where patterns of planning, observing, acting, and reflecting are employed to conceptualize a problem and produce solutions. This notion was buttressed by Coghlan and Coughlan (2015) who indicated

that the materialities of information economy which are marked with high demand for learning have constrained schools to enter into collaborative relationships with the intent of seeking solutions to their difficulties and desideratum. O'Neil and Marsick (2007) elaborated that action learning entails students working on a particular problem in small groups to initiate an action to solve the problem. The teacher becomes a facilitator and assists small groups of students to learn how to balance their discoveries with the learning from their initiatives to solve the problems. O'Neil and Marsick (2007) further clarified that action learning includes outdoor adventure, simulation exercises, case studies, and experiential programmes. Scholars cautioned that action learning is differentiated from other variants of learning by doing because it utilizes participatory activities that focus on tangible social problem in factual time (O'Neil & Marsick, 2007; Rimanoczy & Turner, 2008). It is consequent on the benefits of using action learning to improve students' learning outcomes reported by previous researchers (Amosun et al., 2015; Ige 2012, 2013; O'Hara, Bourner, & Weber, 2004) that this study utilized the action learning to teach ICT concepts in social studies.

1.2 Value Clarification Instructional Strategy

The realities of the computer age demand that values and value clarification with respect to education need to be further explored. The value clarification approach which has been found appropriate for moral education and social studies (Lipe, 2009) comprises a chain of loosely linked techniques that are learner friendly and easily accessible to teachers. Mpeli and Botma (2015) described 'value clarification' as an evolving activity that is subjected to fluid perspectives and experiences that are developed professionally, consciously, and unconsciously. While these scholars situated their conception of value clarification to a profession, the fluid perspectives and experiences do not only apply to teachers but to students in different learning ecologies as well. Oliha and Audu (2015) documented that value clarification is a method of education and morality and ethical principles that take place by drawing students to share their opinions and sentiments. These scholars affirmed that the learning experience inherent in value clarification empowers students as well as teachers to think deeply on their life and actions as they examine societal problems. Scholars opined that value clarification when applied to controversial issues such as abortion (Mpeli & Botma, 2015: 2) and activities in cyberspace (Ige, 2012) is a basic aspect of transformative learning. Taylor (2011) remarked that the transformative paradigm develops students to become reflective, open, and inclusive in making meaning of difficult phenomena. Scholars have found the value clarification strategy effective in arresting undesirable social behaviour (Bello, 2011; Oliha & Audu, 2015). It is consequent on these research outcomes that this discourse utilized this instructional strategy to enable students to have insights in the appropriate global attitudes to ICT concepts using social studies.

1.3 Conventional Lecture Method

Lecture method is a plain-sailing, brisk, and economic mode to present curricula contents to a large group of learners. Babayemi, Ahmed, Yisau and Babalola (2016) exclaimed that this 'teacher-addicted' method is currently a topic of debate among educational researchers, especially in developing countries. This method of teaching is losing relevance consequent on the evolution of information and communication technological devices that have changed the teaching-learning landscape. Golafrooz and Khaghanizade (2010) highlighted the banes of this teaching method as inactiveness of the students, long lectures that are tiring, mono-communication, and nonassimilation of the concepts taught by the teachers. Evidence from research shows that 80% of the lecture contents committed to memory by the students is lost within 8 weeks (Safari, Yazdanpanah, Ghafarian, & Yazdanpanah, 2006). It is consequent on these inadequacies of conventional lecture method that scholars (Babayemi et al., 2016; Ige, 2012; Nnorom, 2015; Sadeghi, Sedaghat, & Ahmadi, 2014) have experimented with new methods of teaching to meet the challenges confronting teachers in twenty-first-century schools. This decline in students' learning outcomes was more evident in science-related subjects. This situation led to the development of the enhanced conventional lecture method by Babayemi et al. to arrest the incessant failure of students in integrated science consequent on the failure trends observed from 2006 to 2015. Scholars like Sadeghi et al. utilized blended teaching methods deployed using the quasi-experimental paradigm to improve students' knowledge of tuberculosis in medical science lessons. Other scholars went as far as supplementing lecture method with music and computer animation to teach electrochemistry concepts (Akpoghol, Ezeudu, Adzape, & Otor, 2016), while Singh and Moono (2015) experimented with concept maps teaching strategy to teach difficult concepts in chemistry in a college of education in Zambia.

The intervening variables in this study are academic ability and gender. Educational researchers generally agreed that academic ability has influence on students' learning outcomes (Ige, 2012, 2013; Phillipson & Phillipson, 2012). Sungur and Tekkaya (2003) discovered that reasoning ability accounted for a significant part of the variance in final examination outcome of students taught using expository and inquiry classes. In this study, academic ability connotes students' self-assessment of their academic-associated skills at low, moderate, and high levels. A review of gender differences in students' attitude to disciplines related to social science indicated noninfluence of gender on students' attitude to biology (Sungur & Tekkaya, 2003), achievement in social studies, and civic education concepts (Ige & Hlalele, 2017). Other researchers reported that differences existed in the learning outcomes of male and female secondary school students (Ige, 2012; Ige & Orungbemi, 2013). In these studies, male students performed slightly better than their female counterparts. In the light of these conflicting findings, this study evaluated the differences in male and female students' attitude to ICT concepts in social studies.

1.4 Hypotheses

Hypothesis One: There is no significant main effect of treatment (action learning and value clarification instructional strategies) on students' attitude to ICT concepts in social studies.

Hypothesis Two: There is no significant difference between male and female students' attitude to ICT concepts in social studies.

Hypothesis Three: There is no significant main effect of academic ability (low, average, and high) on students' attitude to ICT concepts in social studies.

1.5 Information and Communication Technology Concepts in Social Studies

Social studies are concerned with the totality of man's interactions and experiences in her immediate environment. Scholars asserted that social studies have traditionally been instrumental to the inculcation and declaration of civic and popular participation virtues (Fitchett, Starker, & Salyers, 2012: 2). In the views of these scholars, social studies provide the pivot for nation building activities across inter-geographical boundaries. Kus (2014) reviewed the evidences from the literature on the evolution of social studies and concluded that the ultimate goal of social studies is 'citizenship education'. It could be inferred from this review and conclusion that social studies aim to inculcate the appropriate attitudes, skills, knowledge, and values necessary for active participation by citizens or school children in the Information Age.

Amosun et al. (2015) reported that information and communication technology themes were infused into the social studies curriculum by the Nigerian Educational Research and Development Council 10 years ago, consequent on the need for value reorientation that is school-based. The items on the students' attitude to ICT concepts' scale utilized in this study are built around ICT and communication, social issues and problems, problems of ICT, and values (Ige, 2012, 2013). These are topics related to ICT in social studies curricula in Nigeria. This study is of utmost philosophical relevance consequent on the 'push' and 'pull' forces of globalization that has transformed ICT in the education system to an integral tool of national development, an instrument of individual empowerment, and a key to opportunities for students' success in their aspirations (Ige & Orungbemi, 2013: 105). The transformations that information and communication technology has brought to educational development in different nations of the world make it a worthwhile endeavour to evaluate students' dispositions to it, using the disciplinary framework afforded by social studies.

2 Theoretical Framework

Constructivism is no longer an outlandish movement in modern educational circles. Kessler (2016a) attested that constructivism has evolved as one of the integral theoretical schools of thought whose study of different educational phenomena has transformed the conceptual apparatus of social science disciplines. Ross (2006) noted that there is virtually no field of human endeavour that constructivists are not uniquely adept to philosophically make contributions to. The current study is predicated on rational constructivism which emerged on the heels of two traditional schools of thought in educational movements. These are nativism and empiricism (Xu & Kushnir, 2013). Evidences from research show that nativism emphasized internal concepts and core knowledge systems (Chromsky, 1987; Spelke, 1994; Xu & Kushnir, 2013). We are of the opinion that these innate concepts and elemental knowledge systems emanated from values peculiar to each society. On the other hand, empiricism underscores building foundational blocks in relation to associative learning mechanisms (Xu & Kushnir, 2013). The relevance of rational constructivist learning theory to this study is not in doubt because the students that participated symbolically excavated meaning using value clarification and action learning instructional strategies.

In this study, students integrated prior beliefs, knowledge, and biases with the realities availed by the participatory instructional strategies, which is a hallmark of rational constructivism. It should be noted that despite the cries of Kessler (2016b) that constructivism has failed because it has neglected some integral aspects of the world, and incorporated the current fads of social theories, I want to emphatically declare that from my ample educational research experience, constructivism is still at the heart of most participatory initiatives. My position is supported by Feenberg (2017) who argued that the notions of technology and scientific facts have changed over the years, which has led to the dethronement of previously accepted notions of truth and advancement by emerging theories supported by persuasive empirical research. Some of these emerging theories are pragmatic constructivism (Haas & Haas, 2002) as well as rational constructivism that provided the theoretical outlook for this study. Despite the benefits of rational constructivism, the actualities of educational research at present show that many questions on constructivism remain open.

3 Methods and Data

3.1 Experimental Design

This study used the pretest-posttest quasi-experimental design to evaluate the impact of the participatory teaching strategies on secondary school students' attitude to ICT concepts in social studies (Ige, 2012; Ige & Hlalele, 2017). In experimental group I, each intact class of respondents was exposed to action learning instructional strategy, while respondents in intact classes in experimental group II at a different geographical

Table 1 A presentation of 3 × 2 × 3 factorial matrix

Treatment	Gender	Academic ability		
		Low	Average	High
Action learning instructional strategy	Male			
	Female			
Value clarification instructional strategy	Male			
	Female			
Conventional lecture method	Male			
	Female			

location were exposed to value clarification instructional strategy. Respondents in the intact class in the control group were exposed to conventional lecture method. The treatment in the two experimental groups as well as the control lasted for 12 weeks. The pretest was administered at the commencement of the study, while the posttest was administered at the end of the treatment. The gender of the school-age children was systematically computed as male and female, while academic ability was graduated as low, average, and high. The 3 × 2 × 3 factorial matrix drawn below detailed how the confounding variables were controlled during the experiment (Table 1).

Additionally, the quasi-experimental model comprised action learning and value clarification instructional strategies as well as conventional lecture method. Analysis of covariance (ANCOVA) was used to determine the main and interaction effects of treatment, gender, and academic ability on secondary school attitudes to ICT concepts in social studies while controlling for the confounding effects of gender and academic ability. The estimated marginal mean was deployed to show the magnitude of performance across the three groups. All the presuppositions for applying analysis of covariance were fulfilled. ANCOVA was used to analyse the data consequent on its higher power and ability to partial out the initial disparities inherent in the pretest values.

3.2 Participants' Selection and Sample

Participants consist of 146 secondary school students in six junior schools in southwest Nigeria. Of the 146 participants that participated in the study, 24 respondents in experimental group I were exposed to action instructional strategy, and 29 were in experimental group II and were exposed to value clarification instructional strategy, while 93 were in the control group using conventional lecture method. The prevalent instructional strategy used by teachers in the selected schools to teach social studies was conventional lecture method, locally called 'chalk and talk method'. The age range of the participants was 10–16 years (m = 12.96 years, SD = 1.60). A total of 46.6% (68) of the respondents were female, while 53.4% (78) were male. The three groups were comparable with respect to academic ability and gender.

3.3 Procedure

Written informed consent was obtained from the schools' management and respondents in the study before the study commenced in their various schools. The participants, their class teachers, as well as the designated school management official were adequately briefed about the study and assured they could disengage from the treatment at any time without victimization. They were also assured that their identities will only be limited to use in the study and not be disclosed to third parties or the public.

3.4 Measures

1. Action learning instructional guide (ALIG)
2. Value clarification instructional guide (VCIG)
3. Students' attitude to ICT concepts in social studies scale (SAICT)
4. Academic ability test (AAT)
5. Conventional lecture method guide (CLMG)

The scale for evaluating secondary school students to ICT was developed by the researcher. Other research instruments for evaluating the independent variables were adapted to guarantee their psychometric properties. Secondary school students' attitude to ICT concepts in social studies was measured by a 22-item scale that gathered biographical information on the respondents and attitudes to ICT concepts in social studies. The statements on the questionnaire were graduated on 4-point Likert-type statements. The questionnaire was designed to elicit response on the attainment of basic civic literacy on ICT and communication, social issues and problems, problems of ICT, and values of ICT. The scoring of the questionnaire was reversed for negatively worded items. The items on the questionnaire were subjected to peer and professional review to ascertain their appropriateness for secondary school students. The 22 items were evaluated on secondary school students that did not participate in the study; and it yielded a good internal consistency with a Cronbach's alpha of 0.76. The action learning instructional guide emanated from Marquardt and Waddill (2004) and Afolabi's and Akinbobola (2012) blueprint on action learning, while Metcalf's (1971) rational analysis model was utilized to design the value clarification guide. Participants had 35 min of civic engagements per week for 10 weeks. The opinions and suggestions of selected secondary teachers were incorporated into the experimental instructional guides before the commencement of the experimental activities.

The academic ability test (AAT), a modified form of the Sigels cognitive style test, was taken from Ige (2001) and utilized to evaluate the students' academic ability. It is made up of 20 cards of pictorial representations. The first picture on each card is coded 'A', the second 'B', and the third 'C' for easy identification. The students are instructed to identify two of the three pictures that have common charac-

teristics, select any two pictures from the three in each group that they feel have complementary properties, and give reasons for such a choice. The test was first administered on 60 students and readministered after a 2-week interval on the same group of students. The correlation coefficient of the two sets of responses was computed using Pearson product-moment correlation, and the stability coefficients of $r = 0.60–0.72$ were obtained.

The value clarification teaching strategy was administered in sequence as follows:

Step I: The teacher guides the students in identifying and clarifying the ICT concepts.

Step II: The teacher guides the students to gather and organize facts about the ICT concepts. The teacher asks Socratic questions about the ills and benefits of ICT.

Step III: The students do a group evaluation of the problems and values of ICT using real-life experiences.

Step IV: Each of the group nominates one student to present tentative value decisions on the selected ICT concepts.

Step V: The teacher asks probing questions on reasons why the students feel the proposed solutions will abate the selected ICT issues.

Step VI: The teacher asks value-based questions to evaluate the value principle in the group resolutions of the students.

The stages in the action learning instructional strategy were:

Step I: Clarify the objective of the action learning group. The teacher presents the ICT concepts to the group of secondary school students.

Step II: The teacher grouped the secondary school students across gender and ability levels, which had been noted in the pretest attitude scores.

Step III: The students meet in groups twice each week for 10 weeks to analyse ICT concepts and identify ways of studying the problems and prospects.

Step IV: Each group leader presents their reports to other secondary school students in the group and awaits the suggestions of members of the group.

Step V: The group, with the guidance of the teacher, agrees on the most integral concepts to adopt and solve.

Step VI: The group determines the goal.

Step VII: The group develops peculiar action strategies through interaction and reflection and tries these out on the ICT concepts.

Step VIII: The group takes action. The students collect information on the ICT concepts and tackle them with the group-based strategy.

Step IX: The group repeats the cycle of action and learning until new paths are found and the ICT concepts are solved.

Step X: The groups convened under the guidance of the teacher to present lessons learnt, as well as progress, and chart new course for actions. A member of each group records the ICT concepts after phase of action and learning. The process is repeated until the ICT concepts are solved and transfer of learning occurs.

The CLMG was prepared on each of the concepts selected for the study. The conventional (class) teaching method guide is made up of five steps; these are:

- The instructor introduces the concept.
- The instructor assistant discusses facts or ideas on the concepts in steps.
- The instructor assistant gives notes on the concept.
- The instructor assistant asks questions.
- The instructor assistant gives assignment to students.

3.5 Data Analysis

The data collected for the study was analysed using SPSS 24. Analysis of covariance and estimated marginal mean aspect of ANCOVA was deployed to compare the group mean attitude, using the pretest scores as a covariate after the treatments have been administered. In this study, the level of significance was set at $p < 0.5$. Partial eta squared (η_p^2) indicates the effect size; it is small at 0.1, medium at 0.06, and large at 0.14 (Cohen, 1988; Ige & Hlalele, 2017; Piwowar, Thiel, & Ophardt, 2013; Richardson, 2011). Estimated marginal mean was used to indicate the magnitude of attitude across the groups.

4 Results

4.1 Hypothesis One

There is no significant main effect of treatment on students' attitude to ICT concepts in social studies.

Table 2 shows that there is a significant effect of treatment on students' attitude to selected ICT concepts ($F_{(2,129)} = 4.419$, $P > 0.05$, $\eta^2 = 0.064$). Consequent on this result, hypothesis one is therefore rejected. This result implies that there is a significant variation in the attitude attainment of respondents in the experimental and the control groups. The estimated marginal analysis is utilized to show the performance across the three groups of treatment.

Table 3 shows that students taught using ICT concepts in social studies with conventional lecture method had the greatest attitude mean score of 67.65, followed by respondents taught using value clarification instructional strategy ($X = 61.96$), and lastly by students exposed to action learning instructional strategy with a post-attitude mean score of 53.58. In order to ascertain the sources of the significant difference, Scheffe's post hoc pairwise comparison was done and presented in Table 4.

Table 4 shows that the observed sources of significant differences emanated from:

1. The attitude mean scores of students exposed to action learning instructional strategy and conventional lecture method

Table 2 ANCOVA of posttest attitude scores across treatment, gender, and academic ability

Dependent variable: post-student attitudes to ICT concepts						
Source	Type III sum of squares	Df	Mean square	*F*	Sig.	Partial eta squared
Corrected model	19,800.656[a]	16	1237.541	7.306	0.000	0.475
Intercept	16,844.587	1	16,844.587	99.442	0.000	0.435
Pre-civic_attitudes	3140.496	1	3140.496	18.540	0.000	0.126
Treatment	1497.029	2	748.514	4.419	0.014	0.064
Gender	919.218	1	919.218	5.427	0.021	0.040
Academic_ability	443.741	2	221.870	1.310	0.273	0.020
Treatment * Gender	134.825	2	67.413	0.398	0.673	0.006
Treatment * Academic_ability	461.744	3	153.915	0.909	0.439	0.021
Gender * academic_ability	92.027	2	46.014	0.272	0.763	0.004
Treatment * Gender * Academic_ability	544.591	3	181.530	1.072	0.364	0.024
Error	21,851.351	129	169.390			
Total	674,069.000	146				
Corrected total	41,652.007	145				

[a]*R* squared = 0.475 (adjusted *R* squared = 0.410)

Table 3 Estimated marginal means of students' attitudes to ICT concepts in social studies education

Variable	N	Mean $(\bar{x})$	Std. error
Intercept			
Pre-attitude score	146	63.541	–
Post-attitude score	146	61.999	1.729
Treatment			
Experimental Group I (action learning instructional strategy)	29	53.579[a,b]	2.977
Experimental Group II (value clarification instructional strategy)	24	61.960[a]	3.668
Control Group (conventional lecture method)	93	67.653[a]	1.938

[a]Covariates appearing in the model are evaluated at the following values: students_attitudes_ to ICT_concepts = 63.5411

[b]Based on modified population marginal mean

4.2 Hypothesis Two

There is no significant main effect of gender on students' attitude to ICT concepts in social studies.

Table 1 shows that there is a significant influence of gender on students' attitude to ICT concepts in social studies ($F_{(1,129)} = 5.427$, $P < 0.05$, $\eta^2 = 0.04$). $H_0 2$ is, therefore, rejected. Female respondents had a better posttest attitude score ($X = 65.76$) than male respondents ($X = 58.24$).

Table 4 Scheffe's pairwise comparisons of students' attitudes to ICT concepts across the treatment groups

Treatment	Mean	ALIS	VCIS	Control
Action learning instructional strategy (ALIS)	53.579[a,b]	*		*
Value clarification instructional strategy (VCIS)	61.960[a]			
Control Group (conventional lecture method)	67.653[a]	*		*

*Implies that there is a significance difference of $p < .05$

4.3 Hypothesis Three

There is no significant main effect of academic ability on students' attitude to ICT concepts in social studies.

Table 2 shows that there is no significant main effect of academic ability on students' attitude to ICT concepts in social studies ($F_{(2,129)} = 1.310$, $P > 0.05$, $\eta^2 = 0.02$). Students with high ability had the better post-attitude mean score ($X = 69.52$) compared to average academic ability students ($X = 61.67$) and students with low academic ability ($X = 57.32$).

5 Discussion

The findings of this study can be summarized as follows:

I. There is a significant main effect of treatment on students' attitude to ICT concepts in social studies.
II. Students taught with conventional lecture method performed better than students taught using value clarification and action learning instructional strategies.
III. Female students had a better attitude than male students to ICT concepts in social studies.
IV. Academic ability had no significant influence on students' attitude to ICT concepts in social studies.

Despite persistent outbursts by scholars (Babayemi et al., 2016; Golafrooz & Khaghanizade, 2010) on the weaknesses of the conventional lecture method, it is amazing that the method turned out to be the best instructional strategy to teach ICT concepts in social studies. This negates the findings of Ige and Hlalele (2017) that indicated that computer-aided and blended teaching strategies are better than conventional lecture method in teaching concepts in civic education. This finding also does not align with the outcomes of a quasi-experimental study by Ige (2012) which reported the strengths of a participatory teaching method over the conventional lecture method.

The significant influence of gender on students' attitude to ICT concepts in social studies observed in this study aligns with the outcome of previous educational research (Avolio, Mhatre, Norman, & Lester, 2009; Green, 2015; Reber, Downs, & Nelson, 2017; Smith, Pasero, & McKenna, 2014). Smith et al. assessed the gender effects on student attitude towards science and discovered that boys exhibited more confidence with science than girls; however, the effect was small. Other scholars discovered no significant difference in the attitude of male and female students to social studies concepts (Ige, 2012, 2013; Ige & Hlalele, 2017). Ige (2012) utilized an action strategy to enhance the attitudes of male and female students to cybercrime prevention and discovered that there are marked differences in their dispositional constructs.

The insignificant influence of academic ability on students' attitude to ICT concepts in social studies aligns with the findings of Ige and Hlalele (2017) on the friendliness of computer-aided teaching strategies to students of different academic abilities. However, this finding negates the discovery of educational researchers who confirmed that analytic and non-analytic techniques of processing information improve students' attitude to learning a great deal.

6 Conclusion

The outcome of this study has implications for teaching ICT concepts in social studies education as well as other disciplines. The efficacy of the conventional lecture method implies that social studies teachers should de-emphasize the use of bogus teaching methods to improve students' attitudes to ICT concepts in social studies. It means a blend of instructional strategies should be deployed to enhance students' achievement, attitudes, as well as thinking dispositions. This is necessary to enable students to develop in a holistic manner. The better attitude development by female as opposed to male students recorded in this study implies that teachers' use of conventional lecture method is friendlier to female students in rural learning ecologies. It is recommended that teachers recording a higher rate of female students' failure in ICT concepts in social studies as well as other disciplines should use conventional lecture method to arrest this trend. The insignificant influence of academic ability at low, moderate, and high levels on students' attitude to ICT concepts in social studies implies that the conventional lecture method is friendlier to teach ICT concepts to students of various abilities in rural schools. It should be noted that this study is limited to rural schools; thus, caution must be exercised in generalizing the recommendations to urban learning ecologies. This study is, therefore, strongly recommended for teachers in training who wish to conduct research in sedentary geographical locations as well as teachers taking a career in rural learning ecologies in developing nations.

The views presented in this paper and any error that accompany them are ours.

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Improving Reading Performance Through Gamification and Analytics

Micah Modell

Abstract Having identified low levels of completion of assigned reading materials, the author employed gamification to improve motivation. The treatment consists of a bounded task during the reading to support a variation on "Buzzword Bingo" – a game played in business contexts to mock the repetitive corporate speech patterns. Some of its subversive nature are carried over into the classroom, leading to students trying to game the system and resulting in tension for the instructor who welcomed these challenges to his authority into the classroom. As the treatment was implemented using a custom digital platform, the author was subsequently able to collect and analyze performance data. The author used the resulting information to customize lessons to student misunderstandings and to make student progress visible. The author discusses student reception, lessons learned, and plans to enhance the treatment in the future.

Keywords Gamification · Learning analytics · Collaboration

1 Introduction

This design case details the efforts of an instructor to combat the fact that their students were not completing assigned readings. After recognizing that my students had legitimate reasons for neglecting the assignments, the instructor sought to address gaps in motivation, task clarity, and structure as well as feedback. The design solution was a gamification based upon Buzzword Bingo experienced in corporate meetings – a game designed to mock the catch phrases so common in the world of business. Implemented using a web-based digital platform, the solution offered interesting possibilities for customizing instruction.

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2 Literature Review

The term "gamification" has risen to prominence in the public consciousness over the last decade. It is the incorporation of game elements into a nongame experience in an effort to capitalize upon the strengths of games (Hamari, Koivisto, & Sarsa, 2014; Smith-Robbins, 2011). These strengths can include some combination of the following:

1. Motivation
2. Competition
3. Structure
4. Clear goals
5. Progress toward goals
6. Direct feedback on performance
7. Providing a framework for interaction

It is, in effect, a new lens on what professional instructional designers have been doing for years to spice up their training materials; disguising a quiz as a Jeopardy™ game is one example of a common treatment.

The approach is distinct from game-based learning in a few ways. In game-based learning, the game mechanics themselves impart an understanding of the intended concepts or content, while the game mechanics in a gamified situation are not connected to the content itself. In effect, gamification is content-agnostic and, with thoughtful design, can be broadly applied to achieve various types of learning goals without deep consideration of what students are intended to learn (Kamasheva, Valeev, Yagudin, & Maksimova, 2015; Nicholson, 2012). Because of this broad applicability, a single treatment can be easily carried through an entire course or even an entire curriculum lending the benefits of consistency described by Shulman (2005). However, this loose coupling often lends these efforts a gimmicky feel.

While gamification is not tightly coupled with the content, this does not imply that no design considerations need be taken into account. Kamasheva et al. (2015) remind us to customize the solution to the context and pay careful attention to the timing of incentives. Robson, Plangger, Kietzmann, McCarthy, and Pitt (2015) offer us a framework for understanding our player-students by evaluating their level of competitiveness and whether they are self- or other-orientation and offer design guidance based upon these classifications.

Gamification treatments are often implemented with minimal supporting materials, but a digital environment offers the designer additional possibilities. By capturing data about student-player interactions with game-like elements, the instructor can later that data to gain a deeper understanding of how individual students are developing and for trends that might indicate potential areas of improvement for the instructors (Siemens & Long, 2011). This analysis can be used to support personalized instruction.

3 Methods

The methodology is best described as design-based research using action research (Andriessen, 2008). In this case, however, the instructor-researcher began with diagnosing the situation and then moved into theorizing and design. This was followed by iterations of implementation and refection on action which fed directly back into the next iteration.

The instructor delivers technology-related content in Department of Technology and Society on the small South Korean campus of an American university. When this project was initiated, he was working with 17 students spread across two classes. In the subsequent semester, there were 34 new students and 53 in the third semester of this study. In the final semester, there were nine students who had worked with earlier iterations in the second semester. The students represent a wide variety of nationalities, but majority are native Korean. All courses are delivered entirely in English.

Student responses in class quickly made it clear early that they were not completing the assigned readings. After reviewing the readings and interviewing the students, the instructor determined that students faced significant challenges in that the language (often not their native tongue) was often dense and, as students, they lacked context for making meaning of the content. Furthermore, the connections between the text and the discussions in class were often indirect. This made it difficult for them to read with confidence that they were meeting the instructors' expectations. As a result, many simply gave up.

It seemed that the students might be helped by any of the following:

1. Make objectives clear.
2. Make it clear when they'd achieved those objectives.
3. Draw connections between the book and the classroom.
4. Provide opportunities to experiment using the two languages.
5. Help them develop context for understanding the material.
6. Provide short-term positive feedback for putting in an appropriate level of effort.

Goals 1, 2, and 6 aligned directly with gamification strengths 3, 4, 5, and 7. Perhaps careful design could make sure that 3, 4, and 5 were met as well.

While students did seem to have difficulty in making connections with the content, there was no evidence to indicate that they lacked appropriate reading skills or strategies to complete the tasks (Afflerbach, Pearson, & Paris, 2008) – the challenge lay instead in their motivation to do so.

3.1 The Concept

Feeling pressure to support his students, the instructor thought back to search for solutions. Having corporate experience, he was amused by the game Buzzword Bingo (see commercial by IBM, 2008). It is a corporate take on the classic game of bingo, but instead of placing numbers in the boxes on the grid and hoping for yours

to be called, you choose from a list of catch phrases and buzzwords and wait for your manager or colleagues to mention them during the next meeting. Winners often disguised their claim of "Bingo!" behind a coughing fit. He didn't often play, but it was fun, and it felt subversive just to talk about it.

Facing this student challenge, Buzzword Bingo came almost immediately to mind.

Students could undertake the measurable task of evaluating and submitting a specified number of what they determined to be important terms from the texts. Then, in class, they would listen for reference to those concepts to be mentioned. If they scored 5 in a row, they could be rewarded with grade points – the currency of the classroom.

The game felt a bit childish and simple, but it would be easily learned and accessible to all. It could serve as a whimsical way to coax students into providing with evidence that they had engaged with the reading assignment while offering up.

4 Results

After a week of deliberation, the instructor was convinced the risk of introducing this change into the classroom was low and began planning.

4.1 Alpha

The first iteration began with development of a set of rules and presentation to the class in the form of a Bingo board template and a few slides with fun creative commons imagery to explain their new activity (Fig. 1).

Two days before we were due to discuss a reading in class, students would use the course LMS's discussion forums to post the related terms they felt to be most important along with definitions in their own words.

In the intervening 2 days, the instructor would:

- Remove duplicates (misspellings, plurals, incorrect names, etc.)
- Remove any words that were invalid:
  - Incorrect
  - Too obvious (e.g., "information" in the 7th week of a class on information management)
  - Not relevant (e.g., "deciduous trees" in a class on information management)
  - Too generic (e.g., "the")
- Post a distilled list of concepts for their Bingo! boards

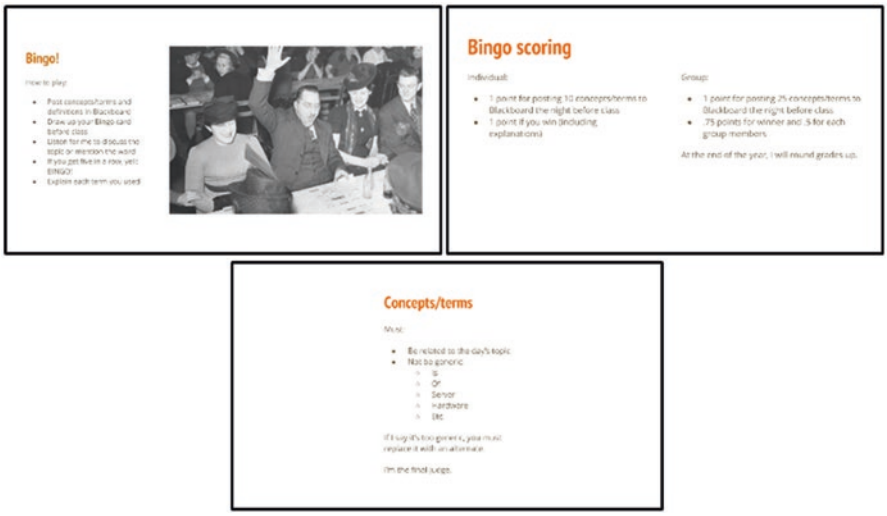

Fig. 1 Original activity introduction slides. Left slide photograph: Conrad Poirer (Public domain), via Wikimedia Commons

Upon receipt of the distilled list, they were to select the 24 concepts they felt were most relevant and place them as they wished on a Bingo! board and bring their board to class.

In class, students were to listen for discussion of the concepts on their board and to mark off the concept if it should come up. Upon achieving five in a row, they were to immediately stand up and call out "Bingo!" at which point they would explain the terms they crossed off and how they were relevant in class. If they got a Bingo! in class, the instructor would award them extra credit.

In addition, because of the instructor's desire to promote effective collaboration, he included a collaborative option. If a group chose to work together, they got a discount on the number of terms they had to turn in. For example, if a student working alone was expected to submit ten key terms, a team of four would be expected to submit a combined total of 40. However, if they opted to work together, they need only submit 25 words – if they split that equally, this meant less than seven words apiece! All team members could choose to play, and, if anyone won, they could call on their team members to help them explain the terms, and, in return, the extra points would be increased and shared.

4.1.1 Initial Launch

Within 3 weeks the first win occurred. As the semester progressed, the instructor found himself with opportunities to gently correct misunderstandings but was lenient with awarding Bingo! wins. It seemed also that some students were tentatively trying to steer conversation toward words on their boards.

4.1.2 Room for Improvement

The initial run was enough of a success that the instructor decided to continue the experiment, but the process of collecting the words was rather cumbersome and error-prone. Accessing the discussion boards was slow, and they were never meant for this purpose. This was frustrating for the students to enter their data in, and everyone entered it in different ways. This was complicated by the fact that students almost always submitted as teams but often forgot to include the name of the team. In a number of cases, students posted to the wrong forum, and this often went unnoticed until they lost points. Much time was spent copying and pasting, and searching for duplicates was incredibly tedious. The instructor didn't even pay much attention to the definitions they provided.

4.2 Beta

The following semester, students in two classes entered their terms into Google Forms designed for this purpose. Students entering data were asked whether they were doing it for themselves alone or for a team, and the form branched appropriately to request the correct number of terms. One of the classes was an iteration of a class previous semester, and one was brand new, with entirely different content and a different textbook.

4.2.1 Successes

Now there were more wins. It was often the same students playing, and now there was no doubt that they were actively directing the conversation toward the information they wanted to hear. In a few cases, the terms they recognized and marked off were arguably not accurate. The instructor often felt taken advantage of – giving out points that might be undeserved. However, students "taking advantage" resulted in some very interesting connections and conversations.

The instructor also noticed that there were fewer blank stares when he posed questions. This led the instructor to feel more confident that students were understanding the lectures as they were properly prepared. This may have been enhanced by the fact that they'd completed the reading and had the information floating around in their heads for at least 2 days prior to the discussion in class. This also emboldened the instructor to introduce more activities to the classroom as there was no longer apprehension my students would be unable to engage. These students were actively engaged. They might be gaming the system, but weren't they winning more than just points?

An unexpected benefit of the new activity was increased insight into students' growing understanding. The instructor could see what they found important in each

reading, and he found himself adapting classes to take advantage of this information.

Students seemed to be responding well to the structure offered by Bingo! game play. Not only did they seem to be reading the book, but now they were more actively contributing in class and making connections. It had also added a bit of a playful atmosphere as they tried to game the system.

4.2.2 Continuing Room for Improvement

There were a few negative comments about Bingo! in midterm course evaluations. A similar statement appeared in response to two separate questions. The complaints were not descriptive, and one can only guess as to what they did not like. Perhaps they were annoyed by the additional (keyword submission) task? Maybe they did not appreciate the disruptions of wins or the attempted tangents? It's possible they may have resented playing such a simple and somewhat childish game as undergraduates. Maybe they were lamenting the fact they could no longer safely skip the readings altogether? After all the actual Bingo! game play was optional, and wins did not happen in every class. Given the similarity of the responses, I believe both were from a single student, and others were enthusiastically playing.

Also, the Google Forms' output was still cumbersome to work with, and the definitions were rarely reviewed for quality. It was difficult to track who had submitted what or the quality of their work or depth of their understanding. Also, students continued to submit to the wrong form, or, in some cases, multiple people from one team submitted the same batch of words twice. Finally, one team with only three students is asking why they needed to enter 25 words just like a team of four.

4.3 Version 1.0

The first two versions of the game proved too tedious to continue. The students completed the task without complaint, but the instructor was spending hours copying and pasting text and spending little time evaluating the quality of their work – much less providing feedback. It was time to build a custom system. Fortunately, the instructor had access to an online collaboration platform (Author).

4.3.1 The User Experience

CoLab itself was written using the Ruby on Rails (http://guides.rubyonrails.org/v4.2/), deployed to using the cloud-based application hosting provider Heroku (http://www.Heroku.com), and uses the JQuery Mobile framework (https://jquerymobile.com/) to provide a mobile-friendly interface.

These decisions, previously made, allowed me to focus my efforts primarily on the interaction logic.

4.3.1.1 Initiating a Game

Given the challenges encountered when faced with a team of more or less than four students, an adaptive mechanism was required for incentivizing collaboration. After thinking through the goals, teams would be offered a group discount. When group play was an option, the instructor would specify a percentage by which the total number of required words will be reduced if they choose to collaborate. For example, if each individual is required to submit ten words but there's a group discount of 25% in place, a team of four that chooses to collaborate will be asked to submit 30 words instead of 40 (ten from each of the four individuals).

While 2 days for processing the submissions was rather tight, but how much time was needed? It was unclear how long to take for this task, so ultimately it was decided not to decide. Instead, the instructor tells the system how many days they'd need for instructor preparation.

4.3.1.2 Students Submit Lists of Candidates

The most common activity would be students submitting their lists of candidates with definitions. Therefore, this should be as simple as possible. At the top, they see a reminder of the topic and a description of the resources from which the terms should be drawn (see Fig. 2). If group play is enabled, they will also see a link to request collaboration from their team. If they do, the rest of their team members will be asked to agree, and if they do, all work done on the assignment today by all individuals in the group will be merged into a single list that they can continue to work on. The new list will be shortened to account for the group discount, but no one's work will be lost – if a group of four had already entered 40 terms, the list will be 40 long. If anyone declines, the request will be reset but can be initiated again. This means that collaboration is optional, and no one can guess if a teammate does not want to collaborate without communicating.

This system allows individuals to contribute at their own convenience as they all have access to the same list. Students can keep making changes until the entry period is finished, so they don't have to coordinate an explicit decision to finalize their lists – they just save their work as they go. While this simplifies coordination of group efforts as compared with previous, fully manual, iterations, it also effectively hid some challenges, increasing the risk of problems – this would soon become apparent and will be discussed shortly.

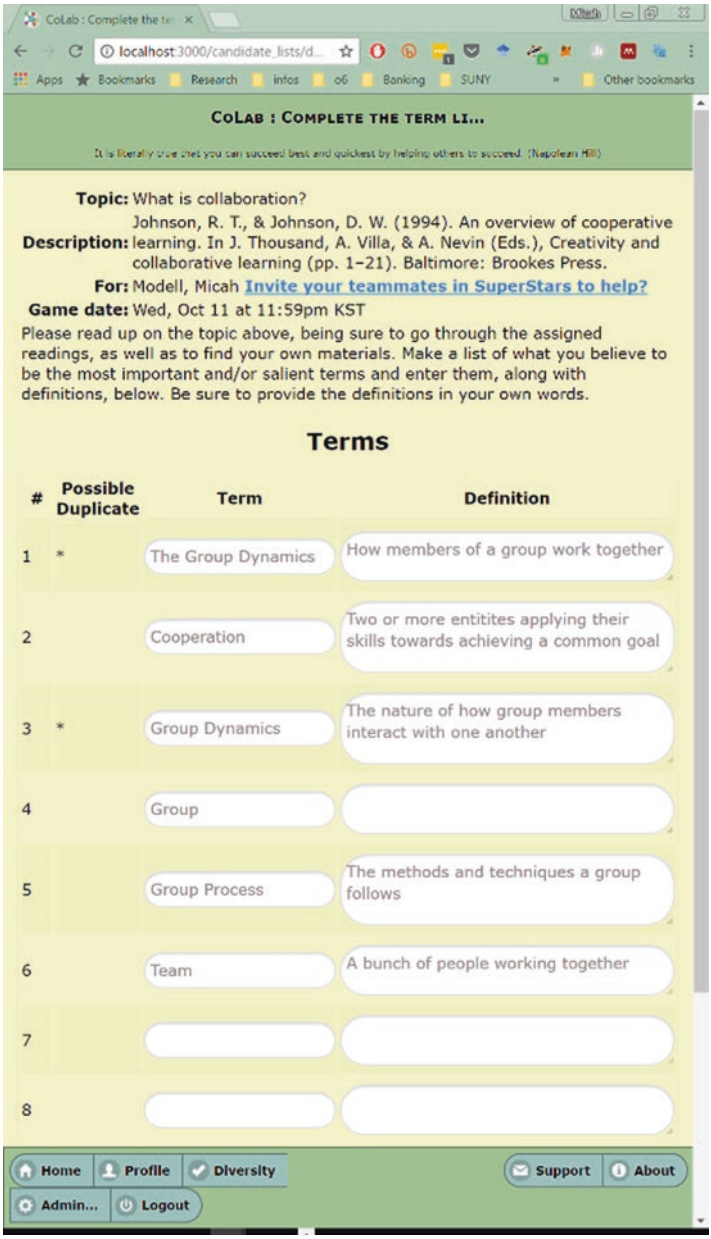

Fig. 2 The candidate entry screen used by students

4.3.1.3 Instructor Review and Feedback

Once the entry period ends, an email goes to the instructor(s) on the course summarizing how their students performed (i.e., how many of the required words they entered) and letting them know their work is ready to be reviewed. When the instructor opens the task, they see a listing of all the words, the provided definitions, feedback options and a field to specify the concept.

Concept specification is important because it allows me to standardize spellings and formatting. The system removes extra spaces and capitalizes all words, but I'm needed to make sure "Business System," "Business Systems," "The Business System," and "The System used by the Business" all present as a single concept. This is particularly important because after their work's been reviewed, students are presented with a listing of the unique concepts to copy onto their Bingo! boards for play in class.

The most important addition, though, was the mechanism for providing students feedback on their efforts. The inability to offer students direct feedback on their submissions in a timely fashion was causing a great deal of stress. Now it was possible to easily review each term and indicate whether it was acceptable or not. If not, the instructor could now let a student know the term they listed was too obvious or irrelevant to the topic at hand (see Fig. 3). Alternatively, maybe the term was OK, but the definition was insufficient as it missed a crucial detail, or perhaps it was written in such a way that it was not understood by me. Finally, it's possible to sort terms and see all the definitions next to one another, making it very easy to detect similarities – and mark those entries as plagiarized.

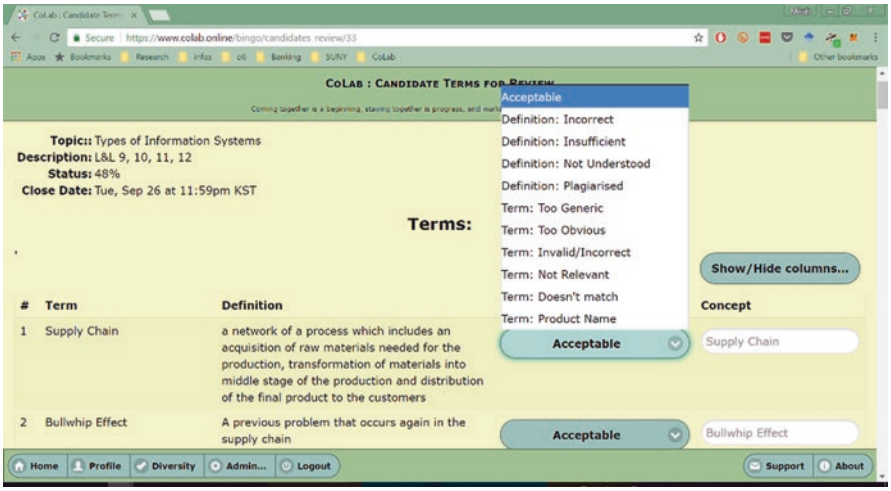

Fig. 3 Instructor assessment of candidate terms

4.3.1.4 Students Get a List of Concepts for Bingo!

Because providing students as much time as possible to review the concepts available for the week is important, upon marking the review as completed, the system emails all affected students to let them know the list is available. From that time through the day of class, students have a new task available, and accessing it reveals all of the available concepts from the entire class for that week. This list is very simple and provides only the topic, the date of game play, and the list of concepts. They can then select a set of those words and enter them on Bingo! boards to play in class.

4.4 Evaluation

It was valuable for me to experiment using the tools at hand before sinking time into development. Iteration improved upon the initial implementation, as has my own experience with the method. As it is always the case when implementing something new, there are both unexpected challenges and benefits. The interface has now been in use for about 6 months now. So far some bug reports and some requests for enhancement have been received – all of which I've tried to address as quickly as possible. However, students mostly seem satisfied with the experience.

4.4.1 Challenges

Development never seems to end. For instance, the initial run didn't provide students any form of access to the feedback. A statistics page has now been created and is accessible from a student's Activity History in the Profile. It is currently simple, providing them with details of how their efforts were rated. This will evolve over time, but for now it is sufficient.

Additionally, as alluded to earlier, since the system now automatically aggregates collaborative contributions, no student is required to manually review the group's submissions, and this increases the risk of duplicate candidates. As a result, in addition to the ability to sort, the system now compares all the terms that have been saved and marks likely duplicates in the student's interface, so they will notice and fix them. This analysis is not comprehensive or complex, but it will catch glaring mistakes.

Similarly, there are indications that some groups are using the system to take turns with the reading and terms entry responsibilities each week. This means it's possible there's only one in four students actually doing the reading in a given week. While this is still better than no one completing the readings, that certainly was not expected. It is unclear if this should be addressed or if, perhaps, in these courses, the collaborative projects cause the knowledge to be shared peer-to-peer in these cases.

There have also been some challenges around classroom norms: many students seem reluctant to announce their Bingo! win – much less to interrupt to do so. After reminding them and pushing them to do so numerous times, the instructor instituted a new rule: the game expires when class ends – if you haven't claimed your credit by the time class wraps, there will be none.

4.4.2 Benefits

Students are actively steering the conversation toward the concepts they placed on their boards. It is sometimes difficult not to resent the feeling of being manipulated, though. They are engaging and that was a goal. Similarly, they should be listening for concepts, and this has led to a number of explanations of wining terms that are a bit of a stretch or that need correction or clarification. However, this too shows that they are applying their minds to the ideas and refining their own understandings of them.

Another unexpected consequence regards instructor confidence in the classroom. In the past, there had been a number of instances when activities were scrapped on the fly because it seemed evident that students weren't prepared to complete them. Other times there was a need to re-explain concepts they should have got from the readings, and, as a result, class was more stressful for and quite boring as well. Now the instructor embraces more engaging activities because there's no more fear that they will fall flat. Perhaps this is also attributable to the instructor's development, but it seems there's real value in having evidence that students possess the base knowledge required.

5 Summary and Conclusions

This design case details the efforts of an instructor to help his students to find value in completing a course's assigned readings. Initially, it was difficult to frame the problem productively and avoiding as they need to do it because the instructor said so approach. When the instructor accepted that none of my objectives were to have them simply obey, an approach that adds value in the classroom was found.

The solution offers students clarity on how much reading is enough reading. The fact that students are playing the game in class indicates that some of them appreciate the rewards and are motivated. They are practicing with the concepts both at home and in the classroom and even drawing some rather creative connections in an effort to win points.

My work on Bingo! is far from over. In addition to analysis of data obtained from a survey of Bingo! participants, there are a number of avenues for further exploration and extension of this method.

5.1 Bingo! Board Generation

There is value in having students manually enter concepts onto their Bingo! boards as it serves to encourage them to consider their word choices. The platform has all the data, and the task of writing down the concepts is a bit tedious. The author is exploring Bingo! board generation interfaces that will enable students to configure the boards the way they want them.

5.2 Mobile Game Play

Similarly, if students are able to play online, it opens up new avenues of possibility. First, I've been thinking I might be able to use this to co-opt mobile devices during class. If they are playing Bingo! on their device, it will be tricky for them to use it for other things. With significant effort, clickers (single-purpose mobile devices) were positively received by students (Crouch & Mazur, 2001), and it seems reasonable this might easily be replicated with Bingo! Second, the system might serve to pre-validate a Bingo! win and then inform me when it happens and give me the list of marked words for more of an interactive experience. Finally, if the system records student actions, instructors might gain from insight into what my students think they heard me say – and how well they are paying attention. This is an area of active development, focused on the human-computer interaction design perspective.

5.3 Analytics

The platform is collecting a great deal of information about how my students make sense of these materials. This enables provision of feedback on student performance (see Fig. 4), offering not only the raw scores but trend lines to indicate their progress. It also guides the topics the instructor focuses on in class, but the potential is much greater. After use in multiple classes, it would be possible to look at the most common concepts in a class or in a given assignment. Further, one could take a look at the ones students have the most difficulty in defining properly and use this to make sure to focus on explaining some of these more thoroughly.

Additionally, it is possible to correlate performance with understanding of the concepts. Do classes select and/or define words more accurately as the semester progresses? Alternatively, do some students need additional help in synthesizing the materials they read as evidenced by high incidences of incorrect, insufficient, or outright plagiarized definitions?

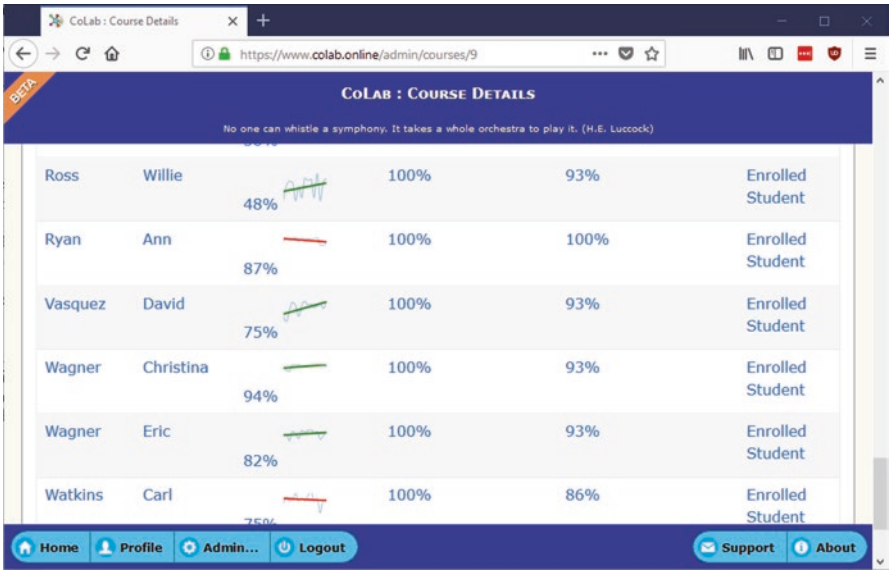

Fig. 4 Provision of feedback on student performance

5.4 Investigate Learning Effects

It seems that the students are more engaged and that ought to lead to more effective learning. Additionally, the instructor is often better prepared to walk into the classroom with greater insight into my students' understanding. Does this have a measurable effect on learning? It would be interesting to study whether students using this method exhibit any increase in retention or ability to apply the content over time. Additionally, is there actual learning value in the Bingo! game play, or are any effects the same even if students only complete the keyword listing task? This could be tested using a simple quasi-experimental setup with a pre- and post-course test.

5.5 More Words for Deeper Content

This method has been used in relatively practical undergraduate courses, and it seems to offer value. However, might this sort of method be useful in a headier graduate course? This focuses on language and vocabulary as representations of concepts, but can this go deep enough to offer value at the graduate level? Would increasing the required word count cause students to engage more deeply with the texts? Does recognizing the language necessarily represent a sufficient start at understanding of complex and challenging ideas?

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Online Knowledge-Sharing Motivators of Top Contributors in 30 Q&A Sites

Yongsi Chen and Khe Foon Hew

Abstract This study reports on the activities from a large question and answer (Q&A) site, Stack Exchange, which brings together individual communities of users on every specific topic. Q&A communities are selected from the top 30 sites from Stack Exchange, ranked by registered users as well as the percentage of answered questions. Using online survey, this study empirically tests a model of knowledge-sharing contribution to examine why individuals share knowledge in Stack Exchange. Research model is developed based on the theory of reasoned action, using attitude as the proxy to study the influence of possible motivations on knowledge-sharing intention. Nine factors were examined including knowledge-sharing self-efficacy, altruism, trust, reciprocity, personal expected returns, identification, shared vision, social network ties, and community-level expected returns. Results show that knowledge sharing is motivated primarily through altruism and personal expected returns.

Keywords Community of practice · Q&A · Knowledge-sharing motivations · Knowledge-sharing contribution model

1 Introduction

Knowledge has long been recognized as the critical resource of organizations (e.g., Fernie, Green, Weller, & Newcombe, 2003; Wasko & Faraj, 2005). Effective use of knowledge can help organizations develop beneficial growth and maintain their advantages in a competitive and dynamic workplace. However, since the growing number of geographically dispersed companies has lessened the opportunities for face-to-face interactions, organizations have failed to process all the required knowledge within their formal boundaries (Anand, Glick, & Manz, 2002). In order to resolve this paradox, knowledge exchange from the outside connections is believed to be crucial for organizational innovation. One way to mine knowledge

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from cross-organizational boundaries is using information and communication technology, such as online discussion forums (e.g., Warrior Forum), community-built encyclopedias (e.g., Wikipedia), and online question and answer sites (e.g., Answer.com).

Question and answer (Q&A) community is a technology-supported distributed community in which participants with common interests interact to share information, seek advice, and exchange ideas. To overcome the difficulty for geographically dispersed learners, Q&A site is considered as an effective tool for successful knowledge management and sharing. This study reports on the activities from a large Q&A site, Stack Exchange (http://stackexchange.com/), which is an open knowledge-sharing platform allowing users to contribute their knowledge by posting or answering questions. Within the recent years of development, Stack Exchange has become one of the most famous Q&A sites of experts on every specific topic.

Because of the potential benefits that can be achieved through Q&A community, an increasing number of studies have been conducted to investigate the impact of motivational factors on knowledge-sharing contribution (e.g., Adamic, Zhang, Bakshy, & Ackerman, 2008; Ardichvili, Page, & Wentling, 2003; Mamykina, Manoim, Mittal, Hripcsak, & Hartmann, 2011; Yang, Wei, Ackerman, & Adamic, 2010). To further the understanding of this research interest, this study empirically tests a model of knowledge-sharing contribution using an online survey. The rest of the paper is structured as follows. This paper firstly reviewed the previous research and highlights the main related theories of online knowledge sharing and the most commonly mentioned factors of knowledge-sharing intention (Sect. 2). A research model is developed based on the theory of reasoned action, using attitude as the proxy to study the influence of possible motivations on knowledge-sharing intension (Sect. 3). The methodology of data collection is presented in Session 4. The empirical results of this study (Session 5) show that knowledge sharing is motivated through altruism and personal expected returns. Possible explanations of the findings are given in Session 6.

2 Background

The purpose of knowledge sharing is to improve the competitive advantage of organizations or individuals' capability (Senge, 1998) by means of knowledge contribution and knowledge seeking for reuse (Chen & Hung, 2010). In the case of Q&A sties, the conversation associated with knowledge sharing typically involves the **knowledge recipients** to post an open question or a request for help to the community. In response, a **knowledge contributor** may either share his or her knowledge in the form of a story describing a similar experience where a method was used to solve a problem, or, if unable, to provide an appropriate solution, share knowledge in relation to contacting someone else who might know and be willing to help.

Knowledge sharing is a form of giving away individuals' unique knowledge. Thus, it seems to be irrational that people voluntarily sacrifice their time and effort

to share their knowledge online for free on Q&A sites. So what motivates people to share their knowledge? To examine existing research that focuses on the motivators associated with knowledge sharing within Q&A communities, this study examined studies from 1995 through the present that provided empirical findings. Since few studies focused exclusively on Q&A communities, this study also included empirical studies pertaining to online communities in general. In total, there are 26 empirical studies which have been examined in this study.

The review of the 26 empirical studies shows that motives for sharing knowledge in online communities can be divided into seven main categories: *theory of reasoned action*, *knowledge-sharing self-efficacy*, *altruism*, *trust*, *principlism*, *egoism*, *and collectivism* (see Table 1). Each of these motives will be described in turn, along with the findings from the past empirical studies.

3 Research Model and Hypotheses

3.1 The Theory of Reasoned Action (TRA)

In this study, the research model is based on the theory of reasoned action (TRA) proposed by Ajzen and Fishbein (1980) to reveal the fundamental motives for knowledge-sharing behavior in Q&A community. Behavioral theories indicate that knowledge-sharing behavior is positively affected by knowledge-sharing intention Fishbein & Ajzen, 1975, which is defined as the degree of effort an individual exerts in taking a particular action (Shu & Chuang, 2011). In other words, knowledge-sharing intention, in turn, leads to knowledge-sharing behavior (Casimir, Ng, & Cheng, 2012). In this study, the use of knowledge-sharing intension is adopted as a proxy for knowledge-sharing behavior. TRA shows that if people evaluate knowledge-sharing behavior as something positive (attitude), this would result in a higher motivation to share knowledge. Attitude is defined as the sum of beliefs about a particular behavior weighted by evaluations of these beliefs (Miller, 2005). Attitude has long been considered to be a significant determinant of behavioral intention (Ajzen & Fishbein, 1980).

3.2 Research Hypotheses

3.2.1 Knowledge-Sharing Self-Efficacy

According to social cognitive theory, self-efficacy is an important concept in social psychology. Individuals attempting to improve the competency of others are motivated by self-efficacy, which is also a form of self-evaluation that influences a person's decision-making on behaviors (Chen & Hung, 2010). Knowledge-sharing self-efficacy can be defined as beliefs in one's confidence to organize and execute

Table 1 Motives for knowledge-sharing behavior with representative references

Categories	Motivations and definition	Representative reference
Theory of reasoned action	**Attitude**: an attitude is defined as the sum of beliefs about a particular behavior weighted by evaluations of these beliefs (Miller, 2005)	Shu and Chuang (2011)
Knowledge-sharing self-efficacy	**Self-efficacy**: the degree of confidence in member's ability to sharing knowledge that is valuable to the virtual communities	Lin, Hung, and Chen (2009)
Altruism	**Altruism**: altruism refers to the voluntary helping actions where one attempts to improve the welfare of others at some cost to oneself. It can be considered as a form of unconditional kindness without expecting anything being provided in return	Wasko and Faraj (2005)
Trust	**Trust**: the degree of belief in good intentions, behaviors, competence, and reliability of members with respect to sharing knowledge in virtual communities	Fang and Chiu (2010)
Principlism	**Reciprocity**: people's salient beliefs that current knowledge sharing to virtual communities would lead to future request for knowledge being met	Teigland and Wasko (2004)
Egoism	**Personal expected returns**: personal expected returns refer to the knowledge contributor's judgment of likely consequences that his or her knowledge-sharing behavior will produce to him or her	Wasko and Faraj (2000)
Collectivism	**Identification**: identification refers to an individual's sense of belonging and positive feeling toward a virtual community	Chiu, Hsu, and Wang (2006)
	Social network ties: social interaction ties represent the strength of the relationships, and the amount of time spent, and communication frequency among members of virtual communities	Chiu et al. (2006)
	Shared vision: a shared vision is viewed as a bonding mechanism that helps different parts of an organization to integrate or to combine resources	Tsai and Ghoshal (1998)
	Community-level expected returns: community-level expected returns refer to a knowledge contributor's judgment of likely consequences that his or her knowledge-sharing behavior will produce to a virtual community	Chiu et al. (2006)

valuable knowledge to others (Kankanhalli, Tan, & Wei, 2005). In this study, it is the members' self-evaluation and confidence in their ability to answer the questions posted by other members and to provide valuable advice and useful knowledge to others. Individuals who have higher level of expertise, skills, and capabilities are more comfortable and willing to provide useful advice online. This belief is supported by some research studies (Chen & Chen, 2009; Chen & Hung, 2010; Lin et al., 2009). Specifically, Chen and Chen reported that knowledge-sharing

self-efficacy is positively related to the knowledge contributing and collecting behavior of members among virtual community of practice.

H1: Members' knowledge-sharing self-efficacy is positively related to their attitude toward knowledge contribution in Q&A community.

3.2.2 Altruism

Altruism is an intrinsic motive to benefit others without benefiting from others (Batson, Ahmad, & Tsang, 2002). Altruism should not be confused with reciprocity because the latter concerns the future benefits from the sharing behavior. Batson et al. (2002) further elaborated that the most commonly purpose of altruistic motive is empathic emotion, which can be described as other-oriented feelings that are consistent with the perceived welfare of another person (Batson, 1991). If the other person is perceived to be in need, then empathy feelings (e.g., compassion) strengthen the desire toward the ultimate goal of relieving the need of the person (Batson, 1991). This study defines altruism as enjoyment obtained from helping others by sharing knowledge or providing suggestion through Q&A community. Examples of empirical evidence that altruism can increase people's willingness to contribute knowledge in online communities can be found in several studies, such as Wasko and Faraj (2005), as well as Hew and Hara (2007) in their comparative analysis across three online environments (advanced nursing practice, university Web development, and literacy education).

H2: Members' altruism is positively related to their attitude toward knowledge contribution in Q&A community.

3.2.3 Trust

Three dimensions of trusts may be described (Mayer, Davis, & Schoorman, 1995): benevolence-based trust refers to the concerns for the needs of others, competence-based trust refers to one's capability to accomplish certain tasks, and integrity-based trust refers to a person's expectation that members of an online community will follow a generally accepted set of values and norms (Chiu et al., 2006). Blau (1964) argued that trust could shape and maintain social exchange relationships, which might lead to knowledge-sharing intension afterward. The importance of trust has been widely studied by prior research. For example, Nahapiet and Ghoshal (1998) argued that when trust exists between the parties, members are more willing to engage in collaborative interaction. Some studies have observed the effect of trust on knowledge-sharing behaviors in terms of different perspective of trust such as trust in management and trust in members from Fang and Chiu (2010). Results suggested that trust in management and trust in members are positively associated with virtual community members' continuance intension to share knowledge. Also, Ardichvili et al. (2003) have observed the effect of two types of trust that are

important to knowledge-sharing intension, regarding as personal knowledge-based trust and institution-based trust. In this study, trust is defined as the generalized trust specifying on the degree of belief in good intentions, behaviors, competence, and reliability of members with respect to the Q&A community. Kankanhalli et al. (2005) found that when generalized trust is strong, knowledge contributors are more willing to believe that knowledge recipients will not misuse the knowledge provided and will give the knowledge contributors credit for their generous dedication.

H3: Members' trust is positively related to their attitude toward knowledge contribution in Q&A community.

3.2.4 Principlism

Principlism is a motive with the end goal of upholding some moral principles (Batson et al. 2002). For example, people who have received help from a community in the past feel that they are obligated to give something back in return. Such a principle is commonly referred to **reciprocity** in the literature. Reciprocity is based on the social exchange theory, which refers to the expectation that knowledge receiver should return the favor to the knowledge giver. Lin et al. (2009) indicated knowledge exchanges are mutual and driven by obligation and fair. This belief is also consistent with the concept of reciprocity from studies of Wasko and Faraj (2005), Hung and Cheng (2013), and Chen and Hung (2010). Reciprocity can be further classified as direct reciprocity, which involves two individuals who take the roles as receiver and giver of knowledge exchange (Nowak & Sigmund, 2000), and generalized reciprocity, which occurs when help given to one person is reciprocated by someone else and not by the original recipient of the help (Ekeh, 1974).

Prior studies have found that reciprocity tends to make people feel more positive to share their knowledge. For example, in a study of why people want to help others in an electronic network, Teigland and Wasko (2004) found that individuals felt obligated to help others in order to receive help from the network. Wasko and Faraj (2000) found that, for some members of online communities, willingness to help others seems to derive from the belief that it is only fair to help others if they had received help from the community. Wasko and Faraj (2000) further noted that many of the members' comments demonstrated that people do not expect to receive help from the same individual, but from someone else; reciprocity in this context reflects generalized reciprocity.

While reciprocity, in general, has been acknowledged by many scholars to be a motivator for people to share knowledge, it is also important to note that not all scholars hold the same view. For example, from the result of an empirical experiment (350 valid empirical data was collected from three virtual communities) of the study of Lin et al. (2009), there is no direct correlation between knowledge-sharing behavior and reciprocity. Also, Chen and Hung (2010) rejected the assumption of reciprocity as a positive affect to members' knowledge-sharing behavior in virtual communities (323 valid empirical data was collected from two virtual IT-related sites).

H4: Members' reciprocity is positively related to their attitude toward knowledge contribution in Q&A community.

3.2.5 Egoism

The ultimate goal in egoism-related motive is to increase one's own welfare, which is mainly referred to **personal expected returns** in this study. People naturally calculate input-output ratios when they perform a target, which is the ratio of what they have to put in effort to what they can receive afterward (Adams, 1963). When the ratio is perceived to be low, people feel discourage to perform a target. While in contrast, when the ratio is perceived to be high, people are motivated to achieve a target. According to Thorndike's law of effect (1911), a behavior is more likely to be continuously repeated if it is rewarded. In this perspective, rewards can cultivate knowledge-sharing behavior if they are perceived as valuable and are provided consistently. In this study, personal expected returns are described as tangible rewards (e.g., pay, prizes) and intangible rewards (e.g., recognition, praise, esteem enhancement). Previous research showed that one of the reasons why people share their knowledge in an online community is due to personal expected returns. For example, in a study of online communities involving employees of Caterpillar Inc., a Fortune 100 multinational corporation, Ardichvili et al. (2003) found that people felt the need to establish themselves as experts (e.g., through gaining the formal expert status by contributing to the community of practice or through gaining an informal recognition through multiple postings and contributions to the community). Similarly, Wasko and Faraj (2000), when studying three Usenet technical newsgroups (comp. lang C++, comp. objects, and comp. database), reported that some people contribute to the online community in order to receive some form of personal gain or status related to their professional position. However, from the study of Casimir et al. (2012), the positive correlation between expected rewards and a positive attitude toward knowledge sharing is not supported by the results of 483 full-time employees from 23 organizations in Malaysia.

H5: Members' personal expected returns are positively related to their attitude toward knowledge contribution in Q&A community.

3.2.6 Collectivism

Collectivism is a motive that aims to increase the welfare of a group or collective (Batson et al. 2002), which is specifically referred to **identification**, **social network ties**, **shared vision**, and **community-level expected returns** in this study. A sense of identification or belonging to a community is a natural human need for individuals (Hollander & Willis, 1967). Stronger identification with virtual community results in greater in-group favoritism, which can increase the quantity of knowledge sharing (Chiu et al., 2006).

Social network ties refer to the channels for information and resource flows (Tsai & Ghoshal, 1998). In other words, the concept of social network ties posits that knowledge sharing happens when individuals interact with each other such as by posting and responding to online messages in a Q&A community. Based on the social capital theory, social network ties is one of the significant structure motivations for knowledge sharing (Nahapiet & Ghoshal, 1998; Wasko & Faraj, 2005). Individuals who are connected to a large number of other people are more willing to sustain their sharing of knowledge.

Based on the three dimensions (structural, relational, and cognitive) of Nahapiet and Ghoshal's theoretical model, the most key facets of cognitive dimension are shared vision and shared language. This study focuses mainly on the effect of shared vision on individuals' attitude toward knowledge sharing, which can be described as a bonding mechanism that helps different parts of an organization to integrate or to combine resources (Tsai & Ghoshal, 1998).

Community-level expected returns derive from outcome expectations, which is defined as an individual's belief that task accomplishment leads to a possible outcome (Chiu et al., 2006). In contrast to personal expected returns, community-level expected returns describe the feeling that motivates people to share because they want to advance the entire community or profession. Individuals believe that their knowledge could ultimately benefit and improve the group rather than their personal expectation (Wasko & Faraj, 2000). Empirical results from the study of Chiu et al. (2006) has shown that members' community-related outcome expectations are positively associated with the quality and quantity of knowledge shared by them (310 valid empirical data was conducted from one professional virtual community called BlueShop). In other words, individuals' community-level expected returns can create a positive attitude toward knowledge sharing.

H6: Members' identification is positively related to their attitude toward knowledge contribution in Q&A community.
H7: Members' social network ties are positively related to their attitude toward knowledge contribution in Q&A community.
H8: Members' shared vision is positively related to their attitude toward knowledge contribution in Q&A community.
H9: Members' community-level expected returns are positively related to their attitude toward knowledge contribution in Q&A community Fig 1.

4 Methodology

4.1 Data Collection

Data were collected through an online questionnaire in this study. Research Q&A communities were selected from the top 30 sites from Stack Exchange, ranked by registered users as well as the percentage of answered questions. Participants are

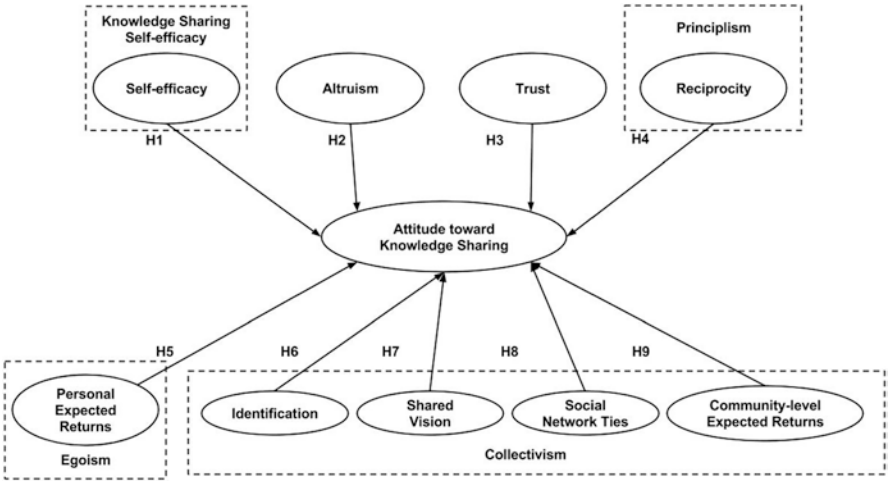

Fig. 1 Research model

chosen from the sites with over 75% answered rate. In total 300 users from Stack Exchange communities were invited via email to fill out a questionnaire on a designated Web site from July 01 to August 23, 2014. In sum, 73 participants answered the questionnaire and 72 responses were complete and valid.

4.2 Measurement Development

All the measurement items used in this study were conducted from prior research, with minor modifications of questionnaire wording to ensure contextual consistency. Specifically, items of **attitude** were adapted from He and Wei (2009) and Yang and Lai (2010). Items of knowledge-sharing **self-efficacy** were developed from Lin et al. (2009) and Chen and Hung (2010). **Altruism** was assessed with items based on Fang and Chiu (2010) and Hung, Lai, and Chang (2011). **Trust** was adapted from Chiu et al. (2006), and Chen and Hung (2010). Items of **reciprocity** were developed from Wasko and Faraj (2000) and Kankanhalli et al. (2005). Items of **personal expected returns** were adapted and developed from Bock and Kim (2002) and Chiu et al. (2006). **Identification** was assessed with items based on Chiu et al. (2006) and Wang and Wei (2011). **Social network ties** were adapted from Chen and Chen (2009). Items of **shared vision** were developed from Chiu et al. (2006). Finally, items of **community-level expected returns** were adapted from Chiu et al. (2006). All items were measured using a 5-point Likert-type scale (ranging from 5 = strongly agree to 1 = strongly disagree). Appendix A lists all survey items used to measure each construct.

5 Results

The reliability of the scales was evaluated using the overall Cronbach's alpha (α), and this alpha value was 0.72, which indicated adequate level of reliability (>0.7), as suggested by Nunnally (1978). Thus, it was confirmed that the variables were reliable. The structure equation modeling (SEM) approach was used to examine the proposed hypothesized model. R-square score of endogenous variable, in this study, referring to the attitude toward knowledge sharing and the structural path significance are examined to assess the explanatory power of the structural model. The R-square value of attitude toward knowledge sharing is 0.643, which indicated that the research model accounted for 64% of the variance of attitude.

The hypotheses test results in Table 2 reveal that the paths of H2 and H5 were positive and significant (H2, path coefficient = 0.613, $p < 0.001$; H5, path coefficient = 0.293, $p < 0.01$), with an excellent model fit (t values >1.96). In other words, members' altruism and personal expected returns are positively related to their attitude toward knowledge contribution in Q&A community. Other hypotheses are rejected by the test results. Specifically, the results of H6 and H7 show that identification and shared vision are negatively correlated to members' attitude toward knowledge contribution in Q&A community, but this correlation is insignificant. Findings of H1, H3, H4, H8, and H9 indicate that self-efficacy, trust, reciprocity, social network ties, and community-level expected returns show no significant influence on members' attitude toward knowledge contribution in Q&A community.

6 Discussion

Against prior hypothesis, the relationship between knowledge-sharing self-efficacy and attitude toward knowledge sharing does not prove previous conjecture. To successfully engage in knowledge sharing, people have to confirm whether they have sufficient knowledge, time, capability to contribute themselves in Q&A community.

Table 2 Results of hypothesis tests

Hypothesis	Effects	Standardized coefficient	*t*-value	*p*-value	Supported
H1	SE->AT	0.009	0.093	0.927	No
H2	AL->AT	0.613	5.034	0.000	Yes
H3	TR->AT	0.093	0.814	0.420	No
H4	RE->AT	0.160	1.396	0.170	No
H5	PER->AT	0.293	2.860	0.007	Yes
H6	ID->AT	−0.114	−1.092	0.281	No
H7	SNT->AT	0.032	0.284	0.778	No
H8	SV->AT	−0.160	−1.486	0.145	No
H9	CLER->AT	0.036	0.282	0.779	No

Therefore, a possible explanation of this result is that learners consider online sharing knowledge as a way to perceive personal outcome expectation; those with low self-efficacy (e.g., lack of confidence) may still have high intentions to strive for the goals (Ho, Ting, Bau, & Wei, 2011).

Supporting the expected hypothesis, altruism has a significant effect on the members' attitude toward knowledge-sharing intention. As extended from TRA literature, the result indicates that participants showing altruistic behaviors are more willing to share knowledge in Q&A community. This finding demonstrates that altruism is an important motive of continuance intentions in online knowledge sharing, even without benefiting from others.

Contrary to prior expectation, reciprocity did not show a significant influence on members' attitude toward knowledge-sharing intension. This result is consistent with the findings of Wasko and Faraj (2005), Lin et al. (2009), and Chen and Hung (2010), indicating that reciprocal expectation may not be an important motivation for knowledge-sharing intension. Reciprocity has proven influential in motivating people's knowledge contribution behavior in an early stage (Wasko & Faraj, 2000). Individuals tend to feel obligated to help others in order to receive help from the network (Teigland & Wasko, 2004). However, this influence may weaken over time. When the member steps as a top contributor into a Q&A community, his/her intrinsic motivations (e.g., enjoyment in helping) begin to stabilize and become the dominant motives. Another possible explanation is the indirect positive impact that reciprocity has on knowledge-sharing intention. A higher sense of reciprocity might be positively correlated to members' personal expected returns.

Surprisingly, trust did not have a significant impact on members' attitude toward knowledge-sharing intension. One possible explanation may be that individuals are willing to share their personal knowledge due to the sense of enjoying helping without necessarily trusting other members in the virtual community. Also, within an online Q&A community, knowledge-sharing relationship among members is less crucial. Members of the online community are used to the sense of interacting to strangers without trusting them in a personal level. However, as argued by Coleman (1990), trust is only needed in the risky relationships. Similar results are also proved by the research of Chiu et al. (2006) and Wang and Wei (2011).

Against expected hypotheses, four of the measured items related to collectivism did not have significant influence on members' attitude toward knowledge-sharing intension. The results of this study suggest that community-level expected returns are irrelevant to an individuals' knowledge-sharing attitude. Differing from personal expected returns, community-level expected returns have no direct influence on knowledge-sharing intension, which indicates individuals value more on their personal expectation (e.g., reputation, credits) rather than the success or development of the Q&A community. This result is consistent with the findings from the research of Ardichvili et al. (2003), indicating that individuals felt the needs to establish personal gain or status related to their professional position in virtual community.

The results of this study show that identification and shared vision are negatively correlated to members' attitude toward knowledge contribution in Q&A commu-

nity. Although the effect is not significant, it is contrary to prior expectation. Identification refers to an individual's sense of belonging and positive feeling toward a virtual community. People with greater sense of identification tend to see themselves as part of the virtual group. However, the lack of the sense of happiness and belonging might have stronger effect on knowledge-sharing intension. Similar dilemma also falls on the effect of shared vision. Whether these two factors motivate knowledge-sharing contribution or hinder, it remains largely unknown. Future research should focus to examine why negative influence of shared vision and identification on attitude toward knowledge-sharing intension exists in this online Q&A community.

7 Conclusion

In the recent years, with the dramatic development of Q&A communities, individuals can now easily log on to Q&A websites to share knowledge and exchange information, which has drawn more attention to this research area. These findings, however, should be viewed with caution due to several limitations. First, the response rate of the questionnaire was only around 25% (72/300) and hence may not be able to represent the thoughts from the majority of participants. Future research should involve a larger data set. Second, this study used knowledge-sharing attitude as a proxy for knowledge sharing. Future research should measure knowledge-sharing behavior directly (e.g., tabulating the actual number of messages contributed).

Appendix

1. I think knowledge sharing is good (**attitude**)
2. I think knowledge sharing is pleasant (**attitude**)
3. I have the expertise, experiences, or insights needed to provide knowledge that is valuable for other members in this virtual community (**knowledge-sharing self-efficacy**)
4. I have confidence in responding or adding comments to messages or articles posted by other members in this virtual community (**knowledge-sharing self-efficacy**)
5. When I have the opportunity, I help members solve their posting questions (**altruism**)
6. I enjoy sharing my knowledge with others through this virtual community (**altruism**)
7. It feels good to help someone else by sharing my knowledge through this virtual community (**altruism**)
8. I know that other members will help me, so it's obligated and fair to help other members in this virtual community (**reciprocity**)
9. When I share my knowledge through this virtual community, I believe that my queries for knowledge will be answered in the future (**reciprocity**)

(continued)

10. Members in this virtual community will not take advantage of others even when a profitable opportunity arises (**trust**)
11. Members in this virtual community are truthful in dealing with one another (**trust**)
12. I believe the knowledge shared by other community members is correct (**trust**)
13. I have belief in the good intent or concern of other community members (**trust**)
14. When I share knowledge in virtual communities, I hope to increase my reputation points in this virtual community (**personal expected return**)
15. When I share knowledge in virtual communities, I hope to increase my badges in this virtual community (**personal expected return**)
16. When I share knowledge in virtual communities, I hope to increase my privilege level in this virtual community (**personal expected return**)
17. I am proud to be a member of this community (**identification**)
18. When someone criticizes this community, it feels like a personal insult (**identification**)
19. I spend a lot of time interacting with some members in this virtual community (**social interaction ties**)
20. I know some members in this virtual community on a personal level (**social interaction ties**)
21. Members in this virtual community share the vision of helping others solve their professional problems (**shared vision**)
22. Members in this virtual community share the same value of helping others (**shared vision**)
23. Sharing my knowledge will be helpful to the successful functioning of this virtual community (**community-related outcome expectation**)
24. I really care about the fate of this virtual community (**community-related outcome expectation**)
25. I feel a great deal of loyalty to the virtual community (**community-related outcome expectation**)

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An Exploratory Study on Learning Attitude in Computer Programming for the Twenty-First Century

Junru Yang, Gary K. W. Wong, and Clive Dawes

Abstract Programming learning is becoming more and more popular among educational institutions, especially in secondary schools. Schools and researchers believe that computational skills are and will be one of essential skills for human beings in the future. Most of researches focus on pedagogical methods and resources of programming learning. However, there is still a gap about learners' attitude toward it. In order to address this gap, we picked up 12 programming workshops in year 7 and 8 and analyzed the process of students' changed ideas about programming throughout workshops. Two hundred thirty students from different countries were involved in these workshops.

In this paper, we discuss about students' attitudes and opinions about programming learning before and after attending workshops. We used questionnaires as the way to collect data and analyze them to explore their attitude changes. We present the process of attitude changes to explore difficulties of programming learning and places need to be improved.

Keywords Computational thinking · Programming learning · Learning attitude · K–12 curriculum

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1 Introduction

In recent two decades, programming learning has been paid increasing attentions by educators and schools. Being regarded as a core part of STEM disciplines, programming learning is becoming one of essential fields for K–12 education.

Programming requires students to use their capacity of computational thinking while constructing projects (Kafai & Burke, 2013). Computational thinking has a long history, evolving from the concept of computer science (Denning, 2009). Nowadays, the definition of computational thinking has been evolved as "a thought process that including formulating problems and solutions to find common rules for solutions of comparable problems in an effective way" (Cuny, Snyder, & Wing, 2010).

Wing (2008) thought that computational thinking will be a fundamental skill for everyone in the middle of the twenty-first century. Computational thinking is an ability to take an appropriate way to solve problems, design systems, and understand human behavior based on computing concepts (Wing, 2006). As a thinking skill, computational thinking can advance students' problem-solving thinking patterns and abilities in a creative way (Yadav, Mayfield, Zhou, Hambrusch, & Korb, 2014).

Computational thinking is able to helping students to think in an abstract way and divide a problem into smaller pieces in various learning contexts, not only for compute learning (programming) but also for other subjects (Wing, 2006). Since programming learning requires students' logical thinking and problem-solving ability, there are close connections between computational thinking and programming learning.

Therefore, programming learning can foster students' capacity of computational thinking. Meanwhile, computational thinking provides skill foundations for effective programming learning. Many researches showed that learning programming offers various benefits for students.

During the process of programming, students are more like builders than users (Barr & Stephenson, 2011). They need to use a series of concepts to create tools and visual artifacts for practical application. Under the contextual background, students need to connect programming with what comes before and after. It requires their logical thinking in a reasonable scope. Unlike other subjects, programming is a spiral-forward process. Students learn programming during the process of bugging and debugging independently. It can enhance ability of designing solutions to problems by using abstraction, creating algorithms, and drawing automations (Barr & Stephenson, 2011).

Programming curricula for K–12 have been carried out in lots of educational institutions. Extra curriculum activities, summer camps, and workshops offer lots of opportunities for students to learn programming.

Not only face-to-face curriculums, online programming learning tutorials also have a diverse development. Some of online platforms are designed as drag and drop programming for relative young learners, such as Scratch and Blocky (Resnick

et al., 2009). Others are text-based programming – finished through programming language. There are rich online resources for text-based programming learning: tutorial-based websites like W3Schools (w3schools.com) and Codecademy (codecademy.com) and lecture-based courses provided by MOOCs (massive open online courses) like edX (edx.org) and Saylor (saylor.org).

The issue of programming learning for K–12 still faces various difficulties. Even though learners have a variety of learning resources in different formats, not many of them learn programming actively. One reason is the design of tutorial and structures. Most programming tutorials emphasize how to practice particular functions and commands. They ignore to offer contextual information to explain why and when to use these functions and commands (Kim & Ko, 2017).

The report Running on Empty: The Failure to Teach K–12 Computer Science in Digital Age (Wilson, Sudol, Stephenson, & Stehlik, 2010) shows that more than two thirds of the USA have few standards of computer science learning in secondary schools. Besides, gender ratio of learners in secondary schools is also an inevitable problem. Low numbers of female learners devote themselves to computing learning.

Except pedagogical reasons, there are students' own reasons causing learning inefficiency. Learners' attitude also has a huge impact on their learning behavior. Understanding learners' attitude toward programming can facilitate the development of appropriate pedagogical methods and environment (Liaw 2008). Various aspects in programming learning measurement can be benefited for the instructional plan.

Attitude is defined as the individual's reaction and attempt to the reality from both inside and outside himself/herself. It is molded by individual's perception, group influence, social values, and self-interest (Philpott, 1991). Ajzen and Fishbein (1975) put forward the theory of reasoned action: behavior intention is based on subjective norms and attitude toward behavior. Thus, students' learning attitude has a major influence on their learning outcomes (Lennartsson, 2008).

The positive attitude is expected to improve learning efficiency. Students are willing to learn programming and do practice under the positive attitude. In another word, they may be more motivated to accept new programming concepts if they're interested in it. On the other hand, less connections between existing knowledges and new knowledges make students cannot find resonance in a new field learning.

Negative attitude can impede students learning efficiency in programming. When students have less confidence toward learning, they will start to be negative, which may have a long-term influence for the future learning. They may be struggling with the unknown field and refuse to learn new concepts proactively.

Students' motivation and engagement are regarded as main driving forces of learning. Students' engagement is related to their own preference and pleasure and to external motivation (OECA, 2003). Students' perspective about their own capacity and learning interests in programming have a significant impact on learning goals and styles they set by themselves, as well as learning outcomes.

It is a logical stage to explore students' attitudes toward programming rather than programming pedagogy individually.

We have many evidences on pedagogical approaches of programming learning, which have indicated practical suggestions on curriculum design and teaching methods (Lye & Koh, 2014). However, few are tailored for exploring learners' subjectivity and attitudes toward programming learning. To address these problems, we took an analytical approach to analyze learners' attitudes in 12 workshops as pilot study to evaluate their thoughts and changes.

There are two research questions:

(i) How did students think about programming before and after having workshops?
(ii) What are changes of students' attitude toward learning programming?

With these questions, we focus on students' learning attitude and its change process. It can help us to have a clear image of learners' attitude, in order to implement programming learning better.

2 Methodology and Research Design

2.1 Participant

The purpose of this research is to explore students' attitude toward programming learning and to discuss the influence of learning programming in person. Based on research questions above, we conducted 12 workshops for Y7 and Y8 students (aged 12–13) in a Hong Kong international school under A-Level system. Students didn't have formal programming language curriculum in school before this workshop. There were 230 students getting involved in this research.

The duration of workshops was 2 days. All schedules were planned. Different workshops had slight differences in timing, but conducting according to schedules in general. The workshop is project-based. Students acquired the knowledge of programming basically by finishing tasks step by step and finishing provided projects.

2.2 Curriculum Design

Each workshop contained 20 students and 1 experienced programming teacher. Each student was equipped with a laptop with Wi-Fi access. Teachers introduced the general picture of HTML, JavaScript, and CSS in the beginning of workshop: the relationships among three codings, general functions, etc. Then they guided students to every planned part. During sessions, teachers gave students space to finish their assignments by themselves instead of explicit instructions. Students can search information online, ask for classmates' help, and seek for teachers' suggestions (see Table 1).

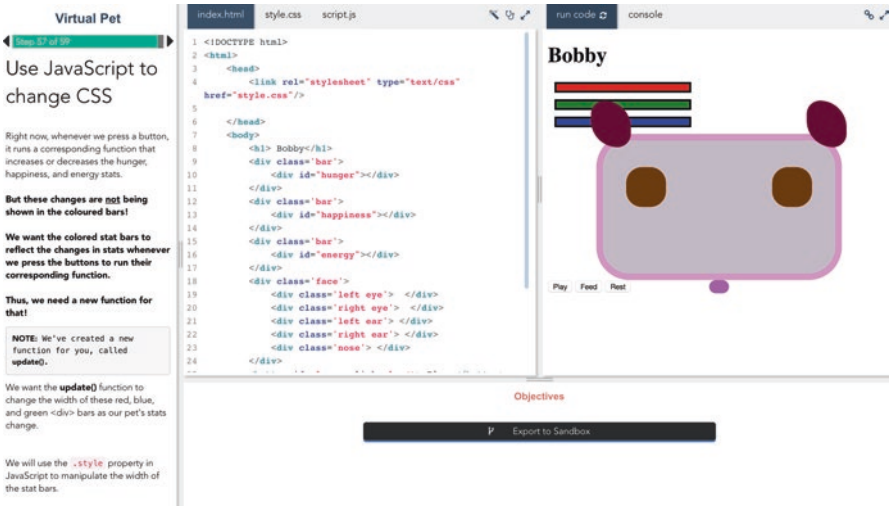
Table 1 Curriculum flow of workshops

Time	Activity	Aimed skill
Session 1: 80 min	1. Intro and welcome (20 min):	1. Social skill: collaboration
	Virtual pet, 10 min; account sign-ups, 10 min	2. Research skill: information literacy
	2. Decomposition (10 min):	
	Name three different types of pet; discuss conditions of keeping a pet (food, litter, play, health, bedding, etc.)	3. Critical thinking
	3. Draw students' own animals and paint by hex color code	
	4. Digital pets (75 min):	
	a: Build the pet by programming: 20 min	
Session 2: 115 min	4. Digital pets (75 min):	1. Research skill: information literacy, media literacy
	a. Build the pet by programming: 55 min	
	b. Shaping the face (abstraction): 20 min	2. Critical thinking
	5. Generalization (155 min):	
	a. Discuss common factors among different pets: 20 min (energy, hunger, happy, etc.)	
	b. Attributes – create three visual bars to represent pets' living status: 30 min	
Session 3: 105 min	b: Attributes – create three visual bars to represent pets' living status: 25 min	1. Social skill: communication
		2. Research skill: information literacy, media literacy
	c: Functions (programming for interaction of variables, algorithm for values): 80 min	3. Critical thinking
	6. Save projects	
Session 4: 105 min	7. Feedback and presentation:	1. Social skill: communication
	a. Reflection, feedback, and improvements: 50 min	2. Self-management: organization, reflection
	b. Presentation: 55 min	3. Critical thinking, creative thinking, transformational thinking

The aims of this workshop were to develop students' social skills while learning in collaboration, to cultivate students' information literacy through learning programming concepts on a digital platform, and to train computational thinking by finishing tasks with critical thinking, creative thinking, and converting thinking (Dorling & Stephens, 2016).

During the 2-day workshop, students were required to finish two projects on a learning platform particularly designed for this workshop. It is a web-based platform.

The platform was designed before workshops. It showed the way of programming by presenting similar examples. Students learnt different concepts by finishing sprints (set a scenario and guide students to explore correct ways of programming). There were four parts on the platform: instructions and examples, program space, visual interface to show performance immediately, and hints area (see Picture 1).



Picture 1 The interface of learning platform

2.3 Instrumentation

This research was conducted through two questionnaires (pre- and post-questionnaires) finished by involved students. After reviewing the status quo of programming learning in K–12, questionnaires were structured with the following objectives: students' attitudes toward programming and students' programming experiences.

As mentioned in the introduction, learning attitude toward programming learning can have an impact on learning behavior and outcomes (Lennartsson, 2008). Hence, these questionnaires included variables of prior programming experience and learning outcomes. These variables were for programming abilities measurement.

For the purpose of this study, the structure of questionnaires was designed to explore students' opinions and learning experience of this workshop.

They were divided into four parts:

1. Students have a favorable attitude toward programming learning – having a positive opinion about workshops, being interested in contents, and tending to retain knowledge learnt from workshops.
2. Students know programming learning's practical values – training their patience and circumspection, promoting peer cooperation and team spirit, and forming abilities of digesting and application.

3. Students understand that programming learning is a link to teach them correct thinking patterns – computational thinking (problem-solving abilities, abstract thinking, and logical thinking), creativity thinking, and thinking independently.
4. Students are instrumentally motivated toward programming learning from this experience – continuing to learn proactively and understanding that it is beneficial for future learning.

3 Data Analysis and Results

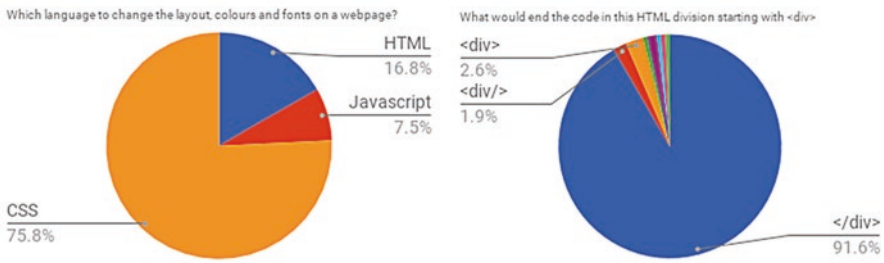
3.1 Learning Outcomes

Learning attitudes has a critical impact on learning outcomes (Lennartsson, 2008). If students have a positive attitude, they will learn new knowledge proactively and independently. It will definitely be beneficial to results of learning. Otherwise, students will feel negatively and refuse to make efforts on learning.

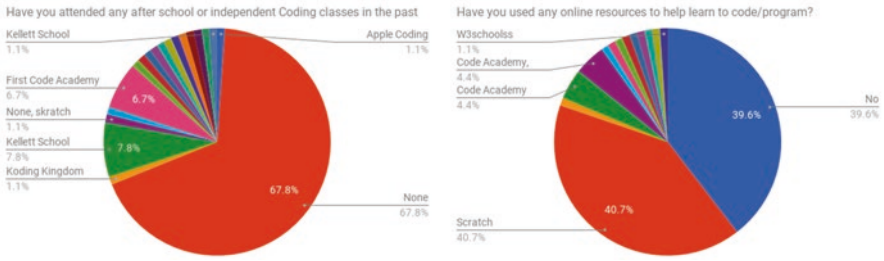
To assess whether students have acquired the knowledge they learnt during workshops, there were two particular questions for the content in the post-questionnaire. As students learnt basic HTML, JavaScript, and CSS under a project, questions are set for examining relationships and most common problems they had (see Picture 2).

We can see that 75.8% of students chose the right options from three different programming languages they learnt. It means that they have acquired basic functions of each programming language. In addition to the assessment of relationships, 91.6% of students are correct to the most common mistakes that they had during the workshop.

From the statistics, it indicates that more than 70% of students did learn programming knowledge from this learning experience and can apply to other questions.



Picture 2 Statistics of students' questionnaire results



Picture 3 Statistics of students' prior programming experience

3.2 Student Evaluations

As Arnold (2009) pointed out, students' evaluations are one of the most common methods to measure teaching quality and learning experience. Open-ended questions allow a greater space of freedom for students to express their own opinions and have a less influence by the questionnaires because they don't have to fit answers in standard categories (Foddy, 1994). Therefore, comments from students can get more useful information about educational issues and a better point of views to improve them. There were three open-ended questions about evaluations in two questionnaires:

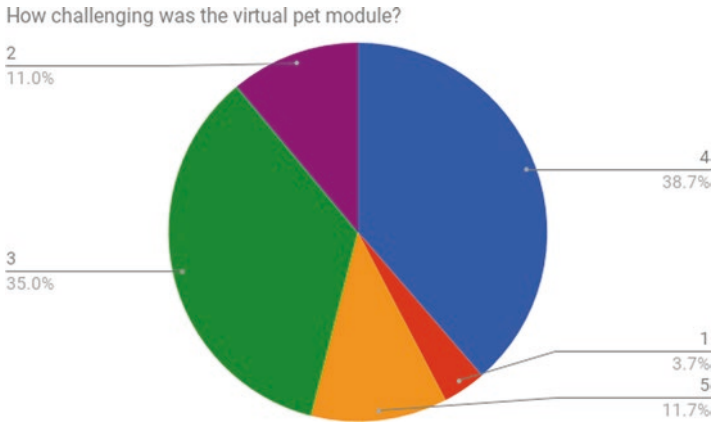
1. Please give any further details which will help us to design a course for you that meets your needs (pre-questionnaire).
2. What do you think of your experience in this workshop (post-questionnaire)?
3. List three things you learnt in this workshop (post-questionnaire).

From these four questions, we found that there were some changes from answers comparing two different questionnaires (pre and post).

From collected results, 67.8% of students didn't attend any programming classes or schools in the past. 39.6% of students didn't use any online resources to learn program (see Picture 3). Because of their prior programming experience, 54.8% of students showed that they felt unconfident before this learning experience. In the group of unconfident students, they expressed this opinion as they had a lack of programming experience. Someone said that "I've never done this before" and "I need a course for lack of confidence." Positively, 32.2% of students showed their interests in programming. They thought that it would be "interesting" and "fun."

In the post-questionnaire, students expressed their individual evaluations about this workshop. 21.7% of students thought that this learning experience was fun and they really enjoyed it. The most comments mentioned "challenging," "fun," and "interesting." Most of students (84.7%) rated this experience as moderated difficult level (see Picture 4).

Meanwhile, the same ratio of students had a sense of accomplishment while finishing their visual pets via this workshop: "I saw my actions were coming to life



Picture 4 Statistics of students' challenge rating

on the screen," "it makes me feel a sense of success," and "I could learn a new life skill."

Apart from above students, 26% of them held positive evaluations for programming learning. 4.3% of students mentioned about collaboration during sessions. They thought that collaboration not only means help seeking but also help offering. 15.2% of students gave the programming platform and instructions a favorable rating. They thought that provided learning instructions were assessable at "explaining things clearly even when you knew nothing previously." 6.5% of students realized that programming would be useful in their life and future learning as it can be used "everywhere on the internet." Thirteen percent of students believed that programming is connected to other aspects, like algorithm, logic, and sequences.

In addition, the rest of the students (11.5%) had negative evaluations. Most of them had this kind of evaluations because it's "hard," "difficult," and "stressful."

From analysis of open-ended questions, we can know that most of students (88.5%) felt positive of learning experience. A small proportion (11.5%) thought that programming was too difficult to enjoy it. Comparing to proportion (54.8%) from pre-questionnaire, most of students have changed their opinions about programming from "being unconfident" to "being enjoyable."

3.3 Student Suggestions

The last question in post-questionnaire is for suggestions from students. From this question, students were allowed to express their own opinions about learning environment, including platform, teaching strategies, and involved teachers. To answer this question, students had reflections by themselves showing their potential intentions of future programming learning when we analyzed suggestions.

There were three major categories of suggestions. The first part (36.2%), which is also the most common suggestions, is about instructions. Students said that more "organized," "clear," and "specific" instructions would be better. The second suggestion is about how to make programming more entertaining. Twenty-seven percent of students wanted to make results more "vivid" and add more interactions will be "attractive" for "future usage." The last category is for platform bugs and interface. Students (16%) expressed their intentions to use the platform after this workshop if bugs can be fixed. Only a few of negative suggestions showed that this workshop was beyond their capacity.

Most part of students offered positive suggestions to improve programming curriculum design. According to these suggestions, "entertaining," "more applicable," and "clear instructions," students expressed that they wanted to use or learn programming afterward if problems can be solved.

4 Discussion and Conclusion

As a pilot study, we found some illuminations from this experience.

Results of this research indicate several discoveries in programming learning:

1. A large part of learners don't have experience of programming out of school. Even though there are rich online learning resources, students won't learn programming proactively.
2. Learners have misunderstandings about programming. They hold a negative opinion – difficult and complicated – because of a lack of experience.
3. Learning programming in person can bring a positive change to learners' attitudes in a certain extent.

Despite the experiment was conducted in Hong Kong, participants come from different countries. They expressed individual opinions at a detailed and comprehensive level. There are lots of existing efforts about programming learning in K–12. However, studies from psychological perspective are still a few in number. This experiment is an attempt to explore students' learning attitude changes in programming learning. It focused on the process of attitude changes after students had programming curriculum in person.

Even though most of students didn't have prior programming experience, we can see that students have acquired programming knowledge in a satisfied level. A major part of comments have changed more positively and showed intentions for future programming learning.

Since it's a pilot study, there are still limitations in our study. Although participants were from different countries, it is not representative of all students' attitudes around the world completely. There are various learning systems other than A-Level. Different systems may have different impacts on programming learning. It is still an issue for us to explore.

Another limitation is our analysis. The emphasis of our study is students' learning attitude rather than pedagogical methods and learning resources. The use of effective strategies with learning resource may be more common among students who have better assessments (Covington & Omelich, 1984). Teaching strategies and learning resources are two key points to influence students' attitudes. Because of research questions, we regarded them as secondary influence factors. Students' prior learning experience was considered as a major factor to influence their attitudes.

Our results show that programming learning experience has a positive influence for students' learning attitudes in this experiment. They can be involved in programming and discover the enjoyment and functions of programming by learning in person. Further researches need to improve limitations and experiment under different learning environment for students in different K–12 grades.

Based on our research, we recommend that schools can try out programming curriculum from fundamental levels and make them attractive in different ways. With further research in the future, students' learning attitude about programming learning will be comprehended. It will be definitely beneficial for future implementations of programming learning in K–12.

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A Framework for Analysis Learning Pattern Toward Online Forum in Programming Course

Qingchun Hu and Yong Huang

Abstract With the online learning platform used widely, learners' behavior in online system should be an important element to assess the achievement and reflect the learning process. This paper proposes an approach to analyze the students' behavior in Moodle's online forum by a two-dimensional framework. One dimension is toward the interaction activities among peers' posts in online forum. Another dimension is described by word clouds related to learning contents of the posts. The students' learning behavior patterns are analyzed and described. It found that there is high correlation between the participating in online forum and achievement. The framework is helpful to design the architecture of automatically recommended system and adaptive learning system in the future.

Keywords Online learning · Learning analytics · Learning pattern

1 Introduction

Currently, online learning system is widely used in high education (Losh, 2017; Vu, Fredrickson, & Moore, 2016). In most online platform, online forum is used for students to communicate with each other. But not all online forums could definitely enhance student learning (Wise, Cui, Jin, & Vytasek, 2017). We wonder to know whether there are any patterns about students' learning process in online forum activities and whether students' forum activities are highly related to their performance in learning.

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The context is C programming course in this study. It is a compulsory course in most subjects in our university. Every year, there are more than 1500 students enrolled in this course. Before online education age, our lecturers struggled with students' questions in the whole semester. Since 7 years ago, the Moodle has been used as a course platform to support teachers' teaching and students' learning.

On the one hand, this platform provides very flexible online learning environment for students and teachers, such as uploading, downloading, and communicating at anytime and anywhere. On the other hand, it is very facile to record and save students' learning information in the database. Obviously, massive online learning information contains implicit behavior characteristics of learners. We hope to find students' learning activities and have an insight into online learning process. But currently, the functions within most online systems to analyze students' behavior are mostly from the log activities rather than contents in online forum (Stich & Reeves, 2017).

Therefore, the paper proposes a framework to analyze the students' activities in online forum, which helps us to better understand the online learning process. Toward online learning process, different interactive patterns and their learning consequences are discussed. The results should be considered when assessing students' achievements.

The data set is collected from C programming course in which 141 undergraduate students were enrolled in one semester. We examine students' interactions in online forum and the relationship with students' performance. The different interaction patterns of students' behavior are analyzed. According to this framework, we analyze the students' learning activities from the two dimensions.

One dimension is viewed from the interactive pattern among posts in online forum, which describe the interaction among the peers and posts. In the interaction, the main focus is on whether and how students post feedbacks in the forum.

Second dimension is about the learning content within posts. Word clouds are used to observe the main concepts what students are with high attentions. In our next study, the word clouds of one semester in online forum could be feedbacks to remind students what are the main or hot discussion points to pay attention in learning contents. The behavior patterns are found and matched with different levels of achievement.

The following is unfolded from the lines. Firstly, it is to review related work. Then, it discusses learning analysis in online learning. After that, a framework is proposed. And then, the data is collected and analyzed. Finally, it is the conclusion and the future plan.

2 Related Works

2.1 Moodle in C Programming Course

In C programming course, one of the main problems students come across focuses on coding during their assignments. But, the interaction in the classroom between teachers and students is not enough. So, it is necessary to explore feasible models to facilitate such interaction and improve learning.

Currently, the traditional classroom is extending. The teachers and students can communicate and interact with each other by means of online environment. Following the online learning trend, online course has come into being suitable for auxiliary support classroom teaching.

This research practice is carried out in C programming courses, which is a compulsory course for science and engineering undergraduate students in our university. The notable feature is the number of students more over 100 in a class. Therefore, an effective teaching method is urgently needed to promote the effect of teaching and learning. In this case, Moodle's anytime, anywhere, convenient content updates, flexible teacher-student interaction, and the timely answer and feedback mechanism are very suitable for the requirements of programming courses.

The Moodle platform and the combination of classroom teaching have been used in our university 7 years ago. There are many functions in Moodle platform (da Silveira Espindola & Silveira, 2017; Meza-Fernández & Sepúlveda-Sariego, 2017). The students can easily use the online learning platform, such as discussion, question, and answer in anytime. These online behaviors also reflect students' learning process in their knowledge acquisition. It is necessary to integrate learning behavior into learning evaluation. Mining students' activities in online environment are necessary. It is related to the field of learning analytics.

2.2 Learning Analytics

In online learning system, the vast amounts of learning behavior data could be saved automatically and easily. The mining of students' learning in online forum is related to the fields of learning analysis. Learning analytics is a practice of data mining in education. It is derived from the background of big data (Bienkowski, Feng, & Means, 2012). In the International Conference on Learning Analytics and Knowledge, the term of learning analytics was described as the measurement, collection, analysis, and report on the learners and the learning scenario data set, to understand and optimize the learning and scenario (Siemens, 2011). The analysis of learning needs further explanation analysis of students' learning process within the massive data, to evaluate students' academic progress, predict theirs future performance, and find out the factors affecting learning. Its purpose is not only to assess the students but also to find out potential problems and eventually optimize learning, that is, by collecting and analyzing the related data of a large number of learners within a period of time, exploring learning process and the change, and correlating between learners' current learning behavior and learning result in the future. And another aim is to use the established correlation, according to the current learning behavior, to predict their future learning trends and results. This kind of analysis and prediction is not only meaningful for educators, teachers, but also for students.

Toward the students' data in online forum, the main characteristics are scale and diversity. These data imply characteristics of learners in real time. The purpose and method of learning analysis are closely integrated with learning evaluation. Without

the purpose of learning evaluation, the analysis of learning will be too macroscopic and abstract. This study is carried out around the learning analysis for learning and learning evaluation.

2.3 Learning Analytics for Learning Evaluation

The main difference between blended teaching model and traditional classroom teaching is that learning evaluation methods should be different. Because of the emergence and intervention of online learning environment, the method of evaluation for students needs to be rethought and improved.

This research is consistent with the current international attention in this field (Berland, Baker, & Blikstein, 2014; Blikstein et al., 2014). In *Future Ready Learning: Reimagining the Role of Technology in Education* (Thomas, 2016), from five aspects of learning, teaching, leadership, evaluation, infrastructure, and other aspects are described. Among them, one of the emphases is to put on the use of educational data to make education evaluation more comprehensive and diversified. In the evaluation aspect, the future teaching evaluation should have the following characteristics: adaptive to learner's knowledge and ability, embedded learning process, real-time feedback, and so on. At the same time, a comprehensive evaluation system to summative evaluation and formative evaluation combined to evaluate students to master and apply knowledge, and with the help of evaluation data targeted to adjust the teaching activities, so as to enhance the teaching effect.

In current online learning platforms, most learning evaluations are mostly based on the traditional evaluation methods, such as mainly using the test scores, by statistical information of courses' web link clicked, and so on. There are also other ways, including using the log file analysis, link network analysis, content analysis by visualization and assessment tools, learners analysis to identify the difficulties of learners, and some of the intervention (Fidalgo-Blanco, Sein-Echaluce, García-Peñalvo, & Conde, 2015; Serrano-Laguna, Torrente, Moreno-Ger, & Fernández-Manjón, 2012). To a certain extent, these methods can reflect students' mastery of knowledge. These studies have made great attention to individual factors in learning evaluation with single data sources, but few studies integrating multiple factors. The data online forum comes from many kinds of learning activities, and it needs to be classified, extracted, and analyzed. This paper focuses on the online forum activities from three aspects: the time consequence, the contents, and the relationship with the final performance in learning.

3 Two-Dimensional Framework

A framework based on student behavior analysis is constructed. Data collection, storage, and analysis are carried out under the framework. In the context, C programming course, as mentioned above, one of main difficulties students come

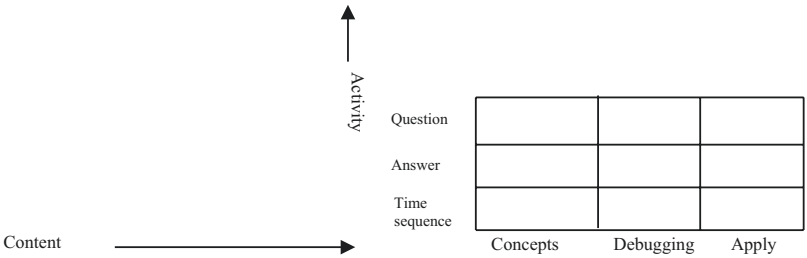

Fig. 1 The framework for analyzing the online forum

across is debugging. But what kinds of concepts lead to the debugging difficulties are not clear. We divide learning contents into two categories: concepts and debug. The former means posting concepts to understand. The second is about posting coding debug and asking for help. These two kinds of posts are related to the lectures.

There are huge data in online forum, such as log file, contents in online forum with data variety. And there are also correlations between different log files. During data analysis, it is easy to lose the correlation information, influencing on user learning behavior judgment. In this paper, we unfolded the analysis from the following aspects:

- The time span toward a post in the forum: because of the large amount of data, the user preference is easy to change, which requires the analysis of user behavior should be completed in the shortest possible time.
- The posts reply activities among peers.
- The contents classified: related to the lecture and not, this will be described in word clouds.

Based on these aspects, data sources in this study include learning logs, learning paths, learning outcomes data, courses' web linking data, and academic achievement data. Through the acquisition, storage, and analysis of these data, a framework for analyzing the online forum is constructed (Fig. 1). The main components of the framework are the activity model and the content model. In content aspect, it is classified in three kinds: concept knowledge, debugging knowledge, and apply knowledge. In activity aspect, students engage in online forum by question, answer, and time sequence. When insight of the time sequence, the time for response of the post and for how long the post are concerned.

4 Method and Data Analysis

In one semester, 141 students were enrolled in C programming course. There were 229 topics by posting. And among them, 173 posts got reply. The number of reply is 360 items. According the framework (Fig. 1), in the dimension of activity, the interaction among the posts and the time sequence within the posts are analyzed. Another dimension is described by the word clouds within reply comments.

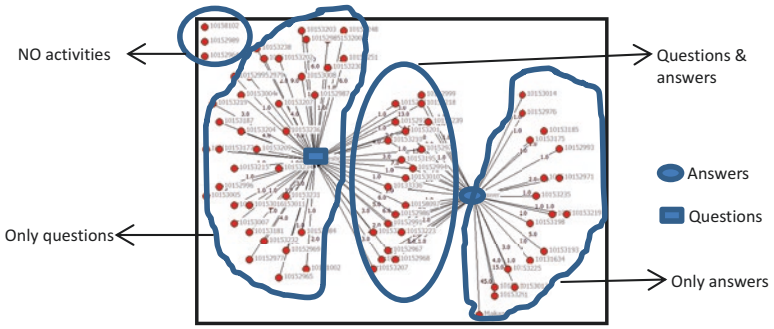

Fig. 2 QA pattern of learners' participation

4.1 The Interaction Among Peers

Learning participation or engaging in online forum is an important activity to reflect the students learning process and knowledge acquired.

In this study, we analyze the participation in the forum by the interaction among the student peers. The posts are classified into two kinds: one is post questions, and another is to answer questions. There are QA behavior patterns found. The visual analysis of the data is shown in Fig. 2.

In Fig. 2, each small dot (red) represents a student. That is, the tag with a number means one student. The small rectangle and the ellipse (blue) are nodes to represent questions and answers, respectively. From this visual analysis (Fig. 2), it shows very obviously that some students are only to answer questions. It is A-group. They are all the right dots in Fig. 2. Some students are only interested in asking questions as shown in left dots. It is Q-group. The middle dots group is not only answering questions but also raising questions. It is QA-group. On the left corner, there are three lonely dots. It was named as N-group. They don't take any activities, neither posting problem nor answering question. Through the QA pattern, it can be found that there are four kinds of groups in the figure: Q-group, A-group, QA-group, and N-group.

The QA pattern is shown by visualization. The pattern helps to acknowledge students' learning process. At the same time, teachers and managers also need further attention and appropriate intervention to the learning process.

4.2 The Time Sequence Within the Posts

Next, we look inside every post according to the time sequence. One is about the first reply time toward every post got (Fig. 3). Another is the time span on each post getting replies in one semester (Fig. 4). These will help lecturers and students to find what contents with the difficulties to reply and what are hot discussions. There are

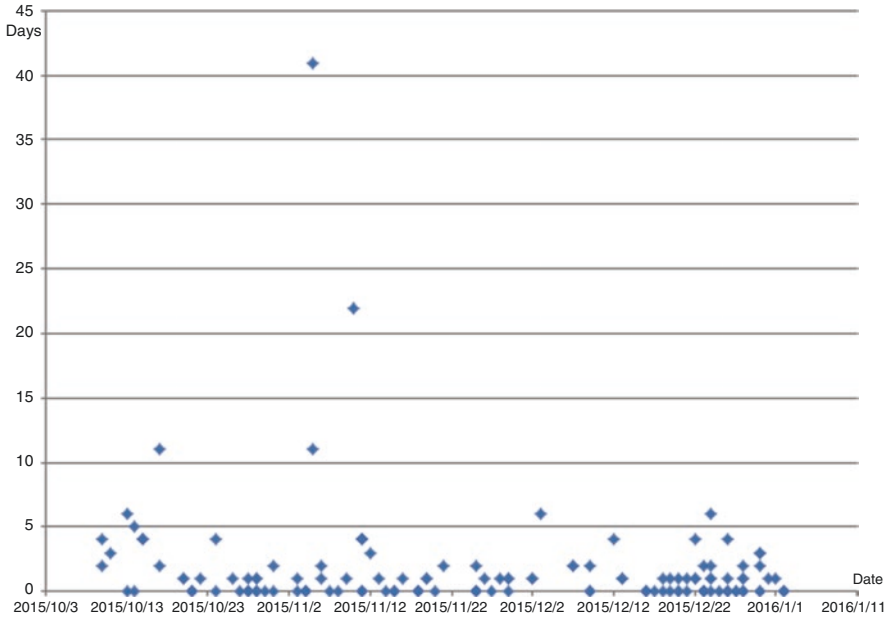

Fig. 3 The first respond time for every post

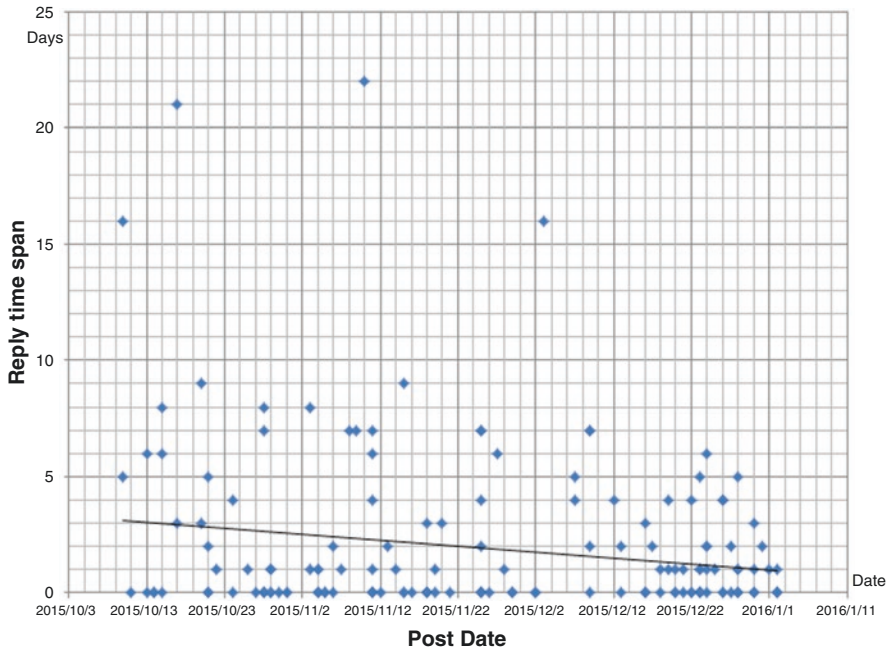

Fig. 4 The reply time span for every post

Table 1 The time sequence within the posts

	Posts			
	Active posts	Inert posts		
Time	In 2 days	In 5 days	In 10 days	Over 10 days
The first reply	145	21	3	4
The reply time span	130	21	18	4

173 posts which got reply. Among these replies, Fig. 3 shows the time how long each post got its first reply. We can see most posts are replied in 5 days. If this post could not get reply in 5 days, then it perhaps will not get reply finally. Therefore, the teacher should intervene the learning process.

Figure 4 shows the reply time span for every post, for example, if a post got the attention from the first post and the final reply. During this period, we call this as the reply time span for every post. It found that the time sequence pattern is clustered. Obviously, the time sequence is classified into four periods: in 2 days, in 5 days, in 10 days, and over 10 days (Table 1).

So, all the posts can be classified into two kinds. One is active reply. Another is inert reply. Based on the time sequence on the posts, next we analyze the active replies with the word clouds aim to look which kind of contents students do not grasp very well.

4.3 The Word Clouds

The active replies mean these questions and answers are more discussed by students. So, it is worthy to look inside what contents students talk about. The word clouds are shown in Fig. 5. The hot discussion contents could be found, including programming structures, loop structures, the functions, and the debugging skills. We analyze this word clouds with the framework (see Fig. 1). In the word clouds, teachers can find what they should pay more attention in teaching. And this is a good way to show to students what they need to focus on during their learning.

4.4 The Participating and Achievements

In the practice, the final performance of a total of 141 students are collected and showed in Table 2. It shows the statistics and the results of the test between the experimental class and parallel class. The average score of the experimental class is significantly higher than that of the parallel common class.

It also found that, QA pattern and active reply help improve students' project cooperation ability. The effect is the number of national college computer contest winners is more than common class, received a total of 13 by national awards and 20 by Shanghai municipal awards.

Fig. 5 The words cloud within posts

Table 2 The data of students' performance

	The experiment class	The common class
	Class A	Class B
The average score of final testing	75.5	69.2
The numbers of students taking part in the competition in information literacy	13 students	Null

5 Future Works

This paper proposes a framework to analyze online forum. We extract one semester data from C programming course. Based on the framework, it is an effective method to have an insight into students' online learning process. In traditional classroom, the lecturers could observe the students' learning process and take some teaching strategies to intervene the learning process. However, it is difficult for teachers to understand how students learn process in online forum. Especially, there are huge data need to be browsed. And if we analyze the data manually, it is also a difficult work. The insight into students' behavior is necessary in online forum. The framework is helpful to design the architecture of automatically recommend system and adaptive learning system in the future.

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Twitter As a Music Education Tool to Enhance the Learning Process: Conversation Analysis

Michele Della Ventura

Abstract In the age of Web 2.0, the social media (SM) represents an important part of the communication in sharing information and, therefore, knowledge. The term SM is often used without clear outlines, and teachers and students do not understand the importance that they could have in a learning process. Teachers and learners can change the method to communicate: when communication is efficient, both the student and the teacher take advantages. This research presents a case study that analyzes the effect on teaching and on learning brought by the use of Twitter to support the classroom lessons of Music Technologies. Students were involved in team work, based on the Problem-Based Learning principle. The focus of the research was the analysis of the conversation among students and teachers to identify problems in the learning process and enhance the student's skills. Results showed that students with dyslexia compensated for their processing deficits by relying on learning strategies and help seeking.

Keywords Conversation · Dyslexia · Learning process · Motivation · Twitter

1 Introduction

Nowadays, Information and Communication Technologies supply teachers with a large variety of tools to enhance the learning process. These tools permit to communicate with people to share information and knowledge through a formal or an informal language: Information and Communication Technologies include communication, expression, and socializing tools (Ferrari, Carlomagno, Di Tore, Di Tore, & Rivoltella, 2013).

Unfortunately, many teachers are cautious about changing in the didactic (Bell, 2001). They are nervous when it is necessary to use the ICT in the classroom lessons; they lack the confidence to take the risk of using technology in their subject areas;

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they are afraid that computers could interfere with the traditional learning based on the book; they are nervous in the use of an unfriendly language, related to the ICT.

It is not the simple introduction of technologies into the classroom that can create innovation in didactics: cultural change is needed in order to go beyond the concept of the classroom being the context within which knowledge is passed on, to the learning environment intentionally designed by the teacher, in which students use different technologies in an integrated manner, taking advantage of their potentialities and allowing the students to become protagonists in the knowledge-building process (Rivoltella, 2015).

The Web technologies provide teachers with a large variety of tools to improve the learning process, tools through which students can learn independently, in their own way and in their own (formal or informal) language (Hatcher, Snowling, & Griffiths, 2002; Reigeluth & Curtis, 1947). The Web technologies offer the opportunity to converse with many people, asking information, answering questions, supplying help in solving a problem, and so on. It is possible to write a message, to record an audio message, and to read or listen many times to a message. These are important factors for all students but particularly for the dyslexic students: the Web technologies represent a support for them reducing the difficulties in the learning process (Gagné & Driscoll, 1988; Spitzer, 1993, 1995).

This paper describes a case study referred to as pilot project in Music Technologies based on Problem-Based Learning (PBL). The main aim of this project was to assist students to construct knowledge and develop skills in problem-solving and decision-making using Twitter. Results showed that Twitter increased student's motivation and permitted to improve educational achievement through work groups and the control of the conversation (communication) among students and teachers.

This paper is organized as follows.

Section 2 describes the social network. Section 3 explains the concept of conversation on Twitter. Section 4 shows an experimental test that illustrates the effectiveness of the proposed method. Finally, conclusions are drawn in Sect. 5.

2 Twitter: The Social Network for Learning

The social networks may be considered a tool "for and of didactics," and the common feature of these environments is content sharing (Boyd & Ellison, 2007; Boyd, Golder, & Lotan, 2010; Ellison, 2013).

Twitter is considered a social network characterized by an environment within which participants may share "what they are doing," by means of short messages (Tweets) (Zhang, 2009): a message may have a maximum length of 140 characters, and it may include an image as well; the distribution of the message depends on the interest among the followers (O'Reilly & Milstein, 2009; Small, 2011).

In a learning process, Twitter is a platform that permits (Java, Song, Finin, & Tseng, 2007):

- Information sharing, which provides opportunity for interactions among people (students/teachers) and the possibility to improve the learning process
- Information seeking, by means of the use of s tag (hashtag)
- Informal communication among students
- Experience sharing, which helps student to recognize a problem analyzed in the past; friendship-wide relationships (Ebner, Lienhardt, Rohs, & Meyer, 2010)
- Communication (conversation) any time (creating the potential for learning beyond the classroom), in a synchronous or asynchronous way, using a mobile device or a computer

The teacher may design a learning process based on problem-solving (Problem-Based Learning) (Della Ventura, 2014), inserting as discussion topic a query relevant to a certain set of problems to solve and taking advantage of the community to solve them.

On the base of the above considerations, it is possible to identify the potentialities of Twitter regarding the student's motivation and the characteristics that may respond to the needs of a dyslexic student: characteristics that may help him/her to integrate spontaneously into the group work, rather than isolate himself/herself (Rivoltella, 2004). The dyslexic student has intuition, the capacity to synthesize, and the problem-solving capacity. The conciseness of the messages helps the students who have a hard time reading, and it does not tire them when learning the content; the insertion of tags helps them in the text analysis; the possibility to write short messages helps them to develop the capacity to formulate a question or an answer (moreover, the automatic spell checker, already present in all devices, allows them to avoid possible spelling errors); the possibility to intervene when they want helps the students to organize and manage their time.

3 Conversation on Twitter

In these new learning environments, where students learn through Twitter, the teacher must focus the attention on the conversation among students. A learning conversation is different from a "normal conversation" because there is a specific focus for thinking and talking (Huth, 2011).

The conversations have to promote learning for all students (non-dyslexic and dyslexic students) involved in a project, by means of:

- A problem-based methodology where "problem" required a solution
- A conversation for investigating theory and practice in a collaborative work among students
- A conversation that is collaborative and challenging

When communication is effective, both the student and the teacher benefit (Ghislandi, Cumer, & Raffaghelli, 2012). Communication makes learning easier, helps students achieve goals, increases opportunities for expanded learning, strengthens the connection between student and teacher, and creates a positive expe-

rience. If the teacher shows interest in an opinion of the student, that student will feel that their ideas are appreciated. This increases self-esteem and confidence (Della Ventura, 2015). The teacher can evaluate the effectiveness of a lecture by student feedback: by asking questions, the teacher can determine if the student needs help to support the personal study (Della Ventura, 2016). If there is a lack of responses from the class, it is likely that the students were unable to understand the lecture. This can lead to poor performance (Venable & Milligan, 2012).

One of the aims of the teacher is to analyze the communications among the participants, using a set of quality indicators (see Table 1).

4 Application and Analysis/Research Method

The research presented in this article refers to a pilot project that analyzes the effects on learning and on teaching brought by the implementation of the social network in the classroom lesson. The discipline forming the object of the project is Music Technology. The research was conducted for a time period of 7 months (from November 2016 to May 2017), and it engaged the third grade of the Music High School, with a total of 29 students (16 girls and 13 boys) of which 3 are affected by dyslexia.

The Music Technology discipline was taught once a week in a 2-h class. For the first 2 months of work, the students participated in the lessons in the classroom listening to the teacher's explanations and taking notes in addition to the teacher's lecture notes. During this period the students were introduced to the knowledge of microphones and stereo recording techniques. During the classes explanations were also given on how to assemble and disassemble the recording equipment.

Simultaneously (starting with the first week of work), Twitter was used with simple questions related to the topics explained in class, to analyze the presence of potential doubts and then try to exceed them by group work. This way we tried to make the students more familiar with the SN.

At the end of the period, a practical/theoretical simulation, identical for non-dyslexic and dyslexic students, was carried out. The dyslexic students were allowed to use the compensatory tools and the dispensatory measures, specified in the PDPs (Personalized Didactic Plans). Each of the three students used what was specified in the corresponding PDP.

The result supplied important (and at the same time expected) indications so as to be able to continue with the project. In particular, the following data emerged (Fig. 1 – color black):

1. Thirty-eight percent of the students (11 students – none of the dyslexic students) knew how to assemble the cables for the recording equipment (without being guided by the teacher), motivating their choices and making connections between different concepts (Fig. 1 – *column 1*).

Table 1 Quality indicators to evaluate the conversation

Indicators referred to the internal process	Construction of simple sentences for the message
	Use of the technical terms in simple sentences
	Use of target language
	Creation of an inclusive experience for the students
	The messages are used in meaningful ways to engage and support learning
	Willing participation in tasks and activities
	Student ability to assess own progress and to reflect on learning
	Students are aware of his/her role in the work group
	Provides accessible information for intended target audience
Indicators referred to the learning and growth process	Number of messages
	Choosing the adequate strategy to solve the problem
	Number of messages from dyslexic students
	Number of strategies to compensate gaps of the technical language
	Student develops skills in using a variety of technical terms
	Absence of correction in answering a message
	Correction without explanation in answering a message
	Correction with explanation in answering a message
	Correction and proposal for reflection and help
	Number of proposals of a new theme on a theme already presented
	Number of student-led discussions
	Conclusions are connected with other knowledge and experience
	Use and exploration of contributors' terms, concepts, and meanings
	Discussion of explicit and implicit explanations
	Clear conceptual links between messages and presentations of original data
	Discussion of strengths and weaknesses of data sources and methods
Indicators referred to the user's perspective	Increase of the awareness of the group work
	Awareness of the teacher's short-term planning
	Awareness of the teacher's long-term planning
	Awareness of learning processes and teaching methodologies
	Apprehension about communicating in the target language
	Reflections on the impact of the researcher on the research process

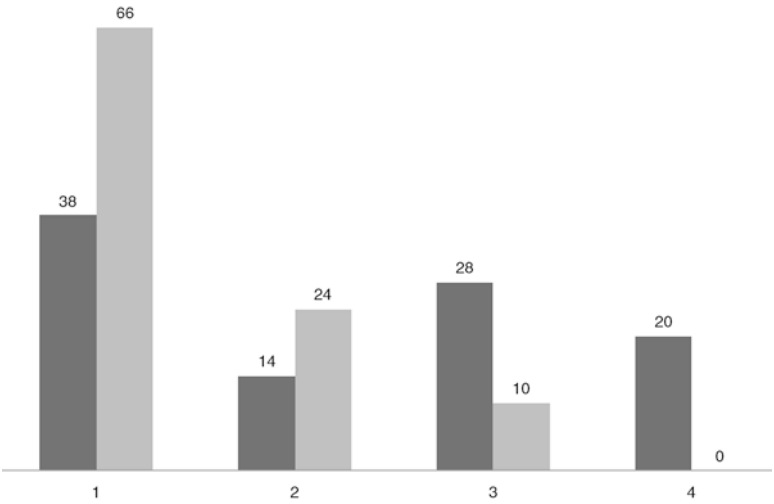

Fig. 1 Results of the first (black color) and second examination (gray color)

2. Fourteen percent of the students (four students of which one dyslexic student) knew how to assemble the cables for the recording equipment (without being guided by the teacher), motivating their choices and partially making connections between different concepts (Fig. 1 – *column 2*).
3. Twenty-eight percent of the students (eight students of which one dyslexic student) knew how to assemble the cables for the recording equipment (without being guided by the teacher), motivating their choices and partially and approximately making connections between different concepts (Fig. 1 – *column 3*).
4. Twenty percent of the students (six students of which one dyslexic student) knew how to assemble the cables for the recording equipment (without being guided by the teacher), without motivating their choices or making connections between different concepts (Fig. 1 – *column 4*).

In the following months, during the in-class lessons, the students were introduced to the "case study," to search for solutions to problems proposed and related to specific situations of audio recording. Simultaneously, a didactic path was initiated on Twitter, where the teacher proposed a set of problems different than the ones analyzed in class and the students were asked to find a solution, motivating and documenting (even by indicating links to external websites) their own choices and commenting on the messages of other colleagues.

At the end of the period, another practical/theoretical simulation, identical for non-dyslexic and dyslexic students, was carried out. The dyslexic students were allowed to use the compensatory tools and the dispensatory measures, specified in the PDPs (Personalized Didactic Plans). Only one dyslexic student used what was specified in his own PDP.

The results met the expectations (Fig. 1 – *gray color*):

1. Sixty-six percent of the students (19 students – none of the dyslexic students) knew how to assemble the cables for the recording equipment (without being guided by the teacher), motivating their choices and making connections between different concepts (Fig. 1 – *column 1*).
2. Twenty-four percent of the students (seven students of which one dyslexic student) knew how to assemble the cables for recording (without being guided by the teacher), motivating their choices and partially making connections between different concepts (Fig. 1 – *column 2*).
3. Ten percent of the students (three students of which one dyslexic student) knew how to assemble the cables for the recording equipment (senza essere guidati dall'insegnante), motivando le scelte e facendo collegamenti tra concetti diversi in modo parziale e approssimativo (Fig. 1 – *column 3*).

Beyond the numerical results that may be read in the diagrams, one of the important points that emerged is related to the fact that all the students motivated the choices they had made for the recording, even though in some cases only partially (Fig. 1 – column 2) and to a minimum extent only approximately (Fig. 1 – column 3). There was a general improvement within the classroom and, above all, for the dyslexic students, two of which managed to perform the delivery without using the compensatory tools and/or the dispensatory measures.

Two main purposes emerged from the analysis of the Tweets: instant communication and content sharing. From an ex post questionnaire submitted to the students, it emerged that most of them agreed or strongly agreed to have drawn benefits from Twitter via interactive learning, instant communication, and autonomous learning.

5 Discussion and Conclusions

The research presented in this paper supports the idea that the social network (Twitter) is not only a tool to enrich the teaching but it is an active tool to increase students' motivation allowing them to be active in the learning process. While the use of Twitter to organize the learning process did not require special attention, the pedagogical use does require advanced planning for leading the work group.

On the base of the achievement tests, the result of this pilot project demonstrates the effectiveness of Twitter in the learning process: it allowed students to create a learning community to share knowledge through messaging.

It allowed the creation of a repository in the field of Music Recording, available for successive analysis of real problem.

The presence of the teacher in the Twitter group had an added value in the learning process. Students perceived the presence of the teacher as facilitator: a teacher who does not operate under the traditional concept of teaching but rather is meant to guide and assist students in learning, taking their ideas and creating material through self-exploration and dialogue.

Every school might start to use Twitter as an important part of the learning process.

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Part III
Learning Management Systems, Mobile Learning & MOOCs

The Impact of Technology Upon Family Co-play Roles

Deborah Cockerham and Lin Lin

Abstract As changes in home technology transform family roles and communication structures, the impact of relationship commitment, communication, and recreational choices upon family organization must be explored (Hertlein Fam Relat 61:374–387, 2012). Family role expectations and communicative practices will need to be redefined in order to clarify and maintain relationships. This paper will examine family communication and relationships, the role of play, the impact of technology upon the family, and intergenerational co-play with technology.

1 Introduction

Home technology has created changes in family relationships for almost 100 years (Morley, 2007), but few studies have attempted to investigate the impact of technology upon the communication structures and roles within the family. As individual family members construct their own meanings of and needs for technology (McLuhan & Fiore, 1967), changes in relationship commitment, communication, and recreational choices are impacting relationship maintenance (Hertlein, 2012). The expeditious rate at which technology is now advancing requires a redefinition of family role expectations and communicative practices in order to clarify and strengthen relationships within families. This study will explore family communication and relationships, the role of play, the impact of technology upon the family, and intergenerational co-play with technology.

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2 Theoretical Background

2.1 Communication and Relationships Within Families

As needs and developmental level of individuals within the family ebb and flow, roles and relationships within the family network are inherently impacted. Family development theories address relationships and their adjustments within the gestalt of the family unit. The network of individuals involved in a family does not stay constant but continues to grow and develop throughout the family lifespan. New roles can serve as dynamic forces, changing the organization and structure of the family as it moves through a series of stages (Rodgers & White, 2009). Each stage is characterized by a marked change (e.g., the birth of a first child) that impacts family norms, structures, roles, and behaviors. Stages move the family through its entire lifespan: childless couple, parents with preschool children, parents with elementary school children, parents with adolescents, and retirement and death of both spouses (Aldous, 1978). Family development theories often maintain the idea of a family unit but define the family according to the structure and process it undertakes in a given developmental stage (Watt & White, 1999).

2.2 Human Ecology Theory

Human ecology theory (Hawley, 1986) is built on the idea of ecology or the relation of individuals to their environment. Human ecology refers to the ways in which humans organize themselves to adapt to their surroundings. A family is seen as an organized group; societal innovations, including technology, cause changes within the family ecosystem. In this theory (Hawley, 1986), the human responses that are required to maintain a group relationship within the environment change the structure and organization of the family (Hertlein, 2012). Creative adaptation and choices that protect the environment are essential for preserving the family unit (Bubolz & Sontag, 2009).

2.3 Multitheoretical Model

Hertlein's (2012) multitheoretical model builds upon human ecology theory as it examines environmental influences that may change relationships. In this theory, family changes may be based upon one of two perspectives: (1) the structural-functional perspective (Johnson, 1971, cited in Hertlein, 2012), which looks at changes in the family's organizational structure, or (2) the interactionist-constructionist perspective (Berger & Kellner, 1974), which focuses on the

development of relationships and interactions through communication, behavior, gestures, and rituals. The types of power, the outcome of the power situation, and the knowledge levels of individuals influence child-adult roles within a relationship (McLeod & Lin, 2010), and these roles are often related to perception of individual agency (Aarsand, 2007).

2.4 The Role of Play

Enjoyment, rather than purpose, is the goal of true play (Eichberg, 2016). For younger children, play is freedom from all but personally imposed rules; for older children, play requires agreement upon externally imposed rules (Bettelheim, 1987). Benefits from play differ between children and adults.

When a child plays, he may experience opportunities to be creative, to practice decision-making skills, and to explore and interact in a world he can control (Ginsburg, 2007). Child play may also serve as training to live with and abide by rules (Eichberg, 2016), as a resource for coping with the past and present, or as preparation for future experiences (Bettelheim, 1987). Parental benefits may include opportunities to engage and interact with the child, to see the world from the child's viewpoint, or to strengthen communication (Eichberg, 2016).

Parent-child play may have an important role in enhancing parent-child relationships and in the child's emotional, behavioral, and social development (Levine, 1988). To understand and relate to a child, an adult must understand the child's play (Bettelheim, 1987).

2.5 Technology and Society

As technology becomes more accessible and simpler to navigate, it assumes a larger role in society. The 2015 videogame statistics (Entertainment Software Association, 2015) indicate that:

- Eighty percent of Americans play videogames on some type of device.
- Although 56% of individuals play games with others, only 21% play with family members, and only 16% play with parents.
- Forty-five percent of respondents feel that videogames help them spend time with family.
- Sixty-three percent of parents consider videogames to be a positive part of their child's life.
- Fifty-nine percent of parents whose children are gamers play games with the children at least weekly.

Parents choose to be involved in children's videogame play for a variety of reasons. A survey of over 4000 American households (Entertainment Software Association, 2015) determined that the top five reasons parents choose to play games with their children are:

- It is fun for the entire family (85%).
- Because they're asked to (75%).
- Opportunity to socialize with child (65%).
- To monitor game content (58%).
- They enjoy videogames as much as the child (54%).

Since a primary factor in group gaming is social interaction (Voida & Greenberg, 2009), both the parent's objective in playing and his attitude toward technology can impact the positive or negative affect of the game experience. In functioning as an "extension of ourselves" (McLuhan & Fiore, 1967), technology creates not only personal, but also family and social changes. The actual technology does not change family relationships, but it is likely to impact the pace or pattern of family life.

2.6 Impact of Technology upon Family Life

The relationship between technology and family life is reciprocal: technology influences family life, and family interactions influence technology (Haddon, 2006). Both parent and child use of media can impact family dynamics. When a parent acquires a device such as an iPhone or an Apple watch, he invests time and energy in learning to navigate the technology. The parent's attitude, in conjunction with the interest and participation level of the family, can affect the technology's impact upon the family. If the parent does not engage the child but chooses to interact independently with the device, the opportunities for parent-child interaction will be diminished. Even if the adult does attempt to engage other family members with his technology, family socialization time will be reduced if other family members lack interest in or time for using the device.

On the other hand, when technology is shared with the family, relationships and socialization may be improved. The family's approach to technology can determine the degree to which it fosters family growth (Villegas, 2013). The amount of time a family spends in sharing technology can impact family dynamics, but parent-child interactions, open communication, and reteaching of technology content are considered essential to the child's social and emotional development (American Academy of Pediatrics, 2016a, b). Parent-child discussions after technology usage can strengthen family ties (Villegas, 2013).

Because new technologies may create family dilemmas as they adapt to social expectations (Humphreys, 2005), parents may need to be proactive in developing a family media plan (American Academy of Pediatrics, 2016a). Family flexibility is an important element as new technology enters the home environment, and adjustments may need to be made, particularly in relation to (1) family rules; (2) perceived

family boundaries, since technology often blurs the borders; and (3) reversed family roles, as children become the "authorities" who are adept at technology (Aarsand, 2007). Papurt (1996) sees technology as a conduit for building the family and argues that parents should be receptive to the need and opportunity for building new relationships with their children. Otherwise, individuals will engage independently with technology, and the resulting decrease in parent-child interaction time may affect relationships and impede communication (Villegas, 2013).

2.7 Parent-Child Co-play with Technology

The American Academy of Pediatrics (1999, cited in Connell, Lauricella, & Wartella, 2015, 2016a, 2016b) encourages parents to co-use technology with their children and teenagers. Because games are important to our culture (Stevens, Satwicz, & McCarthy, 2008), co-playing videogames may allow parents to share perceived or real interests with the child (Padilla Walker, Coyne, & Fraser, 2012). Digital games provide opportunities for social interaction, and families that play games together may discover an increase in meaningful communication (De Kort & Ijsselsteijn, 2008).

Indeed, social interaction is a primary factor in group gaming (Voida & Greenberg, 2009), but children may have different game-related goals and playing approaches than their parents. While the playing partners, the purpose of the play, and the attitudes toward videogames impact the individual's focus, children are frequently independent in videogame play (Villegas, 2013), and the game itself becomes the priority as children learn to interact with society and the world around them (Stevens et al., 2008). Adults are typically more passive game players when playing with children (Voida & Greenberg, 2009) and tend to be more focused on the social relationship than the game (Chiong, 2009).

With physical and board games, parents frequently serve as guides that provide positive feedback and discuss game strategies. With digital games, the child is likely to be the "authority" who instructs the parent on game mechanics (Chiong, 2009). Parents more often co-play videogames with their children when they expect positive game effects and may enforce stricter game playing rules when they are concerned that the game will have negative consequences (Nikken & Jansz, 2006). The impact of videogames upon the child's initiative, creativity, and development may also be a concern for parents (Ginsburg, 2007).

A digital divide may develop as the child's desire to be independent clashes with the adult's desire to strengthen family bonds (Chambers, 2012). Adolescents can view technology as independence, adding to intergenerational conflict (Mesch, 2006), but games with intergenerational appeal may help to solve this dilemma. In a study that allowed intergenerational design of digital games, authors found that games that are short, easy to master, family-oriented, and provide a limited number of instructions promote stronger family connections (Rice et al., 2012). In addition, games that consider ability levels of younger and older generations require the input

of both "player junior" and "player senior," and support communication between generations may positively impact the family dynamics (Kern, Stringer, Fitzpatrick, & Schmidt, 2006).

3 Conclusion

Games can strengthen family growth and relationships between generations, but challenges related to family boundaries and intergenerational conflicts are often major concerns when co-play involves technology (Bacigalupe, Camara, & Buffardi, 2014). As more intergenerational digital family games are designed, Voida and Greenberg (2009) present the following recommendations:

- Players should be able to move in and out of the game easily and quickly.
- Games should allow players of different levels to compete with each other, presenting a shallow learning curve with challenging opportunities for advanced players.
- Competition should be downplayed.
- Opportunities for audience participation may allow larger family networks to play together.
- Diversity in playing options can support intergenerational interest.

Family co-play roles, attitudes, and opportunities can impact the positive or negative effects of digital games, with playtime communication seen as a critical factor for strengthening family ties. With or without technology, family co-play can provide an opportunity for families to learn together and to build relationships through engaging in collaborative problem-solving and social interaction.

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A Cross-cultural Exploration of Primary Students' Learning Management System Use: A Mixed Methods Approach

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Abstract This study aims to explore and compare Hong Kong (HK) and Shenzhen primary students' learning manage system (LMS) use and the factors affecting their LMS acceptance. The study was conducted in a mixed methods approach with a survey on 272 grade five students first and focus group interviews with 16 of the survey students followed by. The results of a structural equation modeling analysis on survey data confirm the technology acceptance model and indicate significant differences between two student groups on the model. Specifically, while all paths are supported among Shenzhen students, the effects of perceived ease of use on perceived usefulness and subjective norm on intention to LMS use are not significant among HK students. The results of analysis on interviews data reveal that intrinsic motivation may disassociate perceived ease of use with perceived usefulness. While LMS in HK provides multiple functions that facilitate playfulness, students from Shenzhen reported difficulties in using LMS for learning. Besides, voluntariness of LMS use may play an important role in influencing the effect of subjective norm on intention to use LMS. While HK students who use LMS under voluntary context may disregard social influence, Shenzhen students seem to derive motivation to use LMS from social pressure.

Keywords Technology acceptance · E-learning · Learning management system use · Primary students · Cross cultural · Mixed methods

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1 Introduction

1.1 Understanding Technology Acceptance

Coupled with the rapid development of ICT and the paradoxical relationship between investment in ICT and gains in productivity, understanding the choice an individual makes to accept or reject a new technology has been a long-standing research topic in business information systems. This stream of research is also commonly known as technology acceptance studies. A review of such studies reveals that a variety of well-supported models have been developed to examine and predict individuals' technology acceptance in organizations and higher education context. Of these adoption models, the technology acceptance model (TAM) was proposed and was empirically a success throughout the decades (Davis, 1986, 1989; Davis, Bagozzi, & Warshaw, 1989). Given that TAM has established robust through its replication in information system research as well as in educational settings to understand technology use behavior (King & He, 2006; Mou, Shin, & Cohen, 2017; Park, 2009; Teo, 2014; Venkatesh, Morris, Davis, & Davis, 2003; Venkatesh, Thong, & Xu, 2012), this paper takes TAM as the core model.

1.2 E-Learning Acceptance by Students

With the effort of government to enrich e-learning resources, along with the increasing availability of ICT, has given rise to e-learning as a trend in education in China (e.g., EMB, 1998, 2004, 2008, 2014. E-learning is defined as "an open and flexible learning tool involving the use of electronic media, include use of digital resources and communication tools to achieve learning objectives" (EMB, 2014, p. 36). A review of literature reveals that e-learning acceptance studies focus almost exclusively on students in higher education institutions (e.g., Cheung & Vogel, 2013; Ma & Yuen, 2011; Park, 2009; Teo, 2009; Wu & Zhang, 2014; Yuen & Ma, 2008); few studies have explored young users' acceptance and use of e-learning. Exceptionally, Liu, Chen, Sun, Wible, and Kuo (2010) explored Taiwan senior high school students' LMS acceptance. The results confirmed the significant effects of user beliefs of system characteristics in predicting high school students' e-learning system use intention.

The present study focuses on e-learning platforms, which is also referred to as learning management system (LMS) (EMB, 2014, p. 37). LMS is a prominent e-learning application in shaping web-based learning and instruction environment, which comprises of various similar functions (e.g., content delivery and sharing). LMSs have been used widely in higher education (Yuen, 2011; Yuen, Fox, Sun, & Deng, 2009). However, given its relatively new experience in primary schools, little evidence has been provided for how primary school students accept and use LMS.

1.3 Cross-cultural Examination of Technology Acceptance

Existing studies revealed that taking into account cross-cultural effects is useful in explaining users' technology use. Straub (1994) conducted a cross-cultural study on Japanese and US knowledge workers' acceptance of different communication technologies. Based on empirical data on western and eastern countries, Japanese tends to be much less comfortable in dealing with uncertainty and ambiguous than America (Hofstede & Hofstede, 1991). Due to the complex written system of Japanese language that may increase the level of discomfort with ambiguity, it was hypothesized that Japanese knowledge workers would report less use of email, perceive it less useful, and thus more incline to the other social media, Fax, than Americans. The results of regression analysis confirmed the hypotheses. As an extended study, Straub, Keil, and Brenner (1997) applied TAM across three countries. It was hypothesized that TAM would not be able to predict Japanese workers' adoption of email because the high level of discomfort in using email might disassociate perceived usefulness from predicting email. Given that the cultural values of American and Swiss samples were similar, it was further hypothesized that TAM could significantly predict email use of both the two western countries, and there was no significant difference between them in the use of email. The results of regression analysis supported the above assumptions. Leidner and Kayworth (2006) reviewed and synthesized previous research effort on studying cultural effects in information system research and argued that "culture at the national, organizational, or subunit level exerts a subtle and yet powerful influence on people and organizations and that information follows and information technologies are often closely intertwined with culture" (p. 358).

Though cross-cultural studies using TAM have been implemented in organizational context, a surprising dearth of such study is conducted in educational context. Teo, Luan, and Sing (2008) compared technology adoption between Singaporean and Malaysian preservice teachers based on TAM. The results indicated significant differences between two samples. However, no cross-cultural study has been conducted to e-learning technology use among young school students.

1.4 Research Purposes and Research Questions

To recap, a comprehensive cross-cultural comparison of young school students' acceptance and use of LMSs as a tool for learning is lacking. Given the promise and educational potential of LMS, how young school students accept and use LMS needs further work. The present study investigates LMS acceptance and use of primary students from HK and Shenzhen. We focus on two research questions: (1) Do HK and Shenzhen primary students have different use of LMS? (2) What factors drive HK and Shenzhen primary students' LMS use?

2 Research Model and Hypotheses

In this study, we take TAM as the theoretical foundation. TAM was developed based on the theory of reasoned action (TRA) (Ajzen & Fishbein, 1980; Fishbein & Ajzen, 1975). According to TRA, behavioral intention is assumed to have a direct impact on whether one will perform the action under consideration. In turn, one's intention to perform a behavior is assumed to be a function of two factors which include behavioral attitude and subjective norm. Drawn from TRA, TAM only remained the part of attitude and intention, with attitude to be the only direct determinant of behavioral intention. Moreover, two additional determinants which include perceived usefulness and perceived ease of use are proposed to directly influence attitude collectively. Perceived usefulness and perceived ease of use represent users' perceived characteristics of a technology. Subjective norm is considered as a disentangle determinant in TRA reflecting the part of social influence, and social influence is especially important for primary students' performance of behaviors. Thus, this study introduces subjective norm to TAM to form the research model, as shown in Fig. 1. The development of each hypothesis is also described as follows.

Perceived usefulness refers to "the degree to which a person believes that using a particular system would enhance his or her job performance," and perceived ease of use is defined as "the degree to which a person believes that using a particular system would be free of effort" (Davis, 1989, p. 320). Across the many empirical technology acceptance studies, perceived ease of use was found to have strong direct effect on perceived usefulness, and perceived ease of use and perceived usefulness collectively were hypothesized to be fundamental determinants of attitude. As these relationships were validated from extensive previous studies, we propose the following hypotheses:

H1. Perceived ease of use will have a significant influence on perceived usefulness for HK and Shenzhen primary students.

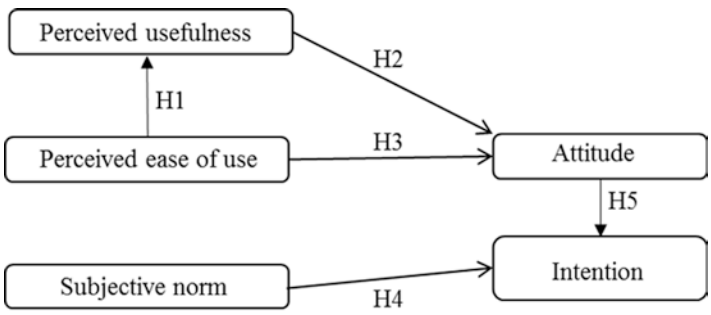

Fig. 1 The conceptual framework

H2. Perceived usefulness will have a significant influence on attitude toward LMS use for HK and Shenzhen primary students.
H3. Perceived ease of use will have a significant influence on attitude toward LMS use for HK and Shenzhen primary students.

According to TRA, subjective norm and attitude collectively determine one's intention to perform a certain behavior. While attitude reflects one's affective response toward the behavior to perform, subjective norm is one's perception of whether most people who are important to him think he should or should not perform that behavior (Ajzen & Fishbein, 1980). With the introduction of TAM, the follow-up studies continued to compare and integrate TAM and TRA across contexts with a variety of technologies. As attitude and subjective norm being fundamental determinants of intention, we propose the following hypotheses:

H4. Subjective norm will have a significant influence on intention toward LMS use for HK and Shenzhen primary students.
H5. Attitude toward LMS use will have a significant influence on intention toward LMS use for HK and Shenzhen primary students.

3 Research Methodology

In the context of educational technology studies, mixed methods research are essential to establish a strong link between research goals and research outcomes (Spector & Yuen, 2016). It is defined as "the class of research where the researchers mix or combine quantitative and qualitative research techniques, methods, approaches, concepts or language into a single study" (Johnson & Onwuegbuzie, 2004, p. 17). As Venkatesh, Brown, and Bala (2013, p. 38) suggested for information system studies with "a strong theoretical foundation already exists, but the context of the research is novel or previous findings were fragmented and/or conclusive, they may consider conducting a quantitative study first followed by a qualitative study to offer additional insights based on the context-specific findings…." For the present study, since the research context as primary schools and research findings regarding primary students' LMS use are lacked, this study was conducted in a mixed methods approach with a quantitative survey first and a qualitative interview second.

3.1 Data Collection

In the first-wave quantitative study, the participants comprised of 135 and 137 grade five school students from a HK and Shenzhen primary school, respectively. The reason for selecting these two schools is because they have comparable background

Table 1 School background summary and data collected

School	A	B
School district	Hong Kong	Shenzhen
School type	Public primary school	Public primary school
School academic performance	Above average	Above average
School ICT resources	Above standard	Above standard

Table 2 Profile of student survey respondents

	Variables		The Hong Kong school ($N = 135$)		The Shenzhen school ($N = 137$)	
			Frequency	Percentage	Frequency	Percentage
Demographic information	Gender	Male	79	58.5	88	64.2
		Female	56	41.5	49	35.8
	Age	10	48	35.6	13	9.5
		11	86	63.7	85	62.0
		12	1	0.7	37	27.0
		13	0	0	2	1.5

especially in terms of school academic performance and ICT resources in general. Before the study, both of the schools were confirmed to use LMS in their teaching and learning. The details of school background are summarized in Table 1. The demographics information of survey respondents are summarized in Table 2.

A survey questionnaire was administered to students in classes with researchers and teachers on site. The questionnaire consists of the following categories of variables: first, students' demographic background, including age, gender, and ICT resources ownership, and second, TAM-related main constructs, including perceived usefulness (PU), perceived ease of use (PEU), attitude (ATT), subjective norm (SN), and behavioral intention (BI). The TAM-related main constructs were measured on a five-point Likert scale ranging from "strongly disagree" (1) to "strongly agree" (5). The items to assess these constructs were adapted from previous studies as shown in Table 3.

In the second-wave study, focus group interviews with students were conducted a week after the survey, which focused on topics under the first-wave survey. For each primary school, a total of eight students who had participated in the survey were randomly selected. These students were arranged into two-student focus group interviews, with two males and two females in each group. The interviews were conducted in Cantonese and Mandarin for HK and Shenzhen, respectively, in both semi-structured and open-ended approaches. All the interview data are recorded in audio. Key questions are as follows: Do you think using LMS to learning is useful for your study? Why? What is your attitude toward LMS use? Do those people important to you think you should use LMS? The profile of students in student focus groups is presented in Table 4.

Table 3 Constructs and corresponding measurement items in the research model

Constructs	Items
Perceived usefulness source: (Davis, 1989)	PU1: Using LMS would help me to finish my learning tasks more quickly
	PU2: Using LMS would improve my learning performance
	PU3: Using LMS would increase my learning productivity
	PU4: Using LMS would enhance my effectiveness in learning
Perceived ease of use source: (Davis, 1989)	PEU1: Learning to operate LMS is easy
	PEU2: It is easy to get LMS to do what I want it to do
	PEU3: My interaction with LMS is clear and understandable
	PEU4: I would find LMS is easy to use
Attitude source: (Compeau & Higgins, 1995)	ATT1: The use of LMS make learning interesting
	ATT2: Learning by using LMS is fun
	ATT3: Overall, I like using LMS in learning
Subjective norm source: (Fishbein & Ajzen, 1975)	SN1: Those people who are important to me would strongly support me to use LMS in learning
	SN2: Those people who have influence on my behavior would think that I should use LMS
Behavioral intention source: (Fishbein & Ajzen, 1975)	BI1: I intend to continue using LMS in learning in the future
	BI2: I intend to use LMS in my learning as often as possible
	BI3: I believe that using LMS in learning is a wise decision

Table 4 Profile of student in focus group interviews

School	Students selected from the school			
School A (Hong Kong)	Focus group 1	A1 (male)	Focus group 2	A5 (male)
		A2 (male)		A6 (male)
		A3 (female)		A7 (female)
		A4 (female)		A8 (female)
School B (Shenzhen)	Focus group 1	B1 (male)	Focus group 2	B5 (male)
		B2 (male)		B6 (male)
		B3 (female)		B7 (female)
		B4 (female)		B8 (female)

3.2 Data Analysis and Results

The data analysis comprised of two stages. First, the survey data was used to examine the proposed research model and corresponding hypothesized relationships using structural equation modeling (SEM). Second, the qualitative data obtained from focus group interviews was analyzed to triangulate and provide context-specific understandings of the quantitative results and gain additional insights.

3.2.1 Hypotheses and Research Model Analysis

Exploratory factor analysis (EFA) was used to explore the factor structure of the research model. Table 5 presents the principal component analysis of the five factors, which explains 77.54% of the variance. The results ensure that the measurement items can load into corresponding measurement constructs.

Since confirmation factor analysis (CFA) is more appropriate than EFA in research studies with measurement scales pre-validated or with a strong prior theory (Bhattacherjee & Premkumar, 2004), this study used item loads via CFA in assessing the scale reliability and validity. A CFA model was examined with the items loading into their corresponding latent variables using AMOS (analysis of moment structures). Following previous studies (Amah, 2010; Bagozzi & Yi, 1988), five indices were used to assess the model fit, and results showed that all indices satisfy the recommended criteria, as shown in Table 6.

Following the criteria proposed by Fornell and Larker (1981), convergent validity of the measurement items and discriminant validity of the measurement con-

Table 5 EFA of the measurement items

	PU	PEU	SN	Attitude	BI
PU1	0.678				
PU2	0.806				
PU3	0.848				
PU4	0.756				
PEU1		0.851			
PEU2		0.816			
PEU3		0.670			
PEU4		0.756			
SN1			0.808		
SN2			0.906		
ATT1				0.797	
ATT2				0.823	
ATT3				0.747	
BI1					0.636
BI2					0.734
BI3					0.709

Table 6 Fit indices of the measurement model

Fit indices	CFA model	Recommended level of fit
χ^2/df	1.967	<3
RMSEA	0.06	<0.08
NFI	0.934	>0.90
TLI	0.957	>0.90
CFI	0.966	>0.90

Table 7 Results of convergent validity and discriminant validity

Construct	Item	Loading	Convergent validity			Discriminant validity				
			Alpha	CR	AVE	PU	PEU	SN	ATT	BI
PU	PU1	0.76	0.88	0.80	0.60	0.76				
	PU2	0.77								
	PU3	0.89								
	PU4	0.81								
PEU	PEU1	0.79	0.84	0.79	0.61	0.45**	0.76			
	PEU2	0.79								
	PEU3	0.76								
	PEU4	0.72								
SN	SN1	0.97	0.78	0.82	0.74	0.39**	0.24**	0.83		
	SN2	0.65								
ATT	ATT1	0.88	0.90	0.76	0.62	0.61**	0.47**	0.39**	0.87	
	ATT2	0.91								
	ATT3	0.83								
BI	BI1	0.86	0.87	0.59	0.49	0.63**	0.52**	0.41**	0.74**	0.83
	BI2	0.77								
	BI3	0.84								

*$p < 0.05$, **$p < 0.01$, ***$p < 0.001$

Table 8 Fit indices of the structural model

Fit indices	Overall model	Hong Kong	Shenzhen	Recommended level of fit
χ^2/df	1.967	1.783	1.337	<3
RMSEA	0.06	0.076	0.05	<0.08
NFI	0.934	0.868	0.92	>0.90
TLI	0.957	0.919	0.972	>0.90
CFI	0.966	0.936	0.978	>0.90

structs were examined. For convergent validity to be appropriate: first, the value of Cronbach's alpha and composite reliability (CR) should be at least 0.7; second, the average variance extracted (AVE) should be at least 0.5. For discriminant validity to be appropriate, the square root of AVE for a measurement construct should be higher than the correlation between the construct and any other construct measured. The measurement items demonstrate good convergent validity, and the measurement constructs demonstrate good discriminant validity, as shown in Table 7.

With confirmation of reliability and validity at both item and construct levels, structural equation modeling (SEM) was performed to test the research model. The same set of indices were used to test SEM models of whole sample, HK, and Shenzhen samples. As shown in Table 8, the model of Shenzhen sample demonstrates a good model fit with all indices exceeding the recommended values, while the model of Hong Kong sample is also considered as appropriate since NFI is slightly below the threshold value.

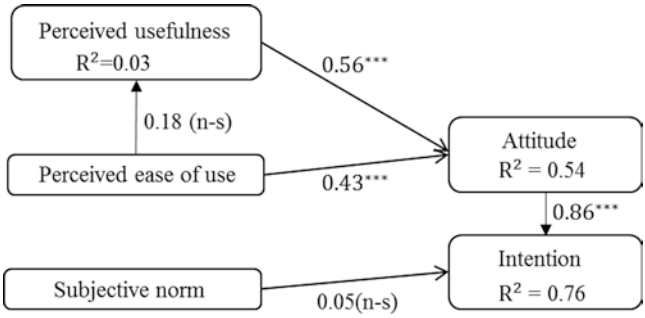

Fig. 2 The model testing results of HK sample. Note: n-s (not significant), *$p < 0.05$, **$p < 0.01$, ***$p < 0.001$

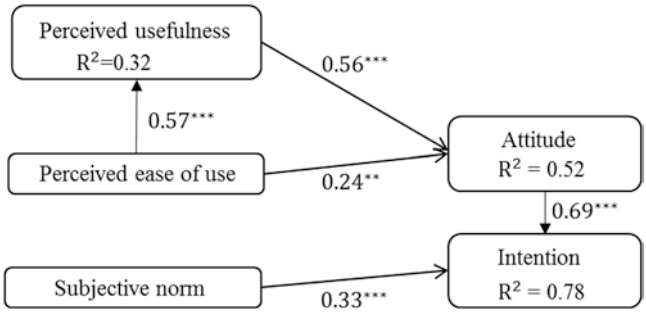

Fig. 3 The model testing results of Shenzhen sample

Standardized parameter estimates were presented in Figs. 2 and 3 for HK sample and Shenzhen sample, respectively. All hypotheses are significant at $p < 0.05$ except for the links PEU-PU and SN-BI for HK sample. More specifically, PEU was found to have no significant influence on PU ($\beta = 0.18$, $p = 0.09$), while SN was also not significantly related to BI ($\beta = 0.05$, $p = 0.46$) for HK students; thus, H1 and H4 are not supported for the HK sample. In contrast, PEU was found to strongly related to PU ($\beta = 0.57$, $p < 0.001$), and SN was also found to have strong effect on BI ($\beta = 0.33$, $p < 0.001$) for Shenzhen group, thus supporting H1 and H4. For both samples, the results supported the strongest direct effect of PU on ATT with path coefficient ($\beta = 0.56$, $p < 0.001$), followed by the effect of PEU on ATT for HK ($\beta = 0.43$, $p < 0.001$) and for Shenzhen sample ($\beta = 0.24$, $p < 0.05$). Thus, H2 and H3 are supported. BI was strongly influenced by ATT for both HK ($\beta = 0.86$, $p < 0.001$) and Shenzhen students ($\beta = 0.69$, $p < 0.001$), thus supporting H5. Overall, PU and PEU collectively explained a variance of 54% and 52% of ATT, while SN and ATT explained a variance of 76% and 78% of BI for HK and Shenzhen students, respectively. The results of hypothesis testing for all models are also summarized in Table 9.

Table 9 Hypotheses testing results

Hypothesis	Path	Whole model	HK	Results	Shenzhen	Results
H1	PEU -> PU	0.46***	0.184 (n-s)	Not supported	0.57***	Supported
H2	PU -> ATT	0.53***	0.558***	Supported	0.56***	Supported
H3	PEU -> ATT	0.32***	0.432***	Supported	0.24**	Supported
H4	SN -> BI	0.24***	0.05 (n-s)	Not supported	0.33***	Supported
H5	ATT -> BI	0.76***	0.86***	Supported	0.69***	Supported

*$p < 0.05$, **$p < 0.01$, ***$p < 0.001$

3.2.2 Analysis of Qualitative Data

The second stage was an analysis on the focus interview responses from the selected survey students. The interview data collected was transcribed into text verbatim. Given the core purpose of this analysis to understand the quantitative results based on specific contexts, the qualitative data was analyzed into general themes corresponding to the measurement constructs in the research model.

While we asked students from HK whether they perceived LMS as ease of use, all of them provided short but firm answers such as "yes, it is easy to use." Moreover, when we asked whether they perceived LMS as useful to use, they appeared excited and said:

- A1: I think LMS is useful. It makes learning become interesting… For example, I can share pictures through it… and I don't need to type.
- A3: Yes, I can record my voice and upload there. LMS also allows me to decorate my portrait.
- A2: I can have online discussion. And when I complete some learning tasks, I will be awarded with some credits and gifts.
- A4: Yes, we can get some gifts!
- A5: It is very useful. I can review learning materials and pass examinations on there and thus can prepare more the examinations.
- A8: It is very creative. I can design my own animated character and I can watch e-books.

In contrast, the responses from Shenzhen students appeared quite different. When we asked them "do you think LMS is easy to use," they responded:

- B1: The homework and learning tasks (in LMS) are too easy and simple. They are really too easy! If it can be multifunctional, for example, to provide exercises with multiple choices and fill in the blanks, it can be more useful.
- B2: Yes, I agree.
- B3: Both functions and learning tasks are too easy.
- B4: Yes, it has poor functions; it always hangs and even crashes.

As we continued to ask their opinions about the usefulness of LMS, students responded:

- B8: I think so. I can complete online assignments and assess the online teaching videos (by using LMS). The teachers will put some videos on LMS. But it takes a long time to update.

- B6: I cannot watch videos; I can only do homework.
- B7: Yes, though it is useful, it is not stable; it sometimes crashes.
- B5: Yes, LMS is useful, but it crashes and hangs sometimes.

From the above student interviews of Shenzhen students, they kept mentioning about functional problems of LMS such as "crash," "hang," and "unstable," and they closely associated these functional problems with the usefulness of LMS. Moreover, while talking about their perception of usefulness of LMS, they tended to frequently connect poor functionalities of LMS with it. In contrast, students from HK focused on the playfulness in using LMS and closely associated the playfulness with PU.

While we asked students whether they like using LMS, students from Shenzhen said:

- B4: Just so-so because it is a little bit troublesome to use LMS for learning.
- B2, B3: Ne too, just ok.
- B5: I want some interesting tasks. But it is too slow and too "foolish."

In contrast, students from HK answered:

- A3: I start to use it because I need to use it to complete homework. But I found it quite interesting later. I hope the teachers can use it more.
- A8: I think it is funny to use LMS for learning; I think all of us are quite good at using it.
- A5: Yes, there are many functions for learning. Edmodo, it is very similar to Facebook, and we can chat over. For example, teachers can ask a question (in LMS), you can type the answer under the question, or you can just refer to others' answers.

It seems that primary students had closely associated functionality to their attitude of LMS use. For HK students, they appeared much more positive attitude toward using LMS facilitated by multiple functions and playful manners of LMS. Such findings from interviews help to understand that, though perceived ease of use did not associate with perceived usefulness among the HK sample, it tended to have much stronger correlation with attitude than Shenzhen students.

While we asked do they think those people around them would influence their LMS use, all the HK students answered with "no."

- A2: I am voluntary to use it.
- A4: Yes, I will continue to use it and we all like using it.
- A5: I hope the teachers can use more (LMS for learning).

In contrast, the Shenzhen students said:

- A3: If I have to use it, I will use it at teachers' desire.
- A2: Teachers request us to use it and thus we have to use it.
- A1: My parents also encourage me to use it. They think it is more efficient to use it for doing homework.

Accordingly, the responses showed that students from HK and Shenzhen appeared noticeably different in terms of subjective norm. It is interesting that while

HK students perceived those people around them would not influence their LMS use, Shenzhen students tended to be strongly influenced by their teachers and parents in using LMS.

Overall, the results of qualitative study revealed that Hong Kong and Shenzhen primary students have different use of LMS. It is interesting that while Hong Kong students perceived LMS use as playful, easy, and useful to use, demonstrate favorable attitude toward LMS use, and perceived voluntary to use LMS, Shenzhen students tended to perceived difficulties in using LMS and thus demonstrated negative attitude and social pressure in using LMS. The results might reflect that factors related to hands-on experience such as perceived ease of use and playfulness might be critical factors in influencing primary students' LMS use.

4 Discussion and Conclusion

The study aims to explore young school students' LMS acceptance and use with a particular focus on comparing whether there are differences between HK and Shenzhen primary students in their LMS use and the factors influencing their LMS use. Through a mixed methods approach, this study has provided in-depth understandings about HK and Shenzhen primary students' LMS acceptance and use.

From the first-wave quantitative study, the results of SEM show that TAM explains a high variance of primary students' intention to use LMS among both HK (R^2 = 76%) and Shenzhen (R^2 = 78%) students. Though both groups of students would most likely to apply LMS for their learning, the predictor variables in influencing their LMS use intention are different. More specifically, all the predictor variables including PEU, PU, ATT, and SN have significant relationships with their dependent variables among Shenzhen primary students. However, the relationships of PEU-PU and SN-BI were not significant among HK primary students. Through the second-wave qualitative study, contextual-specific understandings were provided to explain the quantitative results with a focus on the unsupported hypotheses.

In previous TAM studies, few of them have revealed insignificant relationship between PEU and PU. From the interviews, it was interesting that HK and Shenzhen students appeared to have completely different PEU of LMS. All Shenzhen students reported functional problems of LMS, and they tended to closely associate their perceived difficulties with PU in their responses to questions related to PU. In contrast, all HK students reported that LMS was very easy to use. Moreover, in responding their PU of LMS, they appeared excited and elaborated a lot on the playfulness in using LMS and accordingly considered LMS as useful by connecting the rich learning content and multiple functions of LMS in enabling learning. Such finding from the qualitative study helps to explain the relationships between PEU and PU among samples. With the problematic functions of LMS, Shenzhen students had to struggle to use LMS for learning. Moreover, they considered PEU as closely associated with PU. Thus, PEU explained a high variance of PU (R^2 = 57%) among

Shenzhen students. In contrast, no HK students mentioned about functional problems of LMS, and they considered LMS use as funny. Rather, it seems that the playfulness of LMS is more important in facilitating their PU. Accordingly, they tended to disassociate PEU with PU, which might explain their insignificant relationships.

Though the result that SN was not significantly related to BI was contradictive with some previous studies (e.g., Cheung & Vogel, 2013; Lee, 2010; Park, 2009), it was also supported by some existing studies. The longitudinal studies of Venkatesh and Davis (2000) found that the effect of SN on BI was moderated by voluntariness of system use. SN was found to have a significant effect on BI only when system use is mandatory, but its effect tended to weaken and diminish with increasing using experience. Similarly, Wang and Wang (2009) also revealed SN to have strongest effect on users' intention to use LMS under the mandatory use context. Thus, it is very possible that the insignificant relationship between SN and BI is related to voluntariness of LMS use. This assumption seems can be verified by the second-phase student interviews. From the interviews, it was obvious that HK students enjoyed using LMS and considered themselves voluntary to use LMS. In contrast, the intention to use LMS for Shenzhen primary students seemed to derive from social pressure from their parents and teachers to apply LMS for learning. These results help to explain why SN did not have a significant effect on BI among the HK students, but demonstrated a strong correlation for Shenzhen students.

Future research is also suggested. First, since perceived playfulness is an emergent factor in influencing students' beliefs of LMS from students' interviews, predictor variables related to intrinsic motivation such as playfulness are encouraged to be included in examining young school students' e-learning technology acceptance. Second, since the sample size is limited, mixed methods studies should be conducted on larger young school student sample in cross-cultural contexts in order to generalize and validate the findings. Third, longitudinal studies may be designed to compare students' LMS use under different contexts (mandatory and voluntary) and trace the changes in their LMS use with increasing experience.

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Effects of M-Learning on Students' Learning Outcome: A Meta-analysis

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Abstract M-learning is a potential method for teaching and learning, but its effects on students' learning performance are varied compared with traditional instruction. This meta-analysis is a statistical review of 34 experimental studies during the period 2010–2016, in which 4052 participants and 49 effect sizes were analyzed. The combined effect size is 0.828, which shows that (a) M-learning is more effective than traditional learning with a significant difference. Furthermore, moderating variable analyses manifest that (b) mobile learning has a positive impact on those selected moderators, and (c) there is no significant difference in different levels of manipulated variables. Theory and practice of the findings are discussed.

Keywords M-learning · Meta-analysis · Learning performance

1 Introduction

The integration of information technology and education has produced a series of new teaching methods. In recent years, with the popularity of mobile digital terminals and the Internet, mobile learning (m-learning) has become the most common one widely implemented in education. M-learning is playing a more and more important role in different education stages, domain subjects, and other aspects of education.

Compared with traditional teaching methods, m-learning adopts mobile devices, or mobile learning applications have many potentials. Using mobile technology, teachers and students can communicate with each other to spread learning material and ideas to increase informal interaction; they can also be surfing the Internet to search for different learning resources, to acquire more knowledge that has been

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rarely studied in classroom. In recent years, due to the expansion of big data and learning analysis in the field of education, mobile devices can support the precise teaching and personalized teaching. In short, m-learning is promising if finding the proper way.

M-learning has a great latent force in instruction, whereas the effects are varied in contrast with traditional classroom. Theoretical and practical researches have been made to explore the effectiveness about mobile learning, but synthetic study is lacking in the past few years. As we all know, m-learning is highly correlated with mobile information technology which will change quickly over time, yet hardly any of project insight into the influence of technology on the effects from a historical prospective.

2 Literature Review

M-learning or mobile learning is "learning across multiple contexts, through social and content interactions, using personal electronic devices (Crompton, 2013)." And it is a form of distance education, in which m-learners use mobile device educational technology at their time convenience (Crescente and Lee, 2011). It needs to add new factors (e.g., smartphones, iPad, mobile applications, or teaching strategies) into instruction compared with formal learning. Hence, m-learning may bring learners' and teachers' cognitive load and learning pressure, which would have negative impact on the academic performance of students. Accordingly, many experiments and quasi-experiments are made to explore the effects of m-learning on students' performance. Hui-chun Chu (2014) conducted an experiment to probe whether the existing e-learning strategies are effective when situated in those mobile learning scenarios by analyzing the students' cognitive load and learning performance and found that, without proper treatment, m-learning might cause heavily cognitive load. Jeffrey et al. (2015) found that mobile device may send messages unrelated to class content negatively impacted learning. However, Pei-Luen et al. (2008) indicated that m-learning helps significantly increase student extrinsic motivation without causing higher pressure, and Zacharia, Lazaridou, & Avraamidou (2016) revealed that using mobile devices enhanced students' conceptual understanding. Generally, experimental results of m-learning studies are divided into two sides: positive and negative. A meta-analysis to analyze the synthesized effect is lacked.

Thus, this study committed to take advantage of the method of meta-analysis, a synthetical means, to explore the effect of m-learning and some possible influencing factors. The specific purposes are as follows:

1. Compared with traditional education, to calculate the overall effect size of m-learning on students' learning performance
2. Considering technical maturity of mobile devices, to shape the trend of effect size of m-learning with time from 2010 to 2016

3. Conducting analysis of moderators, to probe the effects of m-learning in different learning stages, different subjects, and different usage times

3 Methods and Procedure

3.1 Literature Search

To collect studies about m-learning and traditional teaching on learning performance, this article searched the literature form January 2010 to December 2016 in electronic databases, including Web of Science, ERIC, Google Scholar, and SAGE journal using keywords like mobile learning, m-learning, and mobile Technology. Finally, 34 researches were searched based on the following criteria: (a) experimental or quasi-experimental studies, (b) tested influence of m-learning and traditional instruction on learning performance, and (c) explicitly reported sample sizes, means, and standard deviation of control group and experiment group.

3.2 Coding Study

For the convenience of meta-analysis, feature coding was finished on the 34 selected papers. We considered the following variables: authors and submit year, education stages, domain subjects, duration of the experiments, and the sample size, means, and standard deviation of experimental group and control group. The following criteria guided the coding procedure: (a) effect sizes of each independent sample were encoded based on an independent sample; (b) if a study has multigroup contrast experiment, the results were coded separately; (c) considering the subjects relatively scattered, the category of domain was divided into art and science; and (d) duration of experiment was converted into weeks.

3.3 Data Analysis

When completed coding, effect sizes of those studies were calculated based on the guidance of meta-analysis (Borenstein, Hedges, Higgins, & Rothstein, 2009). The tool is R software and its package of metafor, and the random effects model was used to compute the mean effect and according to heterogeneity test. Analysis of variance was implemented to test whether the groups of moderators were statistically different.

4 Results and Discussion

4.1 Synthetic Effect Size

Table 1 and Appendix 1 present the synthetic effect size of m-learning. Heterogeneity test ($Q_{(g)} = 422.6292$, df = 48, $p < 0.0001$) shows that random effects model is suitable for this meta-analysis (Lipsey and Wilson 2000). And there was an overall moderate mean effect size of 0.83, with a 95% confidence interval of 0.567–1.093. According to Hattie's (2009) criterion, an effect size of >= 0.60 is high.

In this study it was found that m-learning had a high effect size for learning achievement compared with traditional instruction, and the effect is statistically significant. The result shows that the effect of learning with mobile tools is better than traditional instruction.

4.2 Moderation Analysis

The results of moderator analysis state that m-learning is significantly more effective than traditional teaching methods generally, and there was no statistical difference in different groups while the effect sizes are not equal.

4.2.1 The Effect Size of Different Learning Stages and Variance Analysis

Table 2 indicates that all learning stages had high significant effect size on learning outcome, and the value of effect is increasing from primary education ($g = 0.7301$, $z = 3.0896$, $p < 0.01$) to higher education ($g = 0.8814$, $z = 4.7129$, $p < 0.001$) except for mixed stage. The Q_b achieved significance ($Q_b = 0.09$, $p = 0.965$), meaning that there is no significant difference between the categories. Technical proficiency may be the major factor lead to this result, for high education students have more chance to using mobile devices while low-level students are born with digital resources. So they are all familiar with mobile learning. Thus the difference among them is not obvious.

Table 1 Result get form the random effects model

			95% CI		Heterogeneity test			Tau-squared		
k	N	Mean g	LL	UL	Q(g)	P	I-squared	Tau-squared	SE	Tau
49	4052	0.83***	0.567	1.093	422.6292	<0.0001	93.17%	0.7805	0.1774	0.8834

CI confidence interval
*$p < 0.05$; **$p < 0.01$; ***$p < 0.001$

4.2.2 The Effect Size of Different Intervention Duration and Variance Analysis

Table 2 shows interventions of >12 weeks, and <=36 weeks duration (g = 0.4951, z = 2.4539, $p < 0.05$) had medium effect sizes. Another intervention of <=3 weeks (g = 0.9611, z = 3.0203, $p < 0.01$), those of > = 4 and <=6 weeks (g = 0.7719, z = 4.1109, $p < 0.001$), and those >7 and <=12 weeks (g = 1.2564, z = 3.2375, $p < 0.01$) had high effect sizes. The Q_b did not achieve statistical significance (Q_b = 1.387, p = 0.259), which expresses that the average effect size did not differ significantly among these categories. The trend is to increase first and then decrease, showing that duration between 7 and 12 weeks is more suitable for mobile learning.

Table 2 Effect size of moderators and variance analysis

Category	k	Sample (c/e)	g	z	95%CI	Q_b
Learning stages						0.090
Primary education	17	710,955	0.7301	3.0896**	[0.2669,1.1932]	
Secondary education	5	175,193	0.8717	2.0121*	[0.0226,1.7207]	
Higher education	26	873,1076	0.8814	4.7129***	[0.5148,1.2479]	
Mixed (12–31)	1	25,25	0.9888	3.3001***	[0.4015,1.5761]	
Intervention duration						1.387
<=3 weeks	11	283,253	0.9611	3.0203**	[0.3374,1.5848]	
>=4,<=6 weeks	13	374,383	0.7719	4.1109***	[0.4039,1.1399]	
>7,<=12 weeks	10	432,462	1.2564	3.2375**	[0.4958,2.0170]	
>12,<=36 weeks	15	694,1171	0.4951	2.4539*	[0.0997,0.8906]	
Domain subjects						0.953
Arts	29	1274,1716	0.7740	5.9309***	[0.5182,1.0298]	
Science	20	509,553	0.8970	3.2728**	[0.3598,1.4341]	
Year of experiment						0.793
2010	6	159,135	0.7614	1.4411	[−0.2741,1.7970]	
2011	3	83,85	1.2379	2.2013*	[0.1357,2.3401]	
2012	14	695,974	0.5936	2.9208**	[0.1952,0.9918]	
2013	5	103,102	1.5290	2.9138**	[0.5004,2.5577]	
2014	8	181,249	0.5253	1.4177	[−0.2009,1.2516]	
2015	11	497,659	0.9212	3.8970***	[0.4579,1.3847]	
2016	2	65,65	1.0425	2.2231*	[0.1230,1.9628]	

CI confidence interval
*$p < 0.05$; **$p < 0.01$; ***$p < 0.001$

4.2.3 The Effect Size of Different Subjects and Variance Analysis

Considering the number of sample and the scattered subjects, domain was classified by art ($g = 0.774$, $z = 5.9309$, $p < 0.001$) and science ($g = 0.897$, $z = 3.2728$, $p < 0.01$), and both of them have high significant effect size. The Q_b ($Q_b = 0.953$, $p = 0.498$) manifests the average effect size and did not differ significantly between the two categories. The effect size of science group is higher than art group; we infer that the mobile technology could offer learners exact answer for rational questions in the area of science. But the questions from art subjects are uncertain; using mobile terminal they cannot get enough useful information.

4.2.4 The Effect Size of Different Years and Variance Analysis

Table 2 indicates that effect sizes are fluctuate in different years, and there is no clear pattern of change. Effects in 2012 ($g = 0.5936$, $z = 2.9208$, $p < 0.01$) and 2014 ($g = 0.5253$, $z = 1.4177$, $p > 0.05$) are medium; those in other years had high effect sizes. The Q_b ($Q_b = 0.953$, $p = 0.498$) shows that the average effect size did not differ significantly among those years. In common, the development of mobile learning and devices would improve the performance of learning, because it can bring more functions and learning resources to support instruction compared with formal class. However, the result has nothing to do with that; we guess that the sample is too little and the time span is too short.

4.2.5 The Publication Bias Analysis

In order to guarantee the scientificity and reliability of the research results, the meta-analysis process usually detects the publication bias of the sample data. Appendix 2 shows that the study sample effect value is evenly distributed on both sides of the average effect value, which is the same as the normal value, indicating that publication bias detection is good. We believe that there is no publication bias in this study, and the results of data analysis are reliable and robust.

5 Conclusions and Future Research

The current meta-analysis revealed that mobile learning is significantly more effective than traditional teaching methods, which is consistent with the study conducted by Yao-Ting Sung, Chang, and Liu (2016). Moderator analysis found that integrating mobile devices into instruction is of effectiveness generally, which indicated

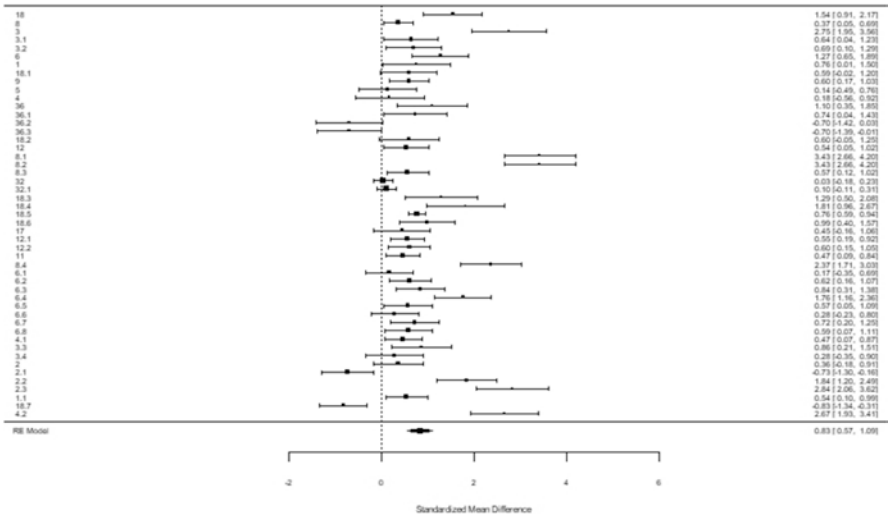
that m-learning is not only for different learning stages but for both subjects of art and science. Hence, teachers could introduce this method to their instruction under the suitable intervention duration decided by the actual needs of teaching and learning. From 2010 to 2016, technology of mobile has progressed tremendously; however, values of effect in years 2010–2016 are waved and have no definite trend, which may explain that technical maturity has no impacts on mobile learning.

The results of this meta-analysis may be due to the convenience of mobile communication technology; it provides learners with more chances than normal class to take spare time to learn (Sandberg, Maris, & de Geus, 2011) and promote the cooperation between teachers and learners (Kim, Lee, & Kim, 2014). Furthermore, new factor of mobile enhances learning motivation (Huang, Yang, Chiang, & Su, 2016), and the efficiency of information acquisition, learners, and teachers with manner of m-learning can make more interactions, feedbacks, and assessments compared with traditional teaching in the equal time.

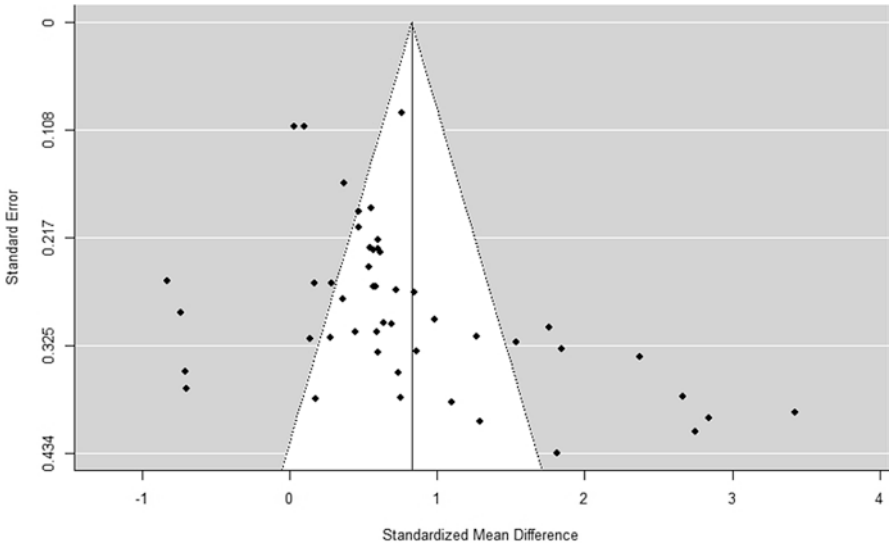
Although m-learning can improve students' learning performance, how the cognitive load and cognitive anxiety brought by mobile device affect learning achievements, and the effects of m-learning on high-level cognition need to be further explored. In addition, because many related researches and data are not available, the sample size is relatively small, which may be the limitation of the research.

Appendices

Appendix 1: Forest plot of the effect sizes and 95% CI of the 34 experiments



Appendix 2: Funnel plot of the effect sizes of 34 experiments



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Implementation of Tool-Based Mathematics Lesson: A Duo of Material and Digital Tools

Huey Lei, Yip Cheung Chan, and Allen Leung

Abstract This paper reports a case study on the implementation of a tool-based mathematics lesson. The design of a tool-based task and the implementation and evaluation of mathematics lessons were analyzed in the lens of a theoretical framework underpinning a duo interplay of material tools and digital tools serving as teaching and learning aids. It was found that material tools and digital tools serve different functions in the manipulation processes. The tools played different roles in the tool-based learning environment where students develop mathematics senses with interplay of the tools.

Keywords Duo of material and digital tools · Tool-based task design · Tool of semiotic mediation

1 Introduction

Norman (1993) reveals that teaching and learning are constrained without assistance of external aids. Proper uses of teaching aids not only can engage students to learn, but also help teachers to reflect on teaching effectiveness. Recent research trend does investigate not only how information and communication technologies can be integrated into curricula and educational practices (Haspekian, 2005), but also the inclusion of concrete artifacts in classroom teaching and learning (Bartolini Bussi & Mariotti, 2008). Didactic research prompts the development of tool-based pedagogy which fosters teachers to teach effectively with tools and engages students to learn actively in class.

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This paper presents a study on investigating the implementation of a tool-based mathematics lesson in which two types of tools are involved. It aims at exploring two main issues related to the research lesson, viz., (1) pedagogical considerations and implementation of the lessons from teacher's perspectives and (2) manipulations of the tools for learning from students' perspectives. In the following sections, we introduce the theoretical frameworks for analyzing the research lesson, followed by the research methods adopted and the findings of this study.

2 Theoretical Frameworks

This study is framed by three related theoretical frameworks. They are theory of tool of semiotic mediation (Bartolini Bussi & Mariotti, 2008), concept of instrumental genesis (Rabardel, 2002), and design of duo of material and digital artifacts (Maschietto & Soury-Lavergne, 2013).

2.1 Tool of Semiotic Mediation

Bartolini Bussi and Mariotti (2008) frame the theory of tool of semiotic mediation to describe the interrelations of tools with other parties in teaching and learning environment. The tools play important role as a mediator cognitively connecting abstract mathematics concepts with activities with the tools. Every tool has its critical features which stimulate users (i.e., students) to generate certain productions in the interaction with the tool. The features of the tools yield semiotic potential of them which cultivates a double semiotic relationship among the tools, the students, and mathematics. First, the tools assist the generation of personal meaning of students in the manipulation process. Second, the tool has the capacity of evolution of the meaning from personal one to mathematical meaning. In other words, this theory emphasizes how students learn something during active participation of activities involving tool manipulation. However, this learning process is not expected to be proceeded automatically. It requires intervention of teachers who orchestrate students to act and think with tools.

Figure 1 shows the theory of tool of semiotic mediation prominently placing tool at its center. The upper part of the figure shows that design of a task critically provokes students to produce some situated texts in manipulation process. Bartolini Bussi and Mariotti (2008) pointed out that the productions at stage are, in general, *artifact signs* which are contextualized in the tools having personal meaning of students. The lower part of the figure represents the teaching goal of the lesson. The artifact signs are being ordinarily converted to mathematical texts or signs which refer to formal mathematics intended to be taught in the lesson. Thus, the connection of artifact signs and mathematical signs is essential for teachers to consider a pedagogy which enables the students to understand how to learn accordingly.

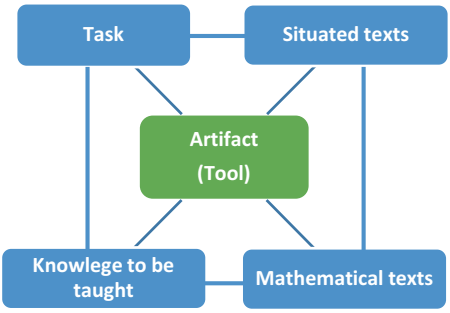

Fig. 1 Artifacts and signs. (Adapted from Bartolini Bussi, Corni, Mariani, & Falcade, 2012)

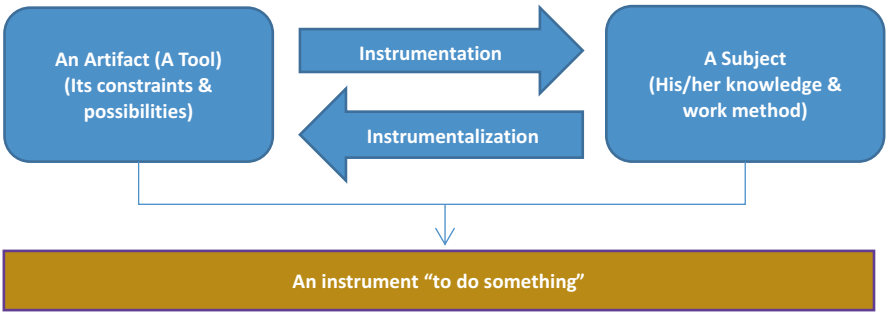

Fig. 2 Instrumentation and instrumentalization. (Adapted from Trouche, 2005, p. 144)

2.2 *Instrumental Genesis*

The generation of productions through students-tool interactions is a complicated process which is called instrumental genesis (Rabardel, 2002). It is pointed out that such process is bidirectional between tools and subjects (i.e., users). In the direction from the tool toward the subject, which is termed as *instrumentation*, the manipulator uses the tool to achieve a certain purpose in a systematic manipulation procedure. This procedure is defined as *utilization scheme* which are specifically developed by the user to accomplish that particular purpose. On the other hand, the user may also intend to further develop specific functionality of the tool, and thus it is a process from the subject toward the tool and is termed as *instrumentalization*. In such situation, the purpose functionality developed by the user may not necessary be an intention of the designer of the tool. It is a combined reaction of the physical component of the tools and the cognitive intention of the user (Fig. 2).

The idea of instrumental genesis is a powerful framework to explore the interacting relation between the tools and the students when the students manipulate the tools in tool-based mathematics classroom settings. Utilization schemes created by the students are essential for analyzing not only the critical features of the tools related to mathematics, but also pragmatic construction of mathematics knowledge of the students.

2.3 Duo of Artifacts

Maschietto and Soury-Lavergne (2013) conducted a research study which investigated how a duo of artifacts (also known as tools) is simultaneously used by students so that students' mathematical learning experience is enhanced. The duo of artifacts is constituted by a physical (i.e., concrete) tool and a digital counterpart (i.e., technological) of the physical one. The theoretical perspective of duo of artifacts is grounded on the instrumental approach (which includes instrumental genesis and other tool-related theories) and the theory of tool of semiotic mediation favoring an articulated use of the tools in the learning process. It illustrates the interplay of the two forms of the tools which provokes students to learn from the existing physical tool and the virtual representation in the digital tool. The interplay emerges through using and improving manipulations between these two tools. The duo of artifacts cultivates students' learning process by using both tools in a single setting. In particular, it considers the differences and complementarities between the two tools in order to discern critical features of the tools. Maschietto and Soury-Lavergne (2013) focused on the features of continuities and discontinuities between the two tools and found that the students determined the features of the objects which influenced their construction of mathematics knowledge during tool manipulation. Moreover, utilization schemes adopted by the students in these two different forms of tools explain the mathematical meaning behind the manipulations of the tools.

The above frameworks provide a lens for us to analyze the design and implementation of the research lesson. In this paper, we present a part of research project, which investigates the interplay of two types of tools concentrating on their functions in a mathematics classroom setting. In particular, we tried to answer the question on how the students learnt mathematics with the use of material and the digital tools for doing measurement. We investigate a case study focusing on a series of research lessons concerning measurement.

3 Method

The aim of this study is to explore interactions among the tools, students, and teachers in pedagogical practices. To answer the "how" question stated above, a single case study is adopted to investigate the teaching and learning phenomenon with in-depth descriptive analysis. Yin (2012) defines case study as investigating ordinary activities with in-depth analysis of their contexts. In this study, the unit of analysis is a series of tool-based mathematics lessons. Teacher's pedagogical considerations in designing, implementing, and refining the tool-based task and his students' learning practices particularly their manipulations with tools are analyzed. The design of the task, flow of the lessons, choices of mathematics topic, and tools are important factors which have been taken into account in the collection of data. Two double lessons for secondary two (equivalent to grade eight) students were designed and conducted

by an experienced mathematics teacher. The researchers observed the lessons unobtrusively. Pre- and post-lesson interviews with this teacher were conducted for probing his perceptions on the tool-based task design and his evaluations of the lessons respectively. Post-lesson group interviews with some students were also conducted for collecting their views to the tool-based learning experience. The double lessons were videotaped, transcribed, and partially translated to English for capturing and analyzing the teaching and learning practices. Moreover, documents, such as lesson plan and worksheets, were analyzed to support and triangulate the findings.

The design of the task (including the worksheets), the interactions among students and the tools were prominently analyzed with the theoretical frameworks mentioned in Sect. 2. Technique of pattern-matching (Yin, 2012) was adopted in data analysis. Two coding schemes were employed to discern the types of signs in emerging productions and usages of tools in the manipulation processes. In the first coding scheme, researcher coded the transcripts in a way of primitively bisecting students' productions into written or verbal forms. The second coding scheme aimed at locating and depicting the utilization schemes of the specific tools according to the usages conducted by the students. After discerning the forms of the productions, the researcher analyzed how they were associated with the manipulations of the tools.

4 Material and Digital Tools

This section presents the details of the research lessons, including the design of the task and the tools used.

4.1 Research Lessons

The case consists of two double lessons (i.e., four lessons) provoking students to use two types of tools to solve a problem. The students were required to estimate the height of the school badge which is located in school playground by using the measuring tools provided. Material tools (including measuring tapes and theodolites) and digital tools installed in tablets (including EasyMeasure and Angle Meter) are designated for the students to measure lengths and angles of elevations respectively.

Two sets of worksheets (i.e., worksheet A and worksheet B) are designed by the teacher. The students worked in pairs. Whereas some pairs were assigned to complete worksheet A, the other pairs were assigned to complete worksheet B. All students were asked to use the designated tools to conduct measurements and estimation in the school playground in the first double lesson. Discussion and students' presentations were conducted in classroom in the second double lesson.

4.2 Task

Two sets of worksheets were designed. They consisted of identical questions except the students' standing positions for performing the measuring activities. Student pairs who worked on worksheet A were asked to stand on a white line marked on the playground to perform the measuring. The other pairs who worked on worksheet B were asked to stand on a yellow line, which is a bit far away from the foot of the school badge, to measure the required objects. The location difference yields discernments of measuring skills and construction of mathematics concepts (e.g., percentage errors of the measurements) (Fig. 3).

There are six tasks in the worksheets. Every student was required to work in pair to measure the specific quantities as stated in the worksheet by using both types of the tools. As an illustrative example, Fig. 4 shows a table on the worksheet. In brief, all students carried out the same measurements with the same designated tools, but some students were standing on the white line, whereas the others were standing on the yellow line.

4.3 Material Tools

One type of the tools is categorized as material tools (also called concrete tools). In this study, measuring tape and theodolite are the material tools which their mechanisms are observable and perceptibly influenced by gestures of users. The students can freely manipulate the material tools in order to have concrete sense of visible movement. At the same time, the concept of length is conceived by the students while the measuring tape is pulling out. The concept of angle is also framed during the process of rotating the theodolite.

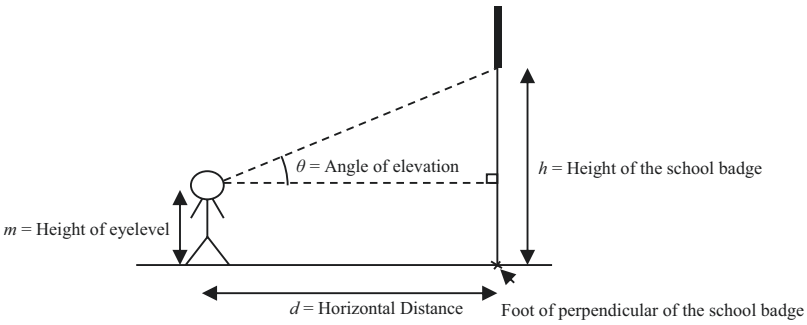

Fig. 3 Figure extracted from the worksheet

Complete the following table:

Distance measured from the foot of perpendicular of the school badge to the first white line (d)		
Method of measurement	Student 1 (in cm)	Student 2 (in cm)
By measuring tape		
By "*Easymeasure*"		

Fig. 4 A part of task one in the worksheets

4.3.1 Production of Signs

We primitively discern the types of signs into verbal and written forms in the first coding scheme. Episode 1 demonstrates a situation in which the verbal and written forms of signs were generated by a pair of students during manipulation of the measuring tape. The verbal form of signs generally refers to the features of the measuring tool (i.e., the tape) and techniques of using it. On the other hand, a written form of signs is found to represent certain kinds of data or numbers generated from the measuring activities.

Episode 1: First Double Lesson

	Verbatim	Code
Student 1:	The measuring tape is not straight	Verbal, straightness
Student 2:	Do I measure your eye level?	
Student 1:	Please mark it down	Written, results
	…	
Teacher:	You can't measure it by yourself. Each one of you holds the two ends of the measuring tape to make it straight	Verbal, straightness
Student 3:	He didn't help me to hold the end	Verbal, gesture

4.3.2 Utilization Scheme

The students developed some specific techniques for manipulating the tools while working on the tasks. Episode 2 shows how a pair of students changed the measuring method in order to fit the actual problem situation. They planned to measure the horizontal distance from their standing position to the foot of the school badge directly. However, they found that the measuring tape was not long enough. Therefore, they divided the measuring into two steps. In the modified method, the students summed up the measured values of the two segments. The constraint of this method was that it would enlarge the possible error. Yet, this is indeed one of the learning objectives mentioned by the teacher in the design of the task.

Episode 2: First Double Lesson

	Verbatim	Code
Student 4:	Method one is to measure the horizontal distance. But, the measuring tape is not long enough. So, method two is to measure the width of stage and the horizontal distance from the stage and then sum them up. But the error is bigger	Verbal, methods of measurements

4.4 Digital Tools

The other type of the tools is categorized as digital tools (also called technological tools). In this study, two apps installed in tablets called EasyMeasure and Angle Meter are the digital tools used in this double lesson. Since the apps are installed in the tablet, the mechanism of functioning is unseen. That means the only observable part is the movements of the students for controlling the tablets, which influence whether correct measured values could be obtained. Thus, the students needed to get use of manipulating the digital tools.

4.4.1 Production of Signs

The productions of students are contextualized in the situations of tool manipulations. It also relates to certain mathematics concepts that some mathematics knowledge should be applied into the situations. The terminology of trigonometric functions shown in Episode 3 connects hands-on manipulations with the tools and the mathematical ideas. The students understood that the measured values were used for calculating the height of the school badge (which is the main task of the problem) by applying trigonometric formulas. However, they reviewed all three formulas of sine, cosine, and tangent in which two of them were not required in that

task. The students should eliminate unnecessary formulas from three of them by looking at the measurable values obtained from the manipulations of the given tools. The mathematical signs would emerge when the students discovered that only the tangent formula was necessary and understood the mechanism of it.

Episode 3: First Double Lesson

	Verbatim	Code
Student 5:	I measured this length [horizontal distance]	Verbal, distance
Researcher:	By using the apps [EasyMeasure] in the tablet?	
Student 5:	Yes. I then measured the angle [of elevation] by using the application [Angle Meter] and then used sine, cosine, and tangent [trigonometric formulas] to calculate the height of the school badge	Verbal and written, trigonometric formulas

4.4.2 Utilization Scheme

Apart from the techniques of using the material tools in the research lessons, the students also developed certain skills of manipulations of digital tools. More importantly, the students, at the same time, conceived some mathematics knowledge in the process. Episode 4 shows the discussion of a pair of students who negotiated on the angle of elevation obtained by the digital measuring tool. A student was curious for the measured value of an angle of elevation which was larger than a right angle. The curiosity reveals that the students possessed some sense about the possible values of angle of elevation. Moreover, after they found that the measured value was unreasonable, they agreed to repeat the measurement by adjusting the method of using the digital tool. In short, the utilization scheme of adjusting the manipulation of the tool was probably emerged while the students encountered an unreasonable answer. To be precise, the students tried to modify their gestures of using the tools in order to obtain a more reasonable measured value.

Episode 4: First Double Lesson

	Verbatim	Code
Student 6:	Looking at the school badge with this [angle meter]	Verbal, method
Student 7:	Why does it show 141 degrees?	Verbal and written, degree of angle
Student 6:	Yes, why is it a hundred something?	Verbal, number sense
Student 7:	Let's do it again	Verbal, method

4.5 A Duo of Material and Digital Tools

In Sect. 4.4.2, we discussed the modification of the way of manipulation of the tools due to an unreasonable value obtained by the students. An interrelation of material and digital tools in a single setting is observed in this case. The original design of the task probes the students to compare the measurements measured by various tools in order to conceive the idea of percentage errors. The students are expected to discover percentage errors during the measurements which are carried out by different students, in distinct locations, and with various tools. The variations stimulate the students to develop the concept of percentage errors as a means for comparing the accuracies of the measurements.

Additionally, Fig. 5 shows a part of worksheet completed by a pair of students. It consists of different values obtained by using material and digital tools (i.e., measuring tape and EasyMeasure, respectively) for measuring lengths. The tables in the figure consist of calculated values according to the measured values and features of the tools. The pair of students obtained 550 cm from the measurement of using measuring tape, while they got 950 cm when EasyMeasure was used.

The reason for such a huge difference between the results of the material tool and the digital tool may be revealed by the following two excerpts of transcripts of post-lesson interviews:

(Using "*Physical Tool*" : measuring tape and theodolite)

	Measured value	Maximum absolute error	Lower limit	Upper limit
d	By measuring tape	0.5	549.5	550.5

(Using "*Electronic Tool*" : IOS apps)

	Measured value	Maximum absolute error	Lower limit	Upper limit
d	By "*Easymeasure*"	0.5	949.5	950.5

Fig. 5 A selected part of worksheet done by a pair of students

Episode 5: Post-lesson Interview with Teacher

	Verbatim	Code
Teacher:	For the technological tool "EasyMeasure" using a camera of the tablet to measure distance, I tested it this morning and got an inaccurate result. For example, if I look at the door [with the tablet], in a right position, it will tell you 550 cm. This makes no sense if it is 550 cm [the distance is about 2 m from the door to the position of the teacher]	Number sense

Episode 6: Post-lesson Interview with Students

	Verbatim	Code
Researcher:	When you were using the tools, did you find any difficulties in using them?	
Student 8:	I did not know how to use the tablet applications. So I did it as I listened to teacher's instruction	Teacher's instruction, functions of tools
Researcher:	What were the difficulties?	
Student 8:	There are some decimal places. So, it seemed that the tablet is not quite realistic to me. I was skeptical if I was wrong	Decimal places

In the post-lesson interviews with the teacher and students, both parties reveal their perceptions of using material and digital tools. In general, the teacher and the students presume material tools are more accurate than digital tools. One reason would be that the digital tools were too sensitive and thus the measured values would change significantly even if the students moved slightly. Therefore, values obtained from material tools could be used as benchmarks to triangulate the numbers generated from digital tools. The students could examine the functions of digital tools by justifying the methods of manipulations of the tools aiming to get similar measured values to the benchmarks obtained by the measurement with material tools.

5 Discussion

In this paper, a series of research lessons is investigated to deliberate significant interrelations of a duo material and digital tools.

5.1 Revisiting the Case

In the study, the teacher perceives the design of the task is to probe the students to conceive mathematics knowledge through three kinds of comparisons. First comparison is made between different locations for conducting the measurements. The second is the comparison between the measurements conducted by individual

students. The third comparison is the uses of different types of tools. These three comparisons aim at yielding the construction of concept of percentage errors. Moreover, the second and the third comparisons are found to additionally conceive interplays of the tools which develop the construction of mathematics knowledge.

For the types of signs emerged in the research lessons, verbal form of signs in general concerns the methods of manipulations of the tools. The students discuss the ways of using the tools with some technical terminologies. Furthermore, in the second double lesson, the teacher and the students discuss the students' calculations based on the measured values and commented on the accuracies of the measurements in different locations and by using different tools. Besides, written form of signs refers to some symbolic representations such as calculation methods and derivation of formulas. To connect these two forms of signs, the terminology of trigonometric functions plays a prominent role to provoke the students to convert the productions from hands-on activities with the tools to organizing and systemic "answers" written on the worksheets. In addition, the productions of the signs are found to emerge in the comparative processes conducted by the students who are using the two kinds of tools to complete the task. That means the signs are viewed as the products generated from the interplaying reactions in between the tools.

The material and digital tools in this case explicitly have an interplay relation in practices. In the duo of the tools, the material tools were used to generate the benchmark of the measurement, whereas the digital tools were used to justify (or legitimate) what was produced by the material tools. In other words, the students tried to remeasure the lengths and the angles by using the digital tools until the values obtained were more or less equal to that obtained by using the material tools.

5.2 Rethinking the Duo of Material and Digital Tools in Our Case

Maschietto and Soury-Lavergene (2013) proposed that each artifact in the duo of material and digital tools adds value to the other artifact so that the students' learning experience could be enlarged and improved. However, the resulting duo in our case was not as effective as what Maschietto and Soury-Lavergne proposed. In the lesson design, the teacher intended to introduce the concept of percentage errors through students' comparison of the measured values obtained from the material tools and that from the digital tools. He assumed that his students would obtain two independent sets of values from these two types of tools. However, his students tried to obtain a consistent set of measurement values by reworking with the digital tools until it matched with what was obtained from the material tools. His students believed that the material tools were more reliable. They were unable to appreciate the requirement of conducting the measurements again by using the digital tools. In other words, the digital tools could not achieve the teacher's pedagogical intention well. Thus, they failed to add value to the material tools. In the following, we will discuss the reason of failure of this duo of tools by evaluating the design and the implementation of this lesson.

Unlike Maschietto and Soury-Lavergene (2013) who designed the digital counterpart of a historical material tool, the teacher in this case used the material tools and digital tools that were already existing for his teaching. These tools were not counterpart of each other, and thus their features were not similar. The only similarity of the two tools was their functions, i.e., measuring lengths and angles. Furthermore, all these tools are general measuring tool. They are not designed for educational purpose and thus do not embed mathematical knowledge per se. Due to this limitation of the tools, the task and teacher's orchestration play a crucial role in determining the success (or failure) of the duo in adding value to each other.

The distinction of the features between material tools and digital tools revealed the pitfalls of the lesson design. The measuring mechanism of the material tools (measuring tape and theodolite) are observable. The students could have concrete sense of visible movement while manipulating the tools. On the other hand, the mechanisms of the digital tools (EasyMeasure and Angle Meter) are hidden. The students could only read off the measured values. Thus, they were working with "black boxes" and relied on their prior mathematical knowledge to make sense of the data provided by the tools. In the perception of the students, the material tools are concrete, whereas the digital tools are abstract. Thus, they trusted the former tools more.

As revealed in Episodes 1 and 2, the students were struggling on the technique of using the material tools. They could verify the correctness of using the tools by observation (for instance, whether the measuring tape was straight enough). Furthermore, since the measuring tape was not long enough (because of teachers' orchestration), the students needed to find an alternative way to use the tools. All the above processes could bring out important ideas about the learning topics. However, the worksheet only required the students to record the results of the measuring activities, whereas the measuring process was de-emphasized (see Fig. 5). It was evidenced from the mismatch of the students' verbal signs and written signs as showed in Episodes 1, 3, and 4. To enhance the transformation of meaning from the utilization of the tools, we propose that some questions related to the working process could be raised on the worksheet so that follow-up discussion is possible. The following are some suggested questions: (1) Describe or draw how you use the tools to do the measure. (2) Were there any difficulties that you faced during the measurement? How did you solve the difficulties?

Unlike the material tools, the mechanism of the digital tools was not observable. Thus, the students could not verify the correctness of the measurement merely through observation. Instead they needed to provoke their mathematical knowledge as well as the results from the material tools for cross-checking (see Episode 4, for instance). However, this was not the teacher's original intention, and the purpose of the duo of the tools was not functioning well. To improve this situation, the teacher may ask the students to make guess on the height of the school badge (the objective of the task) before doing the actual measurement. In that case, the students could make use of their measurement sense (instead of the results of the material tools) as "benchmarking." Thus, the material tools and the digital tools could be put in equal positions (rather than one as benchmark generation and

another as legitimation). We believe that such modification could make the comparison of the measured values obtained from different tools possible and hence enhancing the functioning of the duo of the tools.

Apart from it, our data suggests that both the teacher and the students perceived the material tools were more reliable (accurate) than the digital ones (Episodes 5 and 6). The reason was that the digital tools were too sensitive. The measured values would change significantly even if the user has made a slight movement. In other words, the digital tools in our case were difficult to be used. In view of the nested pedagogical frame for tool-based task design (Leung, 2015), establishing practices is essential for the development of more extended cognitive modes such as critical discernment and situated discourse. We suggest that the teacher should arrange a session for practicing the use of the digital tools before conducting the learning task. This is especially important for those tools which are available in the market and not tailor made for educational purpose, like the tools chosen in our case.

To conclude with, we have proposed some suggestions on fine tuning the arrangement of the tasks. Although these suggestions were only some minor refinements, we believe that they could increase the effectiveness of the task especially enhancing the functioning of the digital tools.

Last but not the least, our data leads us to rethink the concept of the duo of tools. From a philosophical perspective, one may consider the two types of tools as a whole that neither one of them could stand alone in the learning environment. In such case, we put this idea forward to propose that a compounded tool consisting of duo parts of representations is considered in the case. Therefore, mathematics teachers should make a balance between orchestrating material and digital parts of the tool in order to conceive a situation where students could critically manipulate either material part or digital part of the tool to legitimate the functions of the other part. Previous research studies illustrate that students perform different utilization schemes during manipulations of material and digital tools accordingly. From the viewpoint of single tool containing duo parts, it could be said that a utilization scheme includes switches between the material part and the digital part for the purpose of discerning critical features of them. Some research studied digitalizing a material tool as a virtual tool, for instance, Arzarello and Robutti (2010). The presumption in such research regards virtual tool as a kind of "new" tool which generates an innovative representation of knowledge through its mediation. Moreover, further study is suggested to explore any possible forms of interplay of duo part of the tools, specifically stimulating students to generate artifact and mathematical signs.

6 Conclusion

The preliminary findings contribute to empirical study of the idea of duo of tools for enhancing tool-based mathematics teaching and learning in class. Teachers should design tool-based tasks according to critical and relational features of the tools.

Students should have opportunity to communicate between the productions generated from both tools. This study is the first step to analyze the integration of both material and digital tools in classroom setting. Further in-depth investigation will be conducted to demystify the interrelations of these two types of tools.

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Global Learners' Behavior on News in Social Media Platforms Through a MOOC

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Abstract Social media have played a significant role in modern life through popular platforms such as Facebook, Twitter, and WeChat. In a MOOC, "Making Sense of News," global learners participating in the course discussed local journalism practices in different countries. Over 900 messages were posted in the course during a period of 6 weeks. This paper explores how these participants discussed not only traditional journalism but also how verified and non-verified news were disseminated through social media in the course forum. NVivo 11 has been used to do theme coding and analysis. Among over 950 postings in the forum, "social media" emerged naturally in the forum discussion as one of the high-frequency phrases, even though the focus of the course was on practices in national and local corporate news agencies. There were 398 postings made by participants from the top five countries (Canada, China, Hong Kong, India, and the United States) in examining the various ways that news is disseminated. Findings show factors affecting news dissemination through social media, including individuals having greater interest as citizen journalists, making an impact, and responding to government control among the majority of global learners.

Keywords Social media · News · Journalistic practice · Massive online course

1 Introduction

Massive open online courses (MOOCs) aim to provide opportunities for anyone with an interest in learning but with no prior academic entry qualifications. Nowadays, learners have direct access to courses offered by internationally renowned professors from world-class universities via popular platforms such as edX, Coursera, and FutureLearn as long as they have a connection to the Internet. There are some common features to engage learners in the 4–6 weeks of self-study.

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For instance, short video-based presentations by the lead professor in person, animated content, or a mix of both formats are commonly used to explain concepts. Learners can hear and see the teaching staff, although they will never meet in person. However, learning online is not about listening to recorded lectures. Apart from watching weekly videos with questions for contemplation, learners are set a variety of learning activities, including reading relevant web resources, doing quizzes, taking part in forum discussions, participating in synchronous discussions, doing short writing tasks, and completing essays. Results of quizzes, essay writing, and meeting the minimum requirements of forum participation are counted in the overall assessment in a MOOC. Some MOOCs are designed for individual learning experiences, with content that disregards the number of learners in these courses. Adult learners can learn through a reflective process in a variety of learning and assessment tasks. They can take advantage of the flexibility of the online environment to acquire knowledge and skills through self-paced or weekly, structured, live MOOCs (Perna et al., 2014). There is a mix of learning opportunities that allow learners to self-assess and co-construct learning with other global learners through dialogic interactions among learners with diverse backgrounds and experiences. Participating in online discussion can encourage learners to reflect on and evaluate what they have learned when they compile their thoughts and questions (Vonderwell, Liang, & Alderman, 2007).

2 Background of the Study

This study explores a MOOC, "Making Sense of News," as an introductory-level course in which learners are expected to have 2–3 hours of weekly study, and two successful rounds were offered in 2015 and 2016. This course serves to teach participants how to examine the validity and reliability of sources of information in news reports and social communications. Topics of the course included:

- What makes news? The blurred lines between news, promotion, and entertainment
- Why does news matter? Social sharing and the dynamics of the news cycle
- Who provides information? How to evaluate sources in news reports
- Where is the evidence? The process of verification
- When should we act? Recognizing our own biases
- How do we know what we know? Becoming an active news audience

Global learners registered for the course are required to complete a combination of writing tasks and quizzes during the 6-week program, but discussion in the MOOC forum is voluntary. While the forum provides a space for clarification of knowledge and exchanges of experience when learners contribute around the clock, the unfolding situation in forum discussions allows them to reflect on critical stances and interpretation of news. Forum activities in 2015 are investigated in this study,

which explores the natural voluntary responses of those who participated in the forum activities. Making attempts in a quiz or posts on course forums are regarded as active learning after the MOOC commencement date (Grainger, 2013).

3 Methodology

Qualitative data posted in the 2015 course discussion forum were collected. All data from forum discussions were first extracted from the course, and postings made by the teacher and teaching assistants were removed. The top four countries and Hong Kong in the forum activities were identified using Tableau. The postings by the course team in Hong Kong were checked and were removed separately from the postings by participants. The first round of coding was conducted based on subject-specific posts, highlighting the central ideas from each post and excluding posts related to assessment logistics and technical problems from the five locations. Coding was done using NVivo, and individual posts were sorted under "country" and grouped under "country case." Keyword search was conducted on "social media" and "government." Queries were also conducted with the software to explore how social media were used in each location. Auto-coding on sentiment was run, and content was screened through the five locations to investigate both the positive and negative influences of social media in the context of the MOOC.

4 Results

One hundred fifty-six participants made contributions to the MOOC forum, and 398 postings (51% of all postings) were selected for coding. Fifteen from Canada, 26 from China, 20 from Hong Kong, 15 from India, and 80 from the United States were sampled in the study. This paper examines three aspects generated under "social media," including the impact on (1) news broadcasting through mass media platforms, (2) individuals who start taking up the role as "journalists" without professional training, and (3) government influence on news broadcasting in print and social media platforms.

4.1 Power of Social Media for News Broadcasting

Social media play a role in providing a balanced voice, whether it is state-owned or people-generated. This creates a space for individuals to build critical awareness in news shared through the platform, an alternative source of regular news media (print-based or online).

> The reason why behemoths like BBC or CNN would use unverified sources at all speaks to agenda, and the power of social media to outpace the stodgy tradition of broadsheet verification. #73 Canada

> I think one of the challenges with the internet and the proliferation of online news is that anyone can post a "news" story – or opinion, as the case may be – that includes information that backs up their particular opinion. Organizations representing both the right and left wings of the US government selectively use statistics to make their points, which means people who lean one way or another can always find the "proof" they need to back up their side. I think it's a good thing that we engage in these conversations (after all, would they happen if not on Facebook?), but I think people also need to be aware that not everything they find on the internet is necessarily factual. #670 United States

> Now that so many people get their news only from social media, I think now people are more "bubbled" in a sense that they only read things with the same point of view as them since news that come at their feed is usually from his/her friends (which has a fairly high chance to share same views as him/her) or news came up from algorithms developed from their news preference. #246 India

> To be honest, news is very powerful, even it can control and change our thinking. Often there may appear one piece of fake news on social media platform, but many people may think it is true and it will bring bad effect. #362 China

4.2 Citizen Journalist

In the general public, news consumers take social media as a tool to broadcast things that happen around them despite not having professional training. Sharing information or news is a matter of a few clicks or making on-site capture and reporting through social media. Social media can be a form of civic engagement.

> It [Occupy Central] transformed my regard for Twitter from "foolish waste of time" to "important communication tool". #340 Hong Kong

> As I am a student at a high school, I share on a daily basis a dozen articles related to my study field. The sharing is essentially done through Facebook and Twitter, the most followed social media. It becomes like a duty for me. Any good information must be shared. #188 Canada

> In the key points discussion it was suggested to check social media to get different angles on a news story. Given that I am new to using social media, and really only regularly use Facebook, and other than comments which are extremely subjective I'm not really sure how this would be used any differently than reviewing other news media websites. #230 United States

> As a journalist, I do in fact use social media significantly, but I not only use it to find story leads but also to contact people I would not otherwise be able to contact. I did a story about the tuition strikes in… #323 United States

> My question is a common one, is there anything I can do to contribute to those urgent issues I care about? I do believe that public opinion would influence government's attitude towards social concerns to some extent, even in China. #638 China

4.3 Government Influence

Media corporations are revenue-driven, and the influence of industry and government bias in storylines is pervasive. Nevertheless, MOOC participants from different locations shared various degree of government influence on news broadcasting.

> I am originally from Cuba, and I know firsthand how powerful reliable news sources are. For decades the news that got to Cubans in the island were not only filtered but manipulated. Passing news from one person to another instead of getting them from official sources had been common practice in my country before online social media even existed. Another example was the recent events in Venezuela. One of the first things that the government did to take back control was to decline access to social media sites, as well as shut down all official news sources in order to keep citizens in the dark. #521 United States

> Well, as a native Chinese, I don't have access to Google, YouTube and other important websites for information if I don't use a VPN, which makes it hard for me to get the "true" view of my country. Most local news media are controlled by government, so I assume most news reports are results of promotional and/or publicity efforts, which leads them away from the truth. We have social media like Weibo, however, it works under high regulation. It seems that any news that can drive people's concerns about politics, environment, human rights faces high risk. This makes me eager to explore different perspectives about the community I live. #640 China

> I write about my experiences as a victim of corrupt practices in government establishments, which helps in two ways. It allows me to vent my anger, and it alerts the readers about what they might face and they get an idea of what to do when they have to interact with that same establishment. The thin line between what newspapers published and what magazines published is vanishing in the age of social media. #316 India

> My small-scale classroom survey on social media usage in Hong Kong, Vietnam, Myanmar, Japan and Malaysia so far shows that our students' age group (between 16 and 24) are less likely to use social media to share news stories than my generation does (I'm in my mid-40s). It would be interesting to see if this is a real global trend through large-sample surveys. One thing to note, though: many countries in Asia have strict censorship laws wherein governments are monitoring social media content. Many social media comments are deleted, and outspoken bloggers and "Facebook campaigners" can get arrested. Under such an environment, it is very unlikely that students casually share political news items and comment on them. #694 Hong Kong

5 Discussion

Massive open online courses have a few unique characteristics in an educational setting, and they attract massive numbers of learners to participate in a single cohort compared with traditional online and distance learning courses (Breslow et al., 2013). This MOOC aims to enable news consumers to build an understanding of the processes of news production and how sources should be verified and the likelihood of biases and agendas behind news publishing. Although the use of social media as a means of news broadcasting is not part of the course coverage, the participants

naturally started discussions about news shared in social media when the weekly materials covered the processes of journalistic practice. Social networked platforms go beyond showing personal exchanges, like in Facebook or Pinterest, but sharing news sources is an integral part of news experience (Hermida, Fletcher, Korell, & Logan, 2012). Unlike print-based news, online news audiences have a choice to follow and take actions to share. The ease of spreading news through social media creates bubbles for viewers to obtain clusters of news that spread far more quickly through the networking capacity of platforms (Cha, Haddadi, Benevenuto, & Gummadi, 2010). Spreading is commonly done through friends or followers, as discussed in the MOOC forum. However, websites with icons or buttons for sharing make social recommendations easier (Newman, 2009). This may have a significant influence on news dissemination, but speed of spreading may not guarantee validity through a process of verification by professional journalists. Weblogs as a source of information can be used to verify news, and practitioners are aware of the importance of credibility in blogging, which depends on the credibility of the author, i.e., objectivity and reputation, and accuracy, clarity, and comprehensiveness in content (Nurse, Rahman, Creese, Goldsmith, & Lamberts, 2011).

Citizen journalism is becoming more prominent, and social news is created by citizens as eyewitnesses sharing photos and videos in live blogging as a complex network of participatory practices (Goode, 2009). While mainstream journalists have professional processes, i.e., accuracy and independence, citizen journalists are unpaid, self-selected volunteers publishing alternative sources and frames of interpretation and analysis (Bruns, Highfield, & Lind, 2012). This mode of communication among citizens may influence individuals' civic attitudes and behavior, while information is exchanged that may trigger more critical awareness of problems encountered in both local and international communities (Gil de Zúñiga, Jung, & Valenzuela, 2012). Nevertheless, citizen journalism can serve as a complementary news source for mainstream media, although it is highly unlikely to create a driving force that can trigger significant social change in China (Xin, 2010). This is because controlled mass media still play a significant role as propaganda for the government in shaping citizens' perception (Zhu, Lu, & Shi, 2013).

Nevertheless, cognitive diversity is often observed in MOOCs because prior academic backgrounds range from postsecondary to advanced degrees (Bruff, 2013; DeBoer, Ho, Stump, & Breslow, 2014). More importantly, the global communications in this context may promote socialization and address the needs of learners with diverse backgrounds, both cognitively and culturally (Gillani, Yasseri, Eynon, & Hjorth, 2014). This MOOC provides an open and nonjudgmental space for discussion, while comments made by global contributors can reflect regional phenomena on how social media are adopted for news consumption and distribution.

6 Conclusion

News consumed and disseminated through social media emerged naturally through the MOOC "Making Sense of News." Social network platforms have changed how news is portrayed by traditional media in different regions of the world. On the one hand, social media can provide alternative voice and channels to well-established, state-owned, or corporate news agencies. Individuals can take on the role of journalists to share and publish on-site incidents and can possibly receive viral responses. Nevertheless, some countries with authoritarian governments still have a tight grip on shaping news through manipulation of information and sources.

While participants are better engaged through the open interactions of the forum and are more ready to complete the MOOC (Kizilcec, Piech, & Schneider, 2013), exposure to MOOCs may allow students to gain heightened awareness of biases among different types of publishing agency, deepen their understanding of journalistic practices locally and internationally, and establish values of students and consider the values of others. Although knowledge co-construction through the discussion forums occurs in small and episodic snatches (Gillani et al., 2014), the topical discussion contributed to by learners from Canada, China, Hong Kong, India, and the United States showed that participants can build an understanding of both local and international news consumer behavior through the intellectual discussion.

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Part IV
Communication and New Media in Everyday Life

The Relations of Secure Attachment Style and Love Satisfaction with Online Relationship Maintenance

Chi-Keung Chan, Po-Shuen Viann Wong, and Tsz-Ching Candy Lo

Abstract The present study examines the relations of secure attachment style and love satisfaction with online relationship maintenance among dating couples in Hong Kong. There were 100 males and 100 females participated in this study and completed a set of questionnaires to obtain the information on their secure attachment style, love satisfaction, and online relationship maintenance via mobile communication apps (MCAs; e.g., WhatsApp). Linear regression analysis and mediation analysis were employed to analyze the data. Results indicated that there was a significant positive relationship between secure attachment style and online relationship maintenance. Besides, the positive association between secure attachment style and online relationship maintenance was fully mediated by love satisfaction. Furthermore, the positive association between secure attachment style and love satisfaction was partially mediated by online relationship maintenance. The findings of this study highlighted the importance of cultivating love satisfaction for online relationship maintenance.

Keywords Attachment style · Online relationship maintenance · Love satisfaction · Mobile communication apps

1 Introduction

Nowadays, new forms of electronic communication have been playing an important part in interpersonal relationships (Benou & Bitos, 2008; Lai & Katz, 2012). People use mobile communication apps (MCAs), such as WhatsApp and WeChat, to

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contact with others via sending pictures, voice messages, and text messages or just giving calls with audio or video functions (Lai & Katz, 2012). Dating couples use MCAs to keep contact with their lover and to maintain their romantic relationship (Jayson, 2013; MacMillan, 2012). Jeffry (1986) suggested that romantic communication is perceived to play a critical role for the maintenance of love relationship. However, MCAs may have positive or negative effect on this online relationship maintenance. While some people argued that using MCAs may increase love intimacy between lovers, some may argue that it may reduce love quality due to the dehumanization of the MCAs. This study would like to address this debate by investigating how dating couples use the mobile apps to maintain their relationship. Furthermore, it is worthwhile to explore how different attachment styles lead to different patterns of online relationship maintenance? Also, does online relationship maintenance affect the extent of love satisfaction? Therefore, the purpose of this study is to examine how the dating couples in Hong Kong maintain their relationship with mobile communication apps. This study also examines the relationships among attachment style, love satisfaction, and online relationship maintenance.

1.1 Online Relationship Maintenance

In Sternberg's triangular theory of love (1986), he addressed three primary components for all love relationships: intimacy, commitment, and passion. The actions that expended to maintain the nature of the love relationships are called relationship maintenance behaviors (Stafford & Canary, 1991). These relationship maintenance behaviors contribute to relationship stability and longevity. Stafford and Canary (1991) identified five relationship maintenance behaviors: (1) openness, which refers to the desire to disclose information and encompass relational talk to one's partner; (2) positivity, which refers to individual being optimistic and hopeful about the relationship; (3) assurance, which involves talking with the partner about commitment and the future plans for lasting the relationship; (4) sharing tasks, which refers to completing one's responsibilities to the other; and (5) networks, which refers the use of common friendships to keep the relationship functioning.

The concept of relationship maintenance has been expanded to online relationship maintenance behaviors which are defined as behaviors/actions that dating couples use mobile communication apps (MCAs), such as WhatsApp and WeChat, to maintain their love relationship. Brody, Ablon, Brown, Khantzian, and Mack (1993) stated that couples traditionally use nonverbal behaviors such as physical closeness, gazing, and touching to maintain intimacy. However, with the popularity of MCAs, dating couples have one more way to keep interaction with their lover. In this way, they can express their love intimacy even without physically present. Lo (2006) also stated that using MCAs helps couples to maintain their love relationship, for instance, couples can use MCAs to send photos and love messages anytime to one another (Hsu, 2013). Combining with Stafford and Canary's conceptualization of

relationship maintenance behaviors, actions that expended to maintain the nature of relationships and to satisfy one person by using MCAs are called *online relationship maintenance behaviors*. Therefore, the study is to examine the pattern of online relationship maintenance behaviors of dating couples, in other words, the positive or negative (less positive) use of MCAs to maintain love relationship.

1.2 Attachment Style and Relationship Maintenance

Based on attachment theory, Hazan and Shaver (1987) suggested that romantic love is an attachment process in which infant's attachment experiences affect adulthood attachment style and their social skills in establishing an intimate relationship (Mallinckrodt, 2000). Starratt and Shackelford (2012) also suggested that attachment style is critical to the romantic relationship and interaction. Previous studies showed that individuals with secure attachment style reported higher levels of commitment, liking, and relational stability than individuals with insecure attachment style (Collins & Read, 1990; Guerrero & Bachman, 2006; Simpson, 1990). Collins and Read stated that individual differences in attachment style significantly explained variation in relationship maintenance behaviors. And Simpson found that secure individuals reported using more assurances to maintain their romantic relationships than insecure individuals. This study aims to examine whether individual differences in attachment style (secure vs. insecure attachment style) can explain variation in the patterns of online relationship maintenance behaviors.

1.3 Attachment Style, Love Satisfaction, and Relationship Maintenance

Love satisfaction refers to an interpersonal evaluation of the positivity of feelings for one's spouse or dating partner and attraction to the love relationship (Rusbult, Drigotas, & Verette, 1994). According to Hazan and Shaver (1987) and Gillath and Schachner (2006), attachment style is highly associated with love satisfaction. Previous studies found that securely attached individuals reported higher levels of love satisfaction and positively maintained their relationships. According to Péloquin, Brassard, Delisle, and Bédard's study (2013), adults with secure attachment style were found to be better adjusted and relatively resilient and got along well with their lovers. On the contrary, adults with insecure attachment style (anxiety and avoidance) predicted lower love satisfaction (Saavedra, Chapman, & Rogge, 2010).

Previous studies found that there is a reciprocal relationship between online relationship maintenance and love satisfaction. On the one hand, love satisfaction predicts online relationship maintenance. Sanderson and Karetsky (2002) found that love satisfaction predicted romantic relationship maintenance. Individuals in the

mutual romantic situation generally reported the most relationship maintenance behaviors (Guerrero & Chavez, 2005). According to equity theory, individuals who feel equality of a relationship have higher level of love satisfaction and have more positive relationship maintenance to enhance their love intimacy. On the contrary, individuals who feel unfair and unsatisfied in their love relationship have more negative relationship maintenance behaviors (Dainton & Gross, 2008).

On the other hand, online relationship maintenance predicts love satisfaction. Jeffry (1986) suggested that three dimensions of love (intimacy, passion, and commitment) are related to relationship satisfaction. As mentioned above, these three dimensions are also constructs of relationship maintenance behaviors. Hendrick (1988) indicated that one important construct of relationship maintenance, commitment, was strongly related to a higher level of love satisfaction. Guerrero and Chavez (2005) also found that positivity, assurances, and sharing tasks were strong predictors of love satisfaction.

Thus, for this study, it is worthwhile to examine the reciprocal association between online relationship maintenance and love satisfaction. All in all, the study focuses on investigating the interplay among attachment style, online relationship maintenance behaviors, and love satisfaction.

1.4 The Present Study, Conceptual Framework, and Hypotheses

There are a number of previous studies on the relations among attachment style, love satisfaction, and offline relationship maintenance; very few studies have focused on the interrelationships among attachment styles, love satisfaction, and relationship maintenance behaviors on using mobile communication apps (MCAs). Thus, there are four purposes in this study: (1) to investigate the usage pattern (positive versus negative) of MCAs in relationship maintenance, (2) to explore the relationship between secure attachment style and online relationship maintenance behaviors, (3) to investigate the mediation effect of love satisfaction on the relationship between secure attachment style and online relationship maintenance, and (4) to investigate the mediation effect of online relationship maintenance on the relationship between secure attachment style and love satisfaction.

From these four purposes, there are four research questions as follows:

1. Do dating couples in Hong Kong use online relationship maintenance more positively to maintain their love relationship?
2. Is there a significant relationship between attachment style and online relationship maintenance?
3. Is there a significant mediation effect of love satisfaction on the association between attachment style and online relationship maintenance?
4. Is there a significant mediation effect of online relationship maintenance on the association between attachment style and love satisfaction?

The conceptual frameworks for addressing these four research questions are presented below.

In Fig. 1, the first part focuses on the five components of online relationship maintenance behaviors. A higher score in online relationship maintenance indicates that people use MCAs more positively to maintain their love relationships. On the contrary, a lower score indicates that people use MCAs less positively to maintain their love relationship. The first hypothesis (H1) is that dating couples in Hong Kong are more likely to use positive relationship maintenance with MCAs. The second part focuses on the relationship between the attachment style and their usage pattern of online relationship maintenance. It is hypothesized that individuals with secure attachment style significantly use more positive online relationship maintenance than individuals with insecure attachment style (H2).

Figure 2a presents the conceptual framework of testing the mediation effect of love satisfaction on the association between attachment style and online relationship maintenance. It is assumed that there is a significant mediation effect of love satisfaction on the relationship between attachment style and online relationship maintenance (H3). Since the previous literature found a reciprocal relationship between online relationship maintenance and love satisfaction, Fig. 2b shows the conceptual framework to test the mediation effect of online relationship maintenance on the association between attachment style and love satisfaction. It is antici-

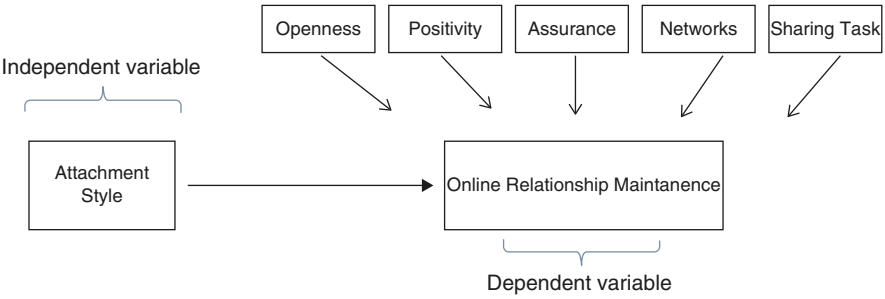

Fig. 1 Conceptual framework for the relationship between attachment style and online relationship maintenance

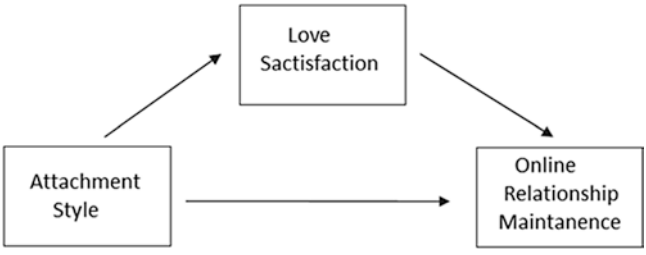

Fig. 2a Conceptual framework for the mediation effect of love satisfaction.

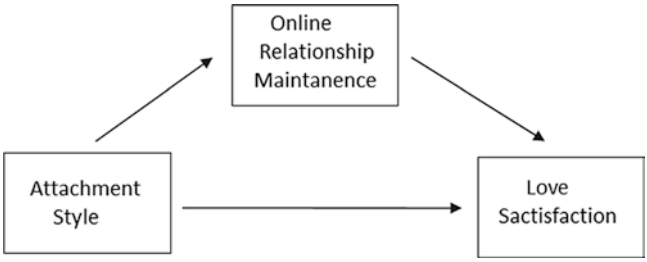

Fig. 2b Conceptual framework for the mediation effect of online relationship maintenance

pated that there is a significant mediation effect of online relationship maintenance on the association between attachment style and love satisfaction (H4).

2 Method

2.1 Participants

In the fall semester of 2015, 100 males and 100 females were recruited via convenient and snowball sampling methods. The average age of both male and female participants was in a range of 18–21 years old. The selection criteria for participants were as follows: (1) they were committed to a love relationship (M = 2.01 years), either heterosexual or homosexual (only 1% of participants reported that they are homosexual), when they participated in this study, and (2) they use MCAs in smartphones to communicate and interact with their lovers. The participants were invited to complete a questionnaire regarding their attachment style, online relationship maintenance behaviors, love satisfaction, and basic demographic information. There were two modes of data collection: (1) a paper-and-pencil survey questionnaire (15%) to collect data in person and (2) online survey questionnaire via Facebook (85%). Validity analysis was conducted and did not find any significant differences in responses between the two modes of data collection.

2.2 Measures

The survey questionnaire of this study includes four sections: demographic information, the Attachment Style Inventory (ASI; Wang, Lin, & Zhang, 1996), the Relationship Maintenance Strategies Measure (RMSM; Stafford & Canary, 1991), and the Relationship Assessment Scale (RAS; Hendrick, 1988).

Demographic The demographic section in the questionnaire was designed to record the participant's age, gender, religion, and length of current love relationship

involved. At the beginning, all participants needed to report if they were committed to a love relationship. If yes, they were invited to report the duration range of the love relationship. Also, participants needed to report their age range on an ordinal scale (1 = below 18 years old, 2 = 18–21 years old, 3 = 22–25 years old, 4 = 26–29 years old, 5 = above 30 years old).

Attachment Style The Attachment Style Inventory (ASI), a Chinese version scale developed by Wang, Lin, and Zhang, (1996), was used to measure an individual's attachment style. The scale contains four subscales in different domains of attachment styles: secure attachment, preoccupied attachment, fearful attachment, and dismissing attachment. There are 24 items in the scale, and each subscale has six items. The participants rated each item on a 6-point Likert scale where 1 = strongly disagree and 6 = strongly agree. Only items of secure attachment were adopted in this present study. The total score of secure attachment style were calculated by summing all the marks in six items (range: 0–36). The participants were classified into secure or insecure attachment style based on the median score (50th percentile) with those above the median as those with secure attachment style. The ASI has high reliability and validity in previous research (Wang, Lin, & Zhang, 1996); the average reliability coefficient (Cronbach's alpha) for the secure attachment subscale was .79. In this present study, the reliability for secure attachment subscale was also good (α = .71).

Online Relationship Maintenance Online relationship maintenance was measured by ten items adapted from the Relationship Maintenance Strategies Measure (RMSM; Stafford & Canary, 1991). Five subscales of RMSM are operationalized as five maintenance behaviors: positivity, openness, assurances, social networks, and sharing tasks. Due to the objective of examining the role of mobile communication apps (MCAs), the scale was edited by the researcher to fit into the context of online relationship maintenance. Participants were asked to indicate how much they agreed to each of the ten items on a 6-point Likert scale with 1 for strongly disagree and 6 for strongly agree. The total score for online relationship maintenance was calculated by summation of the scores of the ten items. A higher total score indicates more positive online relationship maintenance usage. Since this is a modified scale, the researcher arbitrarily decided to use a score of 33 (55%) as a cutoff score for determining less and more positive usage level. For participants who got a score of 33 or above, they were perceived as positive online relationship maintenance users, while for those who got a score between 0 and 32, they are perceived as less positive online relationship maintenance users.

From the previous research, the RMSM had high reliability and validity. The average reliability coefficients (Cronbach's alpha) for each subscale in the original version were as follows: positivity (α = .84), openness (α = .86), assurances (α = .81), social networks (α = .83), and sharing tasks (α = .81). In this present study, the overall scale had a good reliability (α = .85). However, the reliabilities for all subscales in the present study were lower than the original version: positivity

(α = .68), openness (α = .79), task sharing (α = .57), network (α = .72), and assurance (α = .75).

Love Satisfaction Love satisfaction was measured with a 7-item scale adapted from a Chinese version of Relationship Assessment Scale (RAS; Hendrick, 1988) and was translated by Zhang and Lu (2007). Participants were asked to indicate how much they agreed to these seven items on a 5-point Likert scale with 1 for strongly disagree and 5 for strongly agree. Items 6 and 7 were reverse-scored items. A total score across seven items was computed to indicate the levels of love satisfaction. A higher score indicates higher love satisfaction. The scale had a good reliability in the original study (α = 86) as well as in this present study (α = .89).

2.3 Procedures

For the paper-and-pencil survey participants, the researcher obtained the informed consent from the participants after providing information about the purpose of the study, the potential psychological risks during the participation of this study, the participants' rights to withdraw their participation without any consequence, and information about further counseling services. For online survey participants, these messages could be seen on the online consent form before taking the online survey. After the researcher obtained the informed consent from participants, participants were invited to complete the questionnaire. After the participants completed the questionnaire, the researcher delivered a debriefing to the participants. For online participants, they received a debriefing note at the end of the online questionnaire. The participants who did not meet the selection criteria also received a thank you message as well as a debriefing note.

2.4 Data Analysis

Linear regression analysis and mediation analysis were conducted to analyze the relations among secure attachment style, love satisfaction, and online relationship maintenance. All the analyses were conducted with SPSS 21.0. Firstly, a one-sample t-test was conducted to investigate whether participants were more likely (higher proportion) to have positive online relationship maintenance. Secondly, a simple linear regression was conducted to investigate whether individuals with more secure attachment style have more positive online relationship maintenance behaviors. Thirdly, two mediation analyses were conducted to test the mediating role of love satisfaction on the relationship between secure attachment style and online relationship maintenance as well as the mediating role of online relationship maintenance on the relation between secure attachment style and love satisfaction.

3 Results

3.1 Pattern of Online Relationship Maintenance

The study decided to use 33 (55% as a cutoff) as a cut score for more or less positive usage level. The results showed that about 90% of participants ($N = 180$) use online relationship maintenance positively, and about 10% of participants ($N = 20$) use online relationship maintenance less positively ($t = 18.809$, $df = 199$, $p < .001$). Therefore, the results supported the first hypothesis that a majority of dating couples in Hong Kong positively used MCA to maintain their love relationship.

3.2 Attachment Style and Online Relationship Maintenance

The results of linear regression analysis showed that secure attachment style was a significant predictor for the online relationship maintenance ($\beta = .167$, $p = .018$). There was a positive significant relationship between attachment style and online relationship maintenance. These results supported the second hypothesis that individuals with more secure attachment style used more positive online relationship maintenance than individuals with less secure attachment style.

3.3 Mediation Effect of Love Satisfaction

According to Baron and Kenny (1986), there are three conditions in confirming a mediation effect. In testing hypothesis 3, for the first condition, the mediation analysis showed that secure attachment style was a significant predictor for online relationship maintenance ($\beta = .167$, $t\,(199) = 2.385$, $p = .018$). For the second condition, secure attachment style significantly predicted love satisfaction ($\beta = .279$, $t\,(199) = 4.088$, $p < .001$). For the third condition, love satisfaction significantly predicted online relationship maintenance ($\beta = .178$, $t\,(199) = 3.036$, $p < .001$). For the last condition, secure attachment style became insignificant after love satisfaction was entered into the model ($\beta = .117$, $t\,(199) = 1.630$, $p = .105$). It showed that the direct effect from secure attachment style was not significant when love satisfaction was controlled. Thus, love satisfaction had a full mediation effect on the relationship between secure attachment style and online relationship maintenance. Thus, hypothesis 3 was supported.

3.4 Mediation Effect of Online Relationship Maintenance

In testing hypothesis 4, the mediation analysis for the first condition showed that secure attachment style was a significant predictor for love satisfaction ($\beta = .279$, t (199) = 4.088, $p < .001$). For the second condition, secure attachment style significantly predicted online relationship maintenance ($\beta = .167$, t (199) = 2.385, $p = .018$). For the third condition, online relationship maintenance significantly predicted love satisfaction ($\beta = .169$, t (199) = 3.036, $p < .001$). For the last condition, secure attachment style was still significant after online relationship maintenance was entered into the model ($\beta = .251$, t (199) = 3.669, $p < .001$). It showed that the direct effect from secure attachment style was still significant when online relationship maintenance was controlled. However, the beta coefficient dropped to .251. Thus, there was a partial mediation, and hypothesis 3 was partially accepted.

4 Discussion

For hypothesis 1, the findings were consistent with the previous studies that a majority of dating couples in Hong Kong used MCAs positively to maintain their love relationship (Bergdall et al. 2012; Hsu, 2013; Lo, 2006). The results also supported hypothesis 2 that secure attachment style significantly predicted online relationship maintenance, similar to the findings of offline relationship maintenance (Collins & Read, 1990; Guerrero & Bachman, 2006; Simpson, 1990). Supplementary analyses showed that secure individuals used more assurances and romance with MCAs to maintain their love relationships than insecure individuals. Besides, individuals with secure attachment style reported significantly higher levels of commitment, liking, and relational stability under the online relationship maintenance.

For hypothesis 3, the mediating effect of love satisfaction was supported, and a full mediation effect was found. The study confirmed that love satisfaction played a complete mediating role between secure attachment style and online relationship maintenance. Secure attachment people seemed to have higher levels of love satisfaction which in turns led to the positive use of online relationship maintenance (Péloquin et al., 2013). Again, these results showed consistency with previous studies about offline relationship maintenance (Dainton & Gross, 2008; Guerrero & Chavez, 2005; White, 1983).

For hypothesis 4, a partial mediation effect of online relationship maintenance was found. In other words, the relationship of secure attachment style and love satisfaction only slightly weakens after controlling for online relationship maintenance. Although the hypothesis was partially supported and consistent with previous studies (Guerrero & Bachman, 2006), online relationship maintenance played a relatively weak mediating role between secure attachment style and love satisfaction.

Based on the findings, there are several important implications for this study.

First of all, the results indicated a benefit of the positive use of mobile communication apps in maintaining love relationship. It provides couples ways to increase love intimacy via the positive uses of MCAs. Secondly, this study found that there were significant interrelationships among attachment style, online relationship maintenance, and love satisfaction, adding significant contributions to the existing literature about the relations of attachment style and love satisfaction with relationship maintenance.

Moreover, the findings of this study provide important implications for relationship or family counseling practice. It is vital to inform the dating couples that the appropriate use of MCAs could have potential benefits in maintaining their love relationship. Nevertheless and most importantly, the results supported and emphasized the important role of love satisfaction in relationship maintenance. Couples should emphasize more on cultivating the fundamental elements of love satisfaction instead of just the ways they maintain the love relationship. Fletcher, Simpson, and Thomas (2000) also proposed that relationship quality components include trust, respect, commitment, satisfaction, passion, and intimacy.

Gender difference has not been explored in the present study. Previous researchers found gender difference in the perceptions of love (Gagnon, 1981; Tam, 2011). Previous research also found that intimacy and passion predicted women's relationship satisfaction, in both heterosexual and lesbian relationships (Cusack, Hughes, & Cook, 2012). Besides, previous studies showed that female would use more positive relationship maintenance to maintain a romantic relationship (Stafford & Canary, 1991). Lastly, Ottu and Akpan (2011) found that the interaction effect of attachment style and gender on relationship maintenance was found to be significant in their study. These previous studies suggested the significant role played by gender, and future studies should test the gender difference for our existing prediction model in order to get a better understanding of the interrelationships among attachment style, online relationship maintenance, and love satisfaction.

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A Study on the Impact of Involvement in Violent Online Game and Self-Control on Hong Kong Young Adults' Psychological Well-Being

Charlotte Ting Yan Yeung and Raymond Chi Fai Chui

Abstract In the recent era, online gaming has been integrated into the modern culture. With a gadget, it is very handy to get access to any online game. Among different types of online game playing, violent online game has grown to be a prevailing entertainment around the globe. This study aims to examine the relationship between Hong Kong young adults' involvement in online violent game and psychological well-being, the relationship between self-control and psychological well-being, as well as the moderating role of self-control in the relationship between involvement in online violent game and psychological well-being. To answer this question, 718 respondents were invited to fill in a questionnaire. Results have demonstrated that there is a significant negative relationship between young adults' involvement in online violent game and psychological well-being and a significant positive relationship between self-control and psychological well-being. It was also found that participants with higher levels of self-control had higher levels of psychological well-being as compared to those with lower levels of self-control. Implication of the findings was discussed.

Keywords Online game · Self-control · Hong Kong young adults · Psychological well-being

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1 Introduction

In the era of information technology, online gaming is one of the major entertainments for young people. Anderson (2010) estimated that 66% of the young people aged 17–22 are involved in action video violent games; the number of violent game usage has soared by 30% within 10 years. Similar situation has been found in Hong Kong. A local study revealed that over half of the Hong Kong residents aged 14–45 played online games, and they used 46% of their leisure time playing these games while using 35% in the Internet (Fung, 2013). Gaming addiction could be a mental health hazard which is associated with low self-esteem, poor social relationship, aggression, and negative emotions among Hong Kong teenagers (Wong & Lam, 2016). Therefore, this research aims to study Hong Kong young adults' involvement in violent game and will also examine how will Hong Kong young adults' involvement in violent game affect their psychological well-being. Likewise, self-control can be associated with online gaming. The amount of time spent on video games is related with players' level of self-control (Brockes, 2014). Hence, this research also aims to examine how self-control affects young adults' involvement in online violent game and young adults' psychological well-being.

Online violent game can be defined as online game with battlefield or fighting element, which allows players to employ devastating weapon to destroy, shoot, and kill (Markey, 2010). Most of the research that indicate a negative effect of violent game has adopted the General Aggression Model (Anderson & Bushman, 2002). Greitemeyer (2014) suggested that habitual violent game playing is a risk factor to increase daily aggressive behavior, such as feeling restless and irritated. He further added that such feeling is found to hinder the daily interaction and relationship with friends. The possible unpleasant experience caused by daily aggressive behavior implies that habitual violent game playing can affect player's psychological well-being negatively. The abovementioned studies have investigated the situation in the USA and England. However, none of them have focused on examining the online violent game involvement and the situation in Hong Kong. Thus, this study accentuates to explore on whether there is also a relationship between involvement in violent online game and psychological well-being of Hong Kong young adults.

Self-control is one's ability to control emotions, thoughts, and behaviors, in order to change one's current state (Brockes, 2014). People with high level of self-control are less likely to be distracted by immediate pleasures and temptations (De Ridder & Gillebaart, 2017). In contrast, low self-control is associated with a wide range of individual problems, including academic failure and deviant behavior. Self-control enables individuals to give up immediate impulses which lead to a more balanced life and have more control in the daily lives and in turn promotes good functioning and well-being (De Ridder & Gillebaart, 2017). Engaging in healthier lifestyles and desirable activities directly contributes to greater life satisfaction. Self-control is also positively related with one's relationship with families

(Kross, 2012). Individuals feeling more capable of controlling their life have higher frequency of experiencing happiness in their familial relationship, as they have higher ability to restrain themselves from saying harmful words. Therefore, a higher level of self-control is related with more pleasant daily relationships with families and friends. It can be seen that self-control can serve as a contributing factor to affect one's psychological well-being.

Concerning the relationship between level of self-control and involvement in violent online games of Hong Kong young adults, there is no previous research that accentuate on this relationship among Hong Kong young adults. Violent online game playing is largely related with addiction problem in American teenage period (Beheshtian, 2014). Akin (2012) suggested that in his experiment on Scotland college students, addiction in online game playing is affected by their level of self-control; college students who are able to control their time spent on online gaming have a lower probability of addiction in game playing. Previous studies suggested that self-control is a moderator to weaken the effects of drug addiction and gambling addiction (Goldstein, 2012; Petry, 2001). Strong level of self-control can have a profound positive impact and serves as a protective factor against substance abuse and pathological gambling. Self-control regulates antisocial and delinquent behaviors, thoughts, and emotions (Piquero, Jennings, & Farrington, 2010). Self-control is an ability that enhances individual strength to achieve desired outcomes and avoid psychosocial problems (Finkenauer, Engels, & Baumeister, 2005). The above studies suggested that level of self-control helps lower the negative impacts of online game playing addiction. However, there is no previous study that examines the effect of self-control on the involvement in online game playing. Based on the above findings, this study hypothesizes that self-control is a moderator to the relationship between involvement in online violent game and psychological well-being. The following hypotheses were formulated based on previous research:

H1: Involvement in violent online game is related with psychological well-being
H2: Self-control is the moderator to the relationship between involvement in violent online game and psychological well-being

2 Method

2.1 Participants

This research included 718 respondents. Among them, 43.5% are male respondents, and 56.5% are female respondents. The respondents are aged from 18 to 24. Secondly, for the educational level of the respondents, 11.4% are F.4–F.6, 82.3% are in college or university, and 5.4% are postgraduates.

2.2 Procedure

This is a quantitative research with cross-sectional survey design. The researcher adopted a convenient sampling method. A self-administrative questionnaire was distributed to around 700 young adults (aged 18–30) who play video games. The researcher distributed the questionnaires to schoolmates, church friends, and peers who play online violent game from January to February 2017.

2.3 Measures

Involvement in Online Violent Game The scale was based on the eight-item Game Play Motivations Scale, which was developed by Yee in 2007. Items were revised from the original to measure the respondent's involvement in online violent game. The eight-item are, namely, acquiring rare items, optimizing your character as much as possible, competing with other players, chatting with other players, being part of a guild, keeping in touch with your friends, learning about stories and finding strategy to win, and creating a background story and history for your character. The higher the scores, the higher is the respondent's involvement in online violent game. Cronbach's alpha of this scale is 0.952.

Psychological Well-Being The new measures of well-being will be employed, which was developed by Diener in 2008. The scale is comprised of eight questions. Psychological well-being is examined in four domains, namely, relationship with others, self-esteem, purpose and meaning, and optimism. The higher the score, the higher is the respondent's psychological well-being. Cronbach's alpha of this scale is 0.894.

Self-Control 10-Item Self-Scoring Self-Control Scale will be used, which was developed by Tangney, Baumeister, and Boone (2004). This is a ten-item instrument to measure one's level of self-control. After doing the ten-item, all the checked boxes will be added up and divided by 10. The maximum score on this scale is 5 (extremely self-controlled), and the lowest scale on this scale is 1 (not at all self-controlled). The higher the score, the higher is the respondent's level of self-control. Cronbach's alpha of this scale is 0.744.

3 Results

Firstly, for involvement in online violent game, the mean score is 11.24, the minimum score is 0, the maximum score is 24, and the standard deviation is 8.03; the higher the score, the higher is the respondent's involvement in violent online game.

Table 1 Multiple regression analyses: involvement in online video game, self-control, and psychological well-being

		Psychological well-being	
Variables	B (coefficients)	β (standardized beta)	t
Involvement in online violent game	−.302	−.305	−8.018***
Adjusted R^2	.092		
Involvement in online violent game	−.270	−.273	−7.586***
Self-control	.319	.326	9.044***
Adjusted R^2	.196		
Involvement in online violent game	−.265	−.268	−7.481***
Self-control	.327	.333	9.281***
Involvement X self-control	.100	.101	2.826**
Adjusted R^2	.204		

*$p < 0.05$; **$p < 0.01$; ***$p < 0.001$

The result reflects that the respondents have moderate levels of involvement in violent online game. For psychological well-being, the mean score is 40.42, the minimum score is 12, the maximum score is 56, and the standard deviation is 7.64, the higher the score, the higher is the respondent's psychological well-being. This result indicates that the respondents have moderate to high levels of psychological well-being, which represents a tendency to think in positive ways and to not think in negative ways. Lastly, for self-control, the mean score is 27.28, the minimum score is 13, the maximum score is 43, and the standard deviation is 4.87, the higher the score, the higher is the respondent's level of self-control. The result indicates that the respondents have moderate levels of self-control.

The three-step method of analysis suggested by Frazier, Tix, and Barron (2004) was applied in the study to examine the moderating effect of self-control on the relationship between involvement in online video game and psychological well-being. Listwise deletion was employed to handle missing data in the hierarchical regression. Prior to the hierarchical regression analysis, the three variables (involvement in online video game, self-control, and psychological well-being) were centered by subtracting the mean from each data point and dividing the standard deviation. In the first step, involvement in online game was included in the model as predictors. In the second step, the involvement in online game as a predictor and self-control was included in the model as a moderator. In the last step, the interaction term of the involvement in online game with self-control was added to the model. The results of the hierarchical regression analyses are summarized in Table 1.

The results of analysis as shown in Table 1 indicate that online violent game in the first block explained 9.2% of the total variance in psychological well-being. Involvement in online violent game had a significant negative relationship with psychological well-being. Those who had higher levels of involvement had lower levels of psychological well-being. When self-control was added to the model in the second block, they explained an additional of 10.4% of the variance in psychological

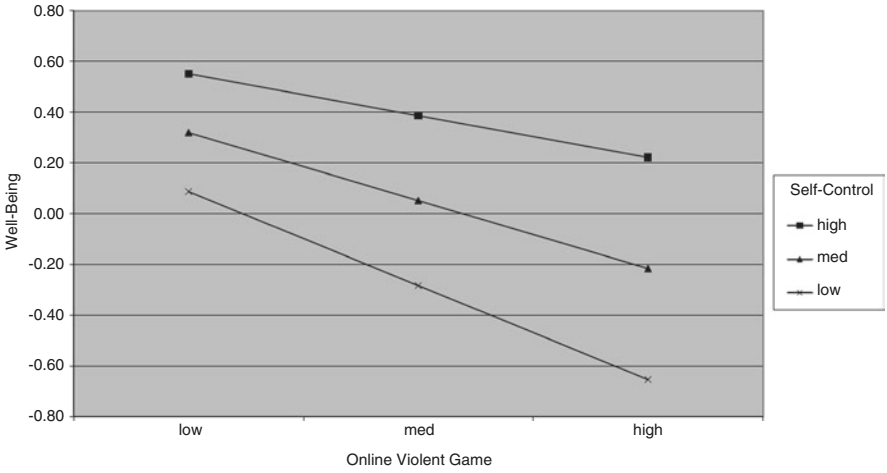

Fig. 1 Moderating effect of self-control on the relationship between online violent game involvement and psychological well-being

well-being. Self-control had a significantly positive relationship with psychological well-being. Those with higher levels of self-control had higher levels of psychological well-being. The interaction term further improved the model when it was added in the third block. The interaction term explained an extra 0.8% of the variance in psychological well-being. The interaction term between the involvement in online video game and self-control was significantly related to psychological well-being.

ModGraph was used to explore the moderating effect of self-control on the association between involvement in online violent game and psychological well-being (Jose, 2008). The value of psychological well-being was plotted according to the predicting variables and moderating variables which were categorized into three groups. The high self-control group was those scored above one standard deviation of the mean (>+1z); the medium self-control group was those scored within one standard deviation above and below the mean (>−1z and <+1z); and the low self-control group was those scored below one standard deviation of the mean (<−1z) (Aiken & West, 1991). Figure 1 indicates that self-control moderated the relationship between the online violent game involvement and psychological well-being. Those with higher levels of self-control had higher levels of psychological well-being as compared to those with lower levels of self-control. When online violent game involvement was low, the difference in levels of psychological well-being was small between those with high levels and those with low levels of self-control. The difference between these two groups was widening when the involvement in online violent game is changing from the low to the high level.

4 Discussion and Conclusion

The purpose of the study was to investigate the relationship between involvement in online violent game and psychological well-being, young adult's self-control and involvement in violent online game, and self-control and psychological well-being. The findings show that all three pairs have a significant relationship.

Firstly, there is a negative significant relationship between involvement in online violent game and psychological well-being, which is consistent with the hypothesis. The result is consistent with Greitmeyer (2014), Oslon (2010), and Brockes (2014) that higher involvement in violent online game has a lower psychological well-being. Those who engaged more in online violent game might have lower esteem and less pleasant experience in daily interactions with people that lead to poor psychological well-being. Secondly, there is a positive significant relationship between level of self-control and psychological well-being. Respondents with higher level of self-control have a higher level of psychological well-being, which means that people with higher ability to control own actions and thoughts have higher self-esteem and more pleasant relationships with others. Thirdly, self-control is a moderator to the relationship between involvement in online violent game and psychological well-being. The finding is consistent with Kross (2012) and Shen and Williams' (2011) result.

From the result, it can be seen that a higher involvement in online violent game leads to lower psychological well-being. It is essential to suggest and implement ways to raise the public's awareness on this finding; thus alleviating the possible negative effect involvement in online violent game can bring to psychological well-being. Moreover, the result also reveals that self-control can help lower the effects of involvement of violent online game on one's level of psychological well-being. In the wake to such finding, which shows how self-control can benefit people, ways of increasing Hong Kong young adults' level of self-control and increasing public's awareness on how self-control is conducive to their well-being should be further explored. Subsequent to the above discussion, suggestions will be made accordingly.

Durkin and Barber (2002) and Allahverdipour, Bazargan, Farhadinasab, and Moeini (2010) both pointed out that an appropriate amount of violent game play has been found to be significant in moderating people's potential well-being. However, excessive violent game play can become problematic and induce detrimental effects on teenagers' psychological well-being. They added that teenagers engaging in excessive violent online game may level up their tendency to involve in aggressive behavior such as physical fight. It can be seen that excessive violent online game playing should be avoided in all means.

To reduce the negative effectives of excessive involvement in online violent game, methods to increase one's level of self-control can be promoted to young adults. Firstly, to start from small steps and minor things in life is a great way to

develop children's self-control. Finland colleges encourage their students to develop or increase self-control by picking up one of their interests such as drawing and dancing and set targets on maintaining it. The counselors in college would invite their students to set goals for attaining the tasks. With the passage of time, the teachers revealed that as students repeat the planned behavior every day, they will have a feeling of mastering their life and able to control themselves gradually. Apart from interventions in college level, interventions at home can also be implemented to increase one's level of self-control. Compas and Hammen (1994) pointed out that reducing the attractiveness of one's temptations is conducive to develop level of self-control. In the very famous "marshmallow study" conducted by Mischel (1972), which was an experiment to test a child's mastering of self-control, it was found that kids who were cued to regard the marshmallow as a picture, by imaging a frame around it, waited twice as long as kids who were cued to pay attention on a real marshmallow. Casey et al. (2011) later added that the "marshmallow study" is also applicable to deduce adults' level of self-control, as many of the children who are willing to delay gratification in the test are found to be professionals and have higher level of self-control when they become adults. In the wake of such finding, it is suggested that reducing the attractiveness of temptation can increase one's level of self-control. For young adults who engaged in excessive online game playing, social worker can encourage them to write a list of pull factors of violent game playing and consider different ways to diminish the attractiveness of each factor. Such method can be suggested to suitable clients to facilitate different parties to increase level of self-control.

Lastly, the researcher has identified two limitations in this research. First of all, owing to the nonprobability sampling strategies, the result cannot be generalized to represent the overall situation of the young adult population. In future studies, a more systematic study that employs stratified sampling is recommended, as such type of sampling helps attain a more representative sample to have a more comprehensive understanding on Hong Kong's young adults. Lastly, in the research, there are only three variables. The lack of variables may affect the comprehensiveness of the research.

In conclusion, this study explores Hong Kong young adult's online violent game playing behaviors. The result enriches the knowledge about the contributing factors related to psychological well-being and level of self-control of young adults. The findings confirm that higher involvement in violent online game decreases level of psychological well-being. Moreover, self-control serves as a moderator to the relationship between involvement in online violent game play and psychological well-being. Avoiding excessive online violent game playing and strengthening young adults' level of control is of significant importance to improve their psychological well-being.

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A Cross-Cultural Analysis: American and Hong Kong Newspaper Organizations' Social Media Use

Eiswein Tsz Kin Wong and Will W. K. Ma

Abstract Many newspaper organizations use social media to report news. Social media platforms gather people from different countries with different cultural backgrounds together. Such platforms help newspaper organizations deliver their news to users around the world. Without geographic barriers, it is wondered whether culture affects newspaper organizations' social media use. Therefore, we explore the differences in social media use in America and Hong Kong. Our main research question concerns whether cultural differences are related to presentation and interactions with and relationships between different variables and feedback from Hong Kong and American audiences. We conducted a content analysis of five newspaper organizations from both places. We found that post lengths were longer, and the frequency of including related news links and reporters' names was significantly higher in Hong Kong than on American Facebook pages. However, the numbers of comments on and shares of posts from American Facebook pages were significantly greater than for Hong Kong Facebook pages. Furthermore, the relationships between different variables and post likes differed between Hong Kong and American newspaper organizations' Facebook pages.

Keywords Newspaper organization · Social media · Cultural differences · Presentation · Interaction · Post likes

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1 Introduction

One in every three Internet users has Facebook, with the number of Facebook users increasing every second. Facebook had an average of 1.13 billion daily active users in June of 2016 (Facebook, 2016). Facebook has a tremendous influence and significantly affects our living habits, behavior, and circumstances. In the social media world, accounts are not limited to individuals but can be created by companies and as fan pages.

Facebook's huge user base has attracted newspaper organizations' attention. Messner, Linke, & Eford (2011) found that in the USA, the adoption rate of Facebook by newspapers and TV stations increased from 86.9% to 94.9% and 81–100%, respectively, between 2009 and 2010. Other studies compared and analyzed the use of Facebook page by news media in Hong Kong (e.g., Ma, Wong, & Hou, 2016).

The main objective of social media, such as Facebook, is to break geographic barriers and encourage globalization. However, studies have argued that cultural difference is still a factor affecting social media use (Ji et al., 2010; Karl, Peluchette, & Schlaegel, 2010). Studies have also shown that, traditionally, the performance of newspaper organizations is affected by cultural differences (Aday, Livingston, & Hebert, 2005). As such, cultural differences may also influence the performance of newspaper organizations' Facebook pages. As newspaper organizations not only want to deliver news but also build communities within their own pages, local elements must be added to their pages' behavior and performance to build up a unique mechanism within the community.

We aim to fill the research gap regarding whether cultural differences affect newspaper organizations' social media behavior and performance, by analyzing their Facebook pages, and thereby explore the best practices for newspaper organizations. We address three research questions:

1. Are cultural differences related to the presentation of newspaper organizations' Facebook pages?
2. Does the interaction of newspaper organizations' Facebook pages with their audiences differ between Hong Kong and America?
3. Do the relationships between different variables and the feedback of Hong Kong audiences differ from those of American audiences?

2 Literature Review and Hypothesis Development

2.1 Changes in Newspaper Organizations in the Social Media New Era

Newspaper organizations are always changing and seeking new platforms through which to deliver their news. The traditional one-way news reporting method is no longer sufficient; therefore there is a need for organizations to find new platforms

through which to transmit and exchange ideas with their audiences. The continuous interest in understanding news readers' behavior has always been a concern in academics and practitioners (e.g., Ma, Hui, Tong, Tse, & Wu, 2015).

When it comes to communication, technology always affects its process and product in terms of both reinforcement and constraint (Rogers, 1986). The birth of news media, which combines computing, telecommunications, and traditional media (Pavlik, 1999), has improved media performance and reporting by enriching media content, increasing media accuracy, and allowing leads, sources, and story angles to be identified faster.

In the past century, newspaper organizations have been controlled by professionals, most of whom were not interested in interacting with audiences. However, when the World Wide Web was developed, both audiences and newspaper organizations wanted to expand their communication from one-way to two-way. The Internet improves newspaper organizations' performance in four aspects, namely, interactivity, customization of content, hypertextuality, and multimediality (Bardoel & Deuze, 2001). Online platforms give audiences and newspaper organizations the opportunity to interact, namely, through medium, medium/human, human/medium, and human interactivity (Chung, 2008).

The birth of social media has brought a new movement to newspaper organizations. As it allows for the production of user-generated content, such as comments on published news articles, audiences can contribute their own opinions, perspectives, and expertise and interact with others. In other words, news organizations open up opportunities for public debate by using social media as platforms through which to deliver their news (Rowe, 2015). Social media use also allows newspaper organizations to grow their Internet audiences (e.g., Ma, Chow, Yip, Ng, & Leung, 2016).

Facebook itself is a constantly improving platform. It allows users to express themselves through text, photos, photo and text, videos, and video and text, which means that newspaper organizations can publish their news stories in various forms (Facebook, 2016). Facebook provides a free, unlimited, flexible, and large audience-based platform for newspaper organizations. Newspaper organizations can also evaluate their post quality using the responses of their audiences, who can provide feedback using three functions: Like, Share, and Comment. This allows newspaper organizations to quickly review and improve their performance post by post from the responses, rather than through day-by-day sales as in the past. In February of 2016, Facebook further improved the Like function by introducing the Love, Haha, Wow, Sad, and Angry options to the Like button. Audiences can now express their feelings to posts in more complex ways. Newspaper organizations can also upload their own websites' hyperlinks to let their audiences visit their websites for full articles and additional information. Newspaper organizations are clearly changing directions and effectively developing their businesses on Facebook by creating Facebook pages.

2.2 Cultural Differences: Content Presentation and Audiences' Interaction

One of the most accepted notions of social media is globalization, as social media bring users from different places and time zones together. It seems that users are no longer distinguished by their physical locations. However, this can only be true if users no longer engage in offline life, which is nearly impossible. Few studies have investigated the cultural differences in social media use, and even fewer have focused on the case of newspaper organizations.

Hall (1959) stated that culture is communication and communication is culture. It seems that communication and culture are not separate (Hanusch, 2009). Hanusch (2009) also defined Hofstede's model (Hofstede, 2001; Hofstede, Hofstede, & Minkov, 2010) as a value system approach to culture that separates culture in terms of different values. This model allows us to investigate the cultural roots of journalism.

Hofstede's model of national culture consists of six dimensions: power distance index (PDI), individualism versus collectivism (IDV), masculinity versus femininity (MAS), uncertainty avoidance (UAI), long-term orientation (LTO), and indulgence versus restraint (IND). One study showed that LTO significantly determines the presence of most types of news frames (Zhou, 2008).

Facebook's design facilitates the collection of behavioral data that are suitable for studying cross-cultural issues (Wilson, Gosling, & Graham, 2012). Studies have shown that IDV, MAS, and UAI influence social media activity to different extents for users from different countries (Ji et al., 2010; Muralidharan, La Ferle, & Sung, 2015).

However, not enough studies have explored cultural differences in Facebook behavior, and even fewer studies have explored the cultural differences in newspaper organizations' Facebook page performance. The presentation of Facebook pages is considered to be the information inside of posts. Interaction includes feedback from the audience. The relationship behind feedback focuses on the variables related to post likes.

As the audiences and managers of newspaper organizations' Facebook pages are influenced by their local cultures, their behavior and the ways that they express their feelings and publish information are also affected by the cultures of their regions. Therefore, we argue that the presentation of and the audience interactions and feedback relationships with newspaper organizations' Facebook pages differ for different cultures:

H1: The length of posts on American newspaper organizations' Facebook pages is shorter than those of Hong Kong newspaper organizations.

H2: The frequency of including related news links on American newspaper organizations' Facebook pages is less than that on those of Hong Kong newspaper organizations.

H3: The frequency of including reporters' names on American newspaper organizations' Facebook pages is less than that on those of Hong Kong newspaper organizations.

H4: The number of audience comments on posts from American newspaper organizations' Facebook pages is greater than that on those of Hong Kong newspaper organizations.
H5: The number of audience shares of posts from American newspaper organizations' Facebook pages is greater than that from those of Hong Kong newspaper organizations.
H6: The relationship between different variables and post likes differ between Hong Kong and American newspaper organizations' Facebook pages.

3 Method

3.1 Background

A content analysis of newspaper organizations' Facebook pages was conducted from August 11, 2016, to August 15, 2016, to investigate Hong Kong and America's newspaper organizations' Facebook page performance. Neuendorf (2002) stated that content analysis is the summarizing, quantitative analysis of messages that relies on the scientific method and is not limited to the types of variables that may be measured or the content in which the messages are created or presented. Krippendorff (2004) stated that content analysis is an empirically grounded method that is exploratory in process and predictive or inferential in intent. The summarizing power of content analysis can give us a macro view of the topic.

According to the number of subscriptions and Facebook page likes for Hong Kong and American newspaper organizations, five newspaper organizations from each region were selected. Newspaper organizations' Facebook pages, such as *USA Today*, *The New York Times*, *The Wall Street Journal*, *Los Angeles Times*, and *New York Post*, which are the top five daily American newspapers (Cision, 2014), were selected to represent American newspaper organizations. *Apple Daily*, *Oriental Daily*, *Ming Pao Daily News*, *HKEJ*, and *HKET* from Hong Kong were selected to represent Hong Kong newspaper organizations because their Facebook pages have the top five numbers of likes among Hong Kong newspaper organizations.

We analyzed various Facebook page behavior factors, such as region, contact number availability, contact address, contact e-mail, website, Instagram account, user reviews, phone number for users to provide news, e-mail address for users to provide news, hyperlinks, related news hyperlinks, tag others option, video format, inclusion of reporters' names, number of pages owned, and length of post. Performance was measured by the number of page likes, post likes, post love, post haha, post wow, post sad, post angry, post comments, and post shares. We analyzed the 20 posts of each of the 10 organization's Facebook page published before 13:00 on August 11, 2016, where in total 200 data were collected. Normality can have serious effects in small samples (fewer than 50 cases), but the impact effectively diminishes when sample sizes reach 200 cases or more (Hair, Black, Babin, & Anderson, 2010, p.77).

3.2 Measures

To measure the region, we used 1 to represent America and 2 to represent Hong Kong. The availability of a contact number, a contact address, a contact e-mail, a website, an Instagram account, user reviews, phone numbers for users to provide news, e-mails for users to provide news, hyperlinks, related news hyperlinks, tag others options, video format, and reporters' names was coded by 0 (*No*) and 1 (*Yes*). We coded length of post using 1 (*no need to click to read more*) and 2 *(need to click to read more*). Exact numbers were used to represent the number of pages owned, page likes, the number of Like, Love, Haha, Wow, Sad, and Angry, and the number of comments and shares received for a post.

4 Findings

4.1 Descriptive Statistics for the Newspaper Organizations

There were 200 data sets. The details are summarized in Table 1. The descriptive statistics for the measurement items; page likes; number of Like, Love, Haha, Wow, Sad, and Angry; and also the number of comments and shares received for each post are shown in Table 2. All of the items were clustered in the middle. The means ranged from 16.92 to 2,986,987.70, and the standard deviations ranged from 71.40 to 3,439,482.5.

4.2 Two-Sample t-test: Comparing Hong Kong and America's Newspaper Organizations' Facebook Pages

An independent two-sample *t*-test was conducted to compare the Facebook posts of Hong Kong and America's newspaper organizations (Tables 3 and 4). Post length was found to be greater for Hong Kong ($M = 1.71$, $SD = 0.46$) than for American ($M = 1.01$, $SD = 0.1$) media Facebook posts ($t(198) = -14.993$, $p = .000 < .01$). In addition, the inclusion of related news hyperlinks ($t(198) = -7.209$, $p = .000 < .01$) in Hong Kong ($M = 0.46$, $SD = 0.50$) and American ($M = 0.06$, $SD = 0.24$) posts and the inclusion of reporters' names ($t(198) = -2.283$ $p = .024 < .05$) in Hong Kong ($M = 0.05$, $SD = 0.22$) and American ($M = 0$, $SD = 0$) posts were also significantly different.

A significant difference was found between the number of comments on Hong Kong ($M = 47.98$, $SD = 118.32$) and American ($M = 117.37$, $SD = 240.48$) media Facebook posts ($t(198) = 2.59$, $p = .01 < .05$). There was also a significant difference between the number of shares of Hong Kong ($M = 70.01$, $SD = 143.51$) and

Table 1 Descriptive statistics of American and Hong Kong newspaper Facebook pages

Subject	Descriptions	Percentage
District	America	5 (50%)
	Hong Kong	5 (50%)
Contact number	Yes	7 (70%)
	No	3 (30%)
Contact address	Yes	5 (50%)
	No	5 (50%)
Contact e-mail	Yes	6 (60%)
	No	4 (40%)
Website	Yes	10 (100%)
Number of pages it owns	2.0	2 (20%)
	3.0	1 (10%)
	4.0	2 (20%)
	8.0	1 (10%)
	10.0	2 (20%)
	11.0	2 (20%)
Instagram	Yes	2 (20%)
	No	8 (80%)
User review	Yes	1 (10%)
	No	9 (90%)
Phone number for users to provide news	Yes	3 (30%)
	No	7 (70%)
E-mail for users to provide news	Yes	1 (10%)
	No	9 (90%)
Length	No need read more	128 (64%)
	Need read more	72 (36%)
Hyperlink	Yes	162 (81%)
	No	38 (19%)
Related news hyperlink	Yes	52 (26%)
	No	148 (74%)
Tag others	Yes	43 (21.5%)
	No	157 (78.5%)
Video	Yes	41 (20.5%)
	No	159 (79.5%)
Reporter name	Yes	5 (2.5%)
	No	195 (97.5%)

American (M = 183.89, SD = 420.19) media Facebook posts ($t(198) = 2.57$, $p = .011 < .05$). Overall, these results support *H1*, *H2*, *H3*, *H4*, and *H5*.

We analyzed the correlations between the variables to see whether relationships exist between post likes, post love, post haha, post wow, post sad, post angry, post comments, post shares, shared third-party posts, post length, hyperlinks, related

Table 2 Descriptive statistics of Facebook page performance

Subjects	Min	Max	*M*	*SD*
Page like	149,319	11,686,756	2986987.7	3439482.5
Post like	5.0	35,000	1233.83	3022.432
Post love	0	1700	48.89	151.491
Post haha	0	3900	66.78	308.103
Post wow	0	970	41.13	107.038
Post sad	0	762	16.92	71.404
Post angry	0	4900.0	111.44	567.109
Post comment	0	2300.0	82.68	192.211
Post share	0	3200.0	126.95	318.338

Table 3 Group statistics of comment, share, length, related news hyperlink, and reporter name

		N	*M*	*SD*	*SE* Mean
Comment	America	100	117.37	240.48	24.05
	Hong Kong	100	47.98	118.32	11.83
Share	America	100	183.89	420.19	42.02
	Hong Kong	100	70.01	143.51	14.35
Length	America	100	1.01	0.1	0.01
	Hong Kong	100	1.71	0.46	0.05
Related news hyperlink	America	100	0.06	0.24	0.02
	Hong Kong	100	0.46	0.50	0.05
Reporter names	America	100	0	0	0
	Hong Kong	100	0.05	0.22	0.02

Table 4 Independent two-sample *t*-test between Hong Kong and America newspaper organization Facebook pages

					95% confidence interval of the diff.	
	t	*Sig.*	Mean diff.	Std. error diff.	Lower	Upper
Comment	2.589	.010	69.39	26.801	16.54	122.24
Share	2.565	.011	113.88	44.402	26.32	201.44
Length	−14.993	.000	−.70	.047	−.80	−.61
Related news hyperlink	−7.209	.000	−.40	.056	−.51	−.30
Reporter names	−2.283	.024	−.05	.022	−.09	−.01

df = 198

news hyperlinks, and tagging others and whether the post was a video or reporters' names were included in both the American and Hong Kong Facebook posts.

Based on the correlation coefficient results, for the American pages, post love ($r = .77$ $p < .01$) was strongly related to post likes. Post shares ($r = .33$, $p < .01$) and whether the post was a video ($r = .39$, $p < .01$) were moderately related to post likes. Tagging others ($r = .206$, $p < .05$) was weakly related to post likes (Table 5).

Table 5 Correlation of variables in America newspaper organization Facebook pages

	Post like	Post love	Post haha	Post wow	Post sad	Post angry	Comment	Share	Share third-party post	Length	Hyperlink	Related news	Tag others	Video
Post like	1													
Post love	.774**	1												
Post haha	0.156	0.083	1											
Post wow	0.119	0.028	.520**	1										
Post sad	−0.007	−0.049	−0.012	.295**	1									
Post angry	0.008	−0.026	.531**	.851**	0.096	1								
Comment	0.168	0.017	.609**	.862**	0.133	.922**	1							
Share	.329**	.326**	.448**	.606**	0.105	.533**	.552**	1						
Share third-party post	0.142	0.012	−0.028	0.037	−0.019	−0.03	0.086	−0.111	1					
Length	−0.049	−0.025	−0.039	−0.008	−0.026	−0.012	−0.046	−0.035	−0.025	1				
Hyperlink	−0.134	−0.002	−0.024	−0.006	−0.019	0.055	−0.043	0.086	−.490**	−0.195	1			
Related news	0.099	0.124	−0.066	0.065	−0.062	−0.03	0.003	0.026	0.113	.398**	−.283**	1		
Tag others	.206*	0.144	0.092	.199*	−0.074	.230*	.263**	0.115	−0.002	−0.045	0.037	.446**	1	
Video	.388**	.212*	.204*	0.146	0.015	−0.055	0.114	0.081	.414**	−0.049	−.501**	.307**	0.188	1

**Correlation is significant at the 0.01 level (2-tailed); *correlation is significant at the 0.05 level (2-tailed)

For the Hong Kong pages, post love ($r = .95$, $p < .01$), post wow ($r = .55$, $p < .01$), post comments ($r = .61$, $p < .01$), and post shares ($r = .67$, $p < .01$) were strongly related to post likes. Post haha ($r = .42$, $p < .01$) was moderately related to post likes (Table 6).

4.3 Linear Regression Analysis: Factors Related to Facebook Page Performance

Stepwise linear regression analysis was used to investigate variables that significantly predict post likes in Hong Kong and America. Post love, post haha, post wow, post sad, and post angry were not included, as users can only choose one of them in a post to express their feelings.

We conducted stepwise multiple regression analysis, which suggested the best model for both regions' newspaper organizations' Facebook pages. The model was statistically significant to explain the variance of post likes for the American newspaper organizations' Facebook page, with R^2 equals to .224 (Table 7). The two variables it included, post shares ($\beta = 0.364$, $p < .01$) and whether the post was a video ($\beta = 0.299$, $p < .01$), were significantly related to post likes (Table 8).

The model was also statistically significant to explain the variance of post likes for the Hong Kong newspaper organizations' Facebook page, with R^2 equals to .460 (Table 9). The two variables it included, post shares ($\beta = 0.699$, $p < .01$) and whether reporters' names were shown on posts ($\beta = -0.172$, $p < .05$), were significantly related to post likes (Table 10).

The Hong Kong newspaper organizations' Facebook page post likes were not significantly predicted by whether the post was a video ($p = .393 > .05$). American newspaper organizations' Facebook page post likes were not significantly predicted by whether reporters' names were shown on posts, as none of the posts included reporters' names. These results support *H6*, as the relationships between the different variables and post likes differed between Hong Kong and American newspaper organizations' Facebook pages.

5 Discussion

The culture helps shape a person's belief, attitude, and behavior. Hence, it will form a like-minded community. In this study, we will examine the media behavior of both the USA and Hong Kong based on the culture theory. We will examine the difference from its media content, reader's interaction, formation of the online reading community, and also the data collected from the newspaper and Facebook pages. Internet is well-known for its effectiveness to bring the global audience together, so it is vital to understand the local cultural context for media organizations to convey

Table 6 Correlation of variables in Hong Kong newspaper organization Facebook pages

	Post like	Post love	Post haha	Post wow	Post sad	Post angry	Comment	Share	Share third-party post	Length	Hyperlink	Related news	Tag others	Video	Reporter name
Post like	1														
Post love	.952**	1													
Post haha	.423**	0.193	1												
Post wow	.551**	.404**	.398**	1											
Post sad	0.191	0.091	.441**	.279**	1										
Post angry	0.112	−0.017	.378**	.285**	.496**	1									
Comment	.614**	.390**	.834**	.605**	.502**	.669**	1								
Share	.665**	.537**	.571**	.783**	.509**	.468**	.765**	1							
Share third-party post	−0.095	−0.075	−0.067	−0.123	−0.121	−0.088	−0.108	−0.169	1						
Length	0.115	0.088	0.107	0.063	0.092	0.155	0.162	0.109	−.480**	1					
Hyperlink	0.117	0.087	0.087	0.099	0.023	0.107	0.146	0.145	−.522**	.415**	1				
Related news	0.189	0.184	0.02	0.054	0.163	.219*	0.158	0.084	−.260**	.413**	.364**	1			
Tag others	−0.133	−0.113	−0.129	−0.088	−0.115	−0.149	−0.178	−0.013	−0.136	−0.073	0.086	0.002	1		
Video	−0.106	−0.074	−0.086	−0.096	−0.013	−0.097	−0.13	−0.085	0.121	−0.164	−.406**	−.332**	0.006	1	
Reporter name	−0.035	−0.041	−0.043	0.163	−0.004	−0.057	−0.027	.197*	−0.081	0.147	0.104	−0.12	.282**	−0.096	1

**Correlation is significant at the 0.01 level (2-tailed); *correlation is significant at the 0.05 level (2-tailed)

Table 7 Adjusted R^2 and ANOVA summary of model testing of American newspaper organization Facebook pages' result

	ANOVA	
Adjusted R^2	*F*	*Sig*
0.224	15.289	0.000

Table 8 Summary of model testing of American newspaper organization Facebook pages' result

	Standardized coefficients		
Variables	Beta	*t*	*Sig.*
Video	0.364	4.096	0.000
Share	0.299	3.371	0.001

Table 9 Adjusted R^2 and ANOVA summary of model testing of Hong Kong newspaper organization Facebook pages' result

	ANOVA	
Adjusted R^2	*F*	*Sig*
0.460	43.173	0.000

Table 10 Summary of model testing of Hong Kong newspaper organization Facebook pages' result

	Standardized coefficients		
Variables	Beta	*t*	*Sig.*
Share	0.699	9.280	0.000
Reporter name	−0.172	−2.287	0.024

their message successfully while fitting in different cultural needs. One of the future keys to success may be on "glo-calization" – the combination of both globalized audience and localized interaction with audience.

In recent years, social media have attracted a lot of research interests. How people use and behave on social media are major concerns that scholars aim to investigate.

Studies have shown that media have facilitated the change from traditional one-way to two-way communication to improve the quality of news articles. With Facebook's development, media can deliver news through this one billion users' platform, to enjoy story-posting with no limits. Breaking down geographical barriers is the main objective of social media, so achieving globalization is easy in social media like Facebook. However, not many researches have been done to investigate whether media will behave differently in different cultures.

We explore the cultural differences between different newspaper organizations' Facebook pages and investigate through the presentation and interactions with and relationships between different variables and feedbacks from American and Hong Kong newspaper organizations' Facebook page audiences.

We also explore posting habits which the results show that American newspaper organizations' Facebook posts are significantly different from those of Hong Kong in terms of length and the inclusion of related news links and reporters' names. As different languages are used in American and Hong Kong newspaper organizations' Facebook pages, the words used to express the same idea are different. The shorter length of posts on American newspaper organizations' Facebook pages may also reason to the reading habits of their audiences. For example, Hong Kong audiences may enjoy richer content in Facebook posts than American audiences.

Hong Kong newspaper organizations' Facebook pages are more likely to include related news links in their posts, thus suggesting other stories to their audience and giving them more information about the issue. As Hong Kong is one of the most fast-paced cities in the world, most people can only read news via Facebook during their transportation time. Therefore, it is suitable for them to have more supplementary information in one post rather than having to conduct their own searches.

Unlike Hong Kong, including reporters' names in the articles is not common for American newspaper organizations' Facebook pages. Identifying the reporter in their article can help boost the reporter's reputation and also shorten the distance between reporters and their audience. This difference may result in the positioning of newspaper organizations in different regions, such as whether they want to maintain authority or lessen the distance by using Facebook.

According to previous research, Facebook users' behaviors such as joining groups and sharing photographs are influenced by their own culture (Vasalou, Joinson, & Courvoisier, 2010). We also found significant difference in both the comments and shares of the American and Hong Kong newspaper organizations' Facebook page audiences. The American audiences tend to comment and share more than the Hong Kong audience. We can see a cultural difference in which American audiences have higher post engagement and interaction with newspaper organizations than Hong Kong audience. As there are several significant differences between American and Hong Kong newspaper organizations' Facebook pages, it is possible for us to determine whether the relationships between different variables and post likes are different between Hong Kong and American audience. The results show that there are correlations between post love and post likes and also post shares and post likes in both regions. The results show that American newspaper organizations' Facebook page post likes are significantly related to shares and whether the post is a video, whereas Hong Kong newspaper organizations' Facebook page post likes are significantly related to shares and whether reporters' names are shown in the post. This indicates that American newspaper organizations' Facebook page audiences are concerned more than Hong Kong audiences with whether the content is a video. Hong Kong newspaper organizations' Facebook page audiences focus more on their closeness to reporters than American audiences.

5.1 Limitations and Further Studies

There are a number of limitations to this study. We explore the cultural differences between American and Hong Kong newspaper organizations' Facebook pages. However, we only obtained the 20 posts before 13:00 on August 11, 2016, which may not represent all posts on the newspaper organizations' Facebook pages. Further studies may use different time intervals to include more posts. Although we believe that the five newspaper organizations are good representations of America and Hong Kong, as they are the top five newspaper organizations in their regions, there are much more newspaper organizations in each region. Thus, further studies are needed to obtain more generalized results and develop more concrete models.

6 Conclusion

Newspaper organizations are changing their focus from traditional media to social media in delivering news. One of the most popular social media platforms used by these organizations is Facebook. Although newspaper organizations from different cultural backgrounds and regions use the same platform, their behavior and performance are significantly different. The presentation, audience interactions, and the relationships between the different variables and feedback vary among American and Hong Kong newspaper organizations. The post lengths are longer, and the frequency of including related news links and reporters' names is significantly greater in Hong Kong. This shows that the presentation style is different between the two regions. The number of post comments and shares in America is significantly greater than Hong Kong, indicating that the level of interaction also differs. The relationships between different variables and post likes are also different between Hong Kong and American newspaper organizations' Facebook pages. Thus, the best practices for newspaper organizations' Facebook pages vary for different locations. Overall, the results of this study confirm that cultural differences affect newspaper organizations' social media use.

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Emoticon, Emoji, and Sticker Use in Computer-Mediated Communications: Understanding Its Communicative Function, Impact, User Behavior, and Motive

Ying Tang and Khe Foon Hew

Abstract Using emoticons, emoji, and stickers can supplement the lack of human nonverbal cues in computer-mediated environment. Although the use of emoticons, emoji, and stickers has become a common practice, we lack a comprehensive understanding of its communicative function, its impact on online user interactions, the characteristics of user behavior, and user motives. This study is by far the first review to systematically categorize and conclude the studies on using emoticons, emoji, and stickers in computer-mediated communications. We searched related literature in 11 databases and reviewed 50 empirical studies. We then summarized the characteristics of previous studies and the major topics and findings in an inductive approach. The results show that proper use of emoticons, emoji, and stickers, especially positive emoticons, is conducive to both relationship formation and cognitive understanding. They not only help participants express emotions and manage interrelations but also function as words to aid message comprehension.

Keywords Emoticon · Emoji · Sticker · Computer-mediated communications

1 Introduction

The use of emoticons, emoji, and stickers has become a common part in various forms of computer-mediated communications (CMCs), with a rapid increase rate. There are six billion emoticons or stickers being sent everyday via mobile instant messaging (MIM) applications around the world (Swyft Media, as cited in eMarketer, 2015), and emoji is said to be the "fastest-growing language" used by 92% online population and sent along with 2.3 trillion mobile messages in 2016 (Emogi

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Research Team, 2016). These nonverbal cues are used to compensate the lack of "personalization" of CMCs. That is, despite the fact that CMCs offer more flexibility for people to exchange information and stay connected, the nonverbal elements in face-to-face communication are deprived, including facial expressions, eye contact, and body movements. Researchers have found evidence that using emoticons, emoji, and stickers can enhance human interaction in virtual environments, by supplementing textual information exchange and allowing people to express emotions with ease (Derks, Fischer, & Bos, 2008).

The first emoticon was conceptualized in the United States by a computer scientist, Scott Fahlman, when he posted a ":-)", a reverted smiley face on a Carnegie Mellon bulletin board (Krohn, 2004) in 1982. Taken literally, an emoticon is an "emotional icon" composed of keyboard characters to represent a facial expression to indicate the corresponding emotional status. Emoji appeared in history more than a decade later than emoticon. The term emoji is borrowed from the Japanese word "pictograph," as "e" represents "picture" and "moji" stands for "character." Merriam-Webster online dictionary (2017) defines emoji as "various small images, symbols, or icons used in text fields." Unlike emoticon which is simply represented by keyboard characters, an emoji, such as 😂, is an actual pictograph. Commonly used emoji are coded in Unicode standard (Davis & Edberg, 2015) and are transferrable across platforms with specific software support. Stickers are pictures exclusive to a specific MIM app. They can be saved for future use within this app, but cannot be transferred across apps. One merit of stickers is the multimodality. A sticker can be simply textual, pictorial, or a combination of both, and it can be either static or animated.

The popularity of using emoticons, emoji, and stickers in CMCs has attracted much attention among researchers. Various topics have been explored in previous studies, among which are general user behavior investigation (e.g., Garrison, Remley, Thomas, & Wierszewski, 2011), the difference between male and female use preferences (e.g., Wolf, 2000), the contexts in which emoticons are used (e.g., Derks, Bos, & von Grumbkow, 2007), the motivation of using emoticons (e.g., Lee, Hong, Kim, Oh, & Lee, 2016), the impact of using emoticons on interpersonal relationships (e.g., Kalyanaraman and Ivory 2006), and the impact of using emoticons on message interpretation (Thompson & Filik, 2016). The diversity of topics has contributed to an extensive understanding of the purpose, process, and impact of using emoticons, emoji, and stickers in online communication but also called for a systematic summary to categorize and conclude relevant.

2 Significance of the Study

Four reviews on emoticon use were identified in literature search. Derks et al. (2008) affirmed that emoticons are used in CMCs to express feelings and decrease the negativity in communication, while Jibril and Abdullah (2013) added that emoticons had actual word functions and were not mere compensatory to language.

Aldunate and González-Ibáñez (2016) reported little evidence on how human brains processed emoticons in communication from a neural-cognitive perspective, while Dunlap et al. (2015) evaluated the possible positive impact of using emoticons on online learning.

These reviews, however, did not sufficiently present a full picture of this field of study. Three studies (Aldunate & González-Ibáñez, 2016; Derks et al., 2008; Jibril & Abdullah, 2013) did not provide evidence that a systematic literature identification process was conducted. Additionally, two reviews (Aldunate & González-Ibáñez, 2016; Dunlap et al., 2015) were prone to address specific areas of interest (i.e., neural-cognitive or educational). There lacks a general description on the status quo of using emoticons, emoji, and stickers in CMC contexts.

This study aims to bridge the aforementioned gap and provide a comprehensive review. Specifically, with a growing body of studies in recent years, it will be interesting to know what topics have been more intriguing, what some major findings are, and what topics are expecting more research efforts. We will benefit from understanding the extant accomplishment and having insights to our future endeavors. The following key research question will be addressed: What are the major topics and findings about using emoticons, emoji, and stickers in computer-mediated communications?

3 Method

A systematic literature search was conducted in 11 databases across disciplines, adopting the following Boolean search: (emoticon OR emoji OR sticker OR nonverbal) AND ("online communication" OR "online interaction" OR "computer-mediated communication" OR "CMC"). As of June 8, 2017, our preliminary search yielded 622 possible articles, and 30 studies were considered eligible for this review after filters being applied. We then carried out a snowball sampling and identified another 20 studies. As a result, 50 studies were identified for further systematic analysis. The data collection process, databases searched, and filters (the inclusion and exclusion criteria) applied are shown in Fig. 1. The topics of each article were summarized and then categorized in an inductive approach. No presumptions were imposed.

4 Findings

This section presents key findings from two main aspects: (1) a general depiction of the 50 studies and (2) the key topics discussed in previous studies, along with the major findings.

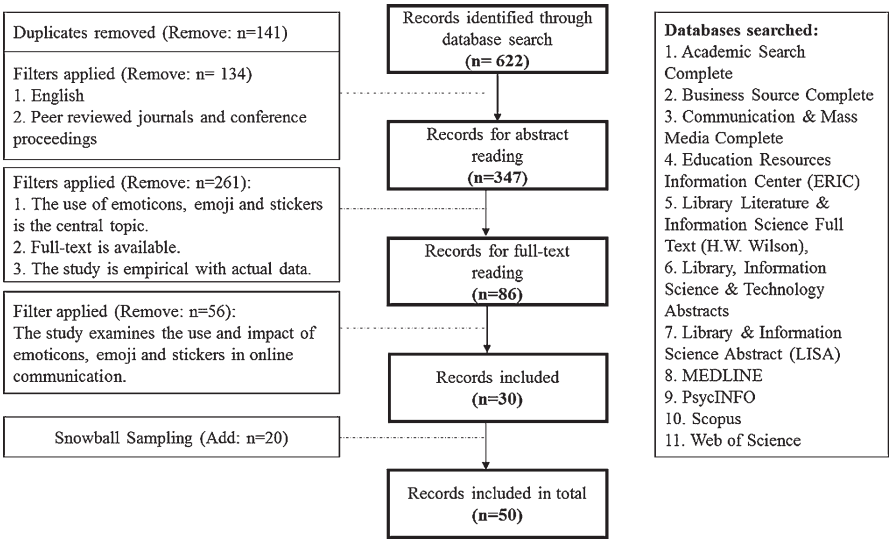

Fig. 1 Flowchart of literature selection process

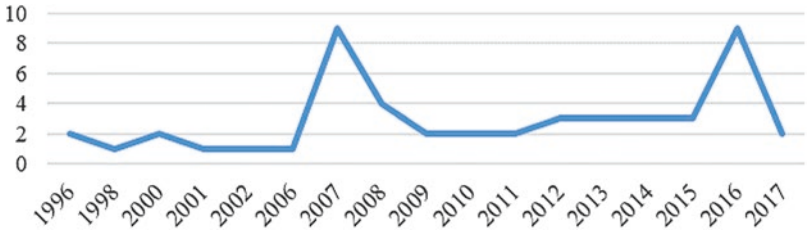

Fig. 2 Articles published by year, from 1996 to 2017

4.1 Characteristics of Studies

First, we collected information of the publishing years (see Fig. 2). The collected articles spanned over 20 years from 1996 to 2017 with two peaks of interest. One appeared in the year 2007, and there was another surge of number in 2016.

Second, we examined the research designs and contexts in which the studies were carried out. The results demonstrated a balance between natural and lab-based research contexts. Twenty-five studies used empirical data from authentic online communication or class assignment, while the other 26 studies were conducted in lab experimental settings. One study (Luor, Wu, Lu, & Tao, 2010) was counted twice because the one stage of the study analyzed the actual messages communicated in an organizational context, and another stage was an experiment.

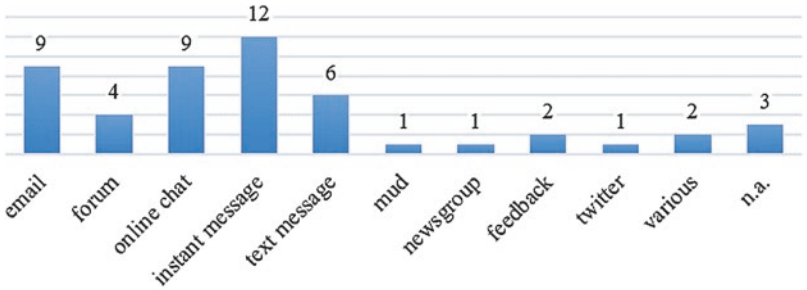

Fig. 3 Platforms examined by previous studies

Third, we sorted out information about the platforms on which previous studies were carried out (Fig. 3). The results show that researchers have paid more attention to instant messaging, email exchanges and online chats.

4.2 Topics and Major Findings

We thoroughly read the results of the 50 studies and adopted a bottom-up approach to categorize the central topics discussed in previous studies (Table 1). The following four categories emerged:

1. Communicative functions of emoticons, emoji, and stickers in CMCs ($n = 28$)
2. Contextual impact on using emoticons, emoji, and stickers in CMCs ($n = 9$)
3. General behaviors of using emoticons, emoji, and stickers in CMCs ($n = 8$)
4. Motives of using emoticons, emoji, and stickers in CMCs ($n = 5$)

Among the four topics, the communicative functions of using emoticons, emoji, and stickers in CMCs have been given the most attention ($n = 28$), with two main subcategories being identified, namely, the impact on relationship and the impact on understanding. The results show that socially speaking, positive emoticon use can improve the perceived intimacy and online relationship. Cognitively, using emoticons can help clarify and strengthen the meaning of the message but can hardly supersede the meaning of verbal texts.

Nine studies examined the impact of different contexts on user preference. Previous research has demonstrated multiple focuses—positive vs. negative intentions, asynchronous vs. synchronous modes, and social-based vs. task-based interactions. More emoticons are used in positive contexts and for asynchronous interactions. No consensus was reached comparing social-based and task-based communications. Two studies (Derks et al., 2007; Xu, Yi, & Xu, 2007) found subjects use more emoticons in social than in task-oriented contexts, while Ahn et al. (2011) reported the opposite.

Table 1 Major topics and findings

Topics	Major findings	Sample studies
Communicative functions	1. To supplement the lack of cues to express emotions and influence human relations	Byron and Baldridge (2007), Jassen et al. (2014), and Derks et al. (2008)
	2. To serve the functions of "words" to help with understanding the meaning	
Contextual impact	1. More emoticons in positive contexts than negative situations	Vandergriff (2013, 2014), Ahn, Park, and Han (2011), and Chang (2016)
	2. Conflicts in task-based vs. social communications	
	3. Less positive emoticons than negative ones in synchronous communications and opposite in asynchronous contexts	
General behaviors	1. The more easily an emoticon is understood, the more it will be used	Cao and Ye (2009), Tossell et al. (2012), and Wolf (2000)
	2. More emoji were used than emoticons	
	3. Females used more emoticons; males would use more emotions when moving from a single-gender group to a mixed-gender group	
Motives	Studies reported at least one of the following motives: (a) accuracy, to avoid misunderstanding; (b) sociability, to facilitate more interaction; (c) enjoyment, to convey amusement; and (d) efficiency, to offer clues of intended meaning	Chen and Siu (2017), Zhou, Hentschel, and Kumar (2017), and Derks et al. (2008)

Eight studies examined general behaviors of using emoticons, emoji, and stickers in CMCs. Research found it was a highly personal and diverse behavior to use emoticons, emoji, and stickers for online communication. For example, emoticons were used more frequently by females than males and more on Facebook than in email and text messages. Regarding why emoticons, emoji, and stickers are used, five studies reported various reasons, including to express emotions, to improve content understanding, and to show politeness.

4.2.1 Communicative Functions

Emoticons, emoji, and stickers can not only supplement the lack of cues in virtual communications to express emotions and influence human relationships but also serve the functions of "words" to help with comprehension.

Using emoticons, emoji, and stickers has influence on human relations in virtual communications. Emoticon users were rated more outgoing and friendly (Fullwood & Martino, 2007), and the use of emoji had significant impact on perception of friendliness and sincerity (Wibowo, Ats-Tsiqoh, Sangadah, Komala, & Utomo, 2016). Specifically, the following three major findings were reported by previous studies:

(a) Positive emoticons can improve the favorable impression of the recipient toward the sender. For example, the sender of an email with a smiley face would be rated more likable (Byron & Baldridge, 2007).
(b) Increased use of emoticons and emoji leads to increased perceived intimacy and friendship formation. According to Utz (2000), The more MUD users used emoticons in their communication, the more friendships they formed. Jassen et al. (2014) also reported users would rate online communication more intimate, if more emoticons were used.
(c) However, excessive emoticon use might have negative impact on the impression formation. When emoticons are overused, individuals might be bored or consider the sender was carelessly involved and trying to hide their real intentions (Yoo, 2007).

Apart from the affective functions, using emoticons, emoji, and stickers also played a part in understanding, i.e., cognitive communication. Studies showed that when emotional cues were not enough, there was a tendency for more misunderstanding (Kato, Kato, & Akahori, 2007). One of the earliest studies on this topic was conducted by Thompsen and Foulger (1996), when they found that flaming (the anger in expression) was mitigated by emoticons. On the one hand, using such cues could strengthen the intensity of a verbal message (Derks et al., 2008) and help people understand the direction of emotions in the communication. For example, to correctly understand an ironic expression is more difficult than to understand a straightforward message; thus emoticons like tongue and wink (Thompson & Filik, 2016) would potentially aid the comprehension. On the other hand, however, emoticons could hardly turn around the valence of a verbal message (Derks et al., 2008). For example, when the verbal message is negative, most likely users will perceive the information as negative, even though a smiley emoticon is added. In addition, emoticons are sometimes used to punctuate a piece of text and to clarify the structure of messages, especially as a closure of a phrase or sentence (Markman & Oshima, 2007).

4.2.2 Contextual Impact

Context plays a critical role in emoticon, emoji, and sticker interpretation in online communications (Vandergriff, 2013, 2014). First, researchers found that people use more emoticons in positive contexts than negative situations (e.g., Ahn et al., 2011). In Chang's (2016) study, 80% emoticons were used to reinforce the positivity, and only 20% were used at a negative criticism statement. Second, an inconsistency was reported when examining the nature of communication tasks. Two studies found that more emoticons were used in social emotional communication than in task-oriented contexts (Derks et al., 2007; Xu et al., 2007), while Ahn et al. (2011) reported the opposite conclusion. Third, in terms of the impact of communicative modes on interpreting emoticons, Braumann, Preveden, Saleem, Xu, and Koeszegi

(2010) found users adopted less positive emoticons than negative emoticons in synchronous communications, while the opposite was reported in asynchronous contexts. Gettinger and Koeszegi (2015) reported that in asynchronous negotiations, using emoticons would increase the positive affect, while in synchronous negotiations, emoticon support would be mainly used to decrease the negativity in communication.

4.2.3 General User Behaviors

It is a diverse and highly personal behavior to use these cues for different purposes and in different situations (Rezabek & Cochenour, 1998; Halvorsen, 2012). With various focuses of user behaviors being reported, we summarized the following two highlights.

Researchers were interested in among all these cues available, what made some more preferred than others. First, when one cue was more easily understood than others, it would be more used (Cao & Ye, 2009). One study found that static stickers (defined as "preload static images" in the study) were most frequently adopted by users on a popular online forum in China, because they were more easily to be decoded (Cao & Ye, 2009). In turn, the more an emoticon was used, the easier it would be understood in communication (McDougald, Carpenter, & Mayhorn, 2011). Second, more emoji were used than emoticons to express emotion on Twitter, when participants were discussing food-related topics (Vidal, Ares, & Jaeger, 2016).

Regarding gender differences, studies have shown that females used more emoticons (Tossell et al., 2012; Wolf, 2000). In the 6-month longitudinal study, Tossell et al. (2012) collected and analyzed smartphone text messages of 22 users (11 males and 10 females). They found that females used more emoticons, while males used wider-range emoticons in their SMSs. However, Wolf (2000) reported a very interesting behavior pattern change when males moved from a same-gender group to a mixed-gender group. Instead of keeping their inexpressiveness, males would keep up with females and express more emotions.

4.2.4 Motives

By conducting questionnaire surveys and interviews with participants, studies have provided multiple motives of people using emoticons, emoji, and stickers in the online communication, including for emotion expression, for humor expression, and for enjoyment, to list a few. Chen and Siu (2017) surveyed 347 young people aging between 18 and 35 and found four major motives of using emoticons, emoji, and stickers. The four motives were: (a) accuracy, to avoid misunderstanding in feelings or meanings; (b) sociability, to facilitate an easier and more interactive

conversation; (c) enjoyment, to convey amusement and energize the communication; and (d) efficiency, to offer clues of intended meaning and to compensate the nonverbal elements in the virtual environment. These four motives were confirmed in other studies (e.g., Zhou et al., 2017). Derks et al. (2008) stated that emoticons were mostly used to express emotions and to strengthen the meaning of a message. Participants in Lee et al.'s study (2016)) reported that they used stickers for strategic and functional purposes, rather than merely expressing emotions.

5 Discussion and Conclusion

This study is by far the first to systematically categorize and conclude the studies on three nonverbal cues: emoticons, emoji, and stickers. We hope it can organize our understanding toward this topic of interest and also inspires future research efforts.

The review of related literature has shown that emoticon, emoji, and sticker use has become increasingly prevalent in computer-mediated communications, particularly with the aid of the popularity of smartphone and instant messaging use. Previous studies pursued multiple directions of exploration, and the range and variety of topics have helped us with a better understanding of why and how these cues are used and what impact they have brought to online interactions.

First, proper use of emoticons, emoji, and stickers, especially positive emoticons, is conducive to both relationship formation and cognitive understanding. In other words, they can not only facilitate affective expressions in the virtual context but also function as textual clues for accurate and efficient mutual understanding. Second, using emoticons, emoji, and stickers is a highly contextualized and personal behavior. Previous studies have proven that task nature (task-based or social), interactive mode (synchronous or asynchronous), valence (positive or negative), gender (male and female), and user preference would all affect the behavior and impact of using these cues.

Several directions may be worth more research efforts. First, despite the fact that emoticons, emoji, and stickers are commonly used in daily communications, many extant studies were done in a lab setting for the purpose of comparison. We can benefit from more studies being done in authentic communicative tasks, to have a more direct understanding of the contextual impact. Second, very little attention has been paid to examine whether the communicative goals have been achieved. Extant studies have investigated the motives and impact independently. However, we do not know whether users achieve the expected goals. In other words, some efforts could be paid on comparing the intention of the sender and the impact on the receiver.

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A Longitudinal Study on Smartphone Use in Hong Kong

Tony Chin-Leung Chow and Will W. K. Ma

Abstract Smartphone use has become our daily habit. However, we are unfamiliar with how people use their smartphone and its development. This study aims to understand the change of smartphone use over a year, which developed a tailor-made smartphone app by new data collection method. It provided an alternative platform for a mass number of researchers to simply observe and record smartphone use of the public. A longitudinal study could be conducted using the data collected to compare the changes of patterns of smartphone use. Three stages of data collection were conducted in summer 2016 (1265 data set), winter 2017 (3780 data set), and summer 2017 (3883 data set) in Hong Kong. The results showed that significant relationships were found between smartphone use and gender, and between smartphone use and weekday. The trend of smartphone use from 2016 to 2017 was discussed, including the increasing domination of instant message, the important role of audio function, the augmentation of female's social networking behavior, and the diversifying communication pattern during weekend. The study suggests sharing the raw data for every researcher to analyze in their own way.

Keywords Smartphone · Use · Hong Kong · Data collection · Longitudinal study

1 Introduction

Smartphone is a handheld and wireless gadget which is able to operate like a computer (Carroll & Heiser, 2010). Falaki et al. (2010) explained that it contained the fundamental features of interpersonal communication, software use, Internet

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surfing, and leisure activities. Smartphone can conduct multitasking mission beyond the low-end feature phone, such as voice chatting, emailing, video playing, social networking, and more. The utilization of smartphone has rapidly increased since its release. According to the statistics of International Telecommunication Union (2017), the mobile phone penetration rate, the number of mobile devices subscribers per 100 people, has doubled in the past decade, from 50.6% in 2007 to an estimated 103.5% in 2017. In developed countries, the mobile network penetration rate increased from 18.5% in 2007 to an estimated 97.1% in 2017, where almost every smartphone user is equipped with Internet service. A similar situation happened in Hong Kong; Census and Statistics Department (2017) reported that 85.8% citizens owned at least one smartphone and 98% users had used the online function.

1.1 Smartphone and Communication

Smartphone acts an important role in social interaction. People habituate to use smartphone for allaying boredom (Fullwood, Quinn, Kaye, & Redding, 2017) and avoiding people around them (Smith, 2015). Sarwar and Soomro (2013) stated that users created their own microcultures and connections all the time through mobile devices. Although instant messaging tools on smartphone diminished face-to-face contact, Hu, Wood, Smith, and Westbrook (2004) explained that this function was able to boost social intimacy rather than hinder it. Another study (Cho, 2015) also indicated that communication app was able to increase user's social capital and reduce the feeling of isolation. According to the previous study of this project (Chow & Ma, 2017), instant messaging and social networking sites dominated the smartphone use. However, some traditional communication functions, such as phone calling and listening, were still useful. People could enhance their ability of multidimensional conversation while taking use of both phone call and text message communication patterns (Quadri, Zignani, Capra, Gaito, & Rossi, 2014).

1.2 Smartphone and Mobile Learning

Mobile learning is a form of learning with handheld and wireless communication devices to provide learning opportunities (Brown, 2005), which transformed the practice of pedagogies in technology outside classroom (Traxler, 2007). Some studies found that the use of smartphone social-oriented application positively promoted student's academic performance (Mouza & Barrett-Greenly, 2015), collaborative learning performance (Moreira, Ferreira, Santos & Durão, 2016), and social involvement (Kim, Wang, & Oh, 2016). For example, learning with WhatsApp advanced high school students' cognitive engagement (Mamba & Kohda, 2017). Mobile learning also supported the classroom interaction (Arreymbi & Draganova, 2010) and teamwork with peers outside the school (Squire & Dikkers, 2012).

On the other hand, the mobile phone, with more individualized design, provides people an opportunity to access their lifelong learning (Benjamin, 2016), which facilitated the users' needs to gain varied knowledge and to fulfill the desire of new conception in daily life (Grant & Hsu, 2014; Hermans, Tondeur, van Braak, & Valcke, 2008). Some studies found that people tend to train their foreign language, including vocabulary, listening, and reading (Dang, 2013), through mobile phone spontaneously (Viberga & Grönlund, 2017) with text, image, video, and audio functions (Brett, 2011).

In order to improve the efficiency of mobile learning, researchers are focusing on the behavior of smartphone use in divergent ways. For example, users' information and entertainment seeking was significantly related to different days in a week (Bae, 2017). About the gender factor, women performed better learning capability with video and social patterns than men (Reychav & Mchaney, 2017). Moreover, some studies (Kim & Jin, 2015; Pham, Chen, Nguyen, & Hwang, 2016) suggested that smartphone followed the design of card-based interface, and auditory guidelines significantly improved users' memory retention and learning capability. Therefore, this study aimed to figure out the patterns of smartphone use for verifying the above results and providing the context of further study in Hong Kong.

Referring to the former two stages of study in the summer of 2016 and winter of 2017 (Chow & Ma, 2017; Wong & Ma, 2017), the smartphone use changed in accordance with different days, gender, and place. It is time to explore the trend of the behavioral change after the third-stage data collection conducted in the summer of 2017. Specifically, we set the following research question:

RQ: *What is the trend of people using smartphone for?*

The paper was organized as follow. First, it explained the procedures of the data collection application. Second, it discussed the rationale to categorize smartphone uses. The pilot data in three stages of the study were analyzed with respect to several factors. It discussed the implication and trend of the smartphone use, followed by the limitation of this study and further studies in the end.

2 Methodology

2.1 Background

In this study, a mobile app, SY MediaLab Big Data Project, was established in the summer of 2016 for data collection (SY MediaLab, 2016). Researchers could record the public's smartphone uses by choosing from eight different types of measurement items on the app, including Game, Instant Communication, Video, Social Media, Phone Call, Information Browsing, Photo, and Audio. This app could be used at different times and at different places across the globe. Therefore, usage patterns and trends could be tracked and compared.

2.2 Subject

There were three half-year stages of data collection. The first data collection (T1) collected 1265 data within 37 days, from 18 July to 23 August 2016. The second data collection (T2) collected 3780 data within 7 days, from 21 to 27 January 2017. The third data collection (T3) collected 3883 data within 7 days, from 20 to 26 July 2017. Twenty-seven researchers, participating in different stages, went to different public areas in Hong Kong randomly and autonomously. They observed and recorded what smartphone usage did people use.

2.3 Instrument of Data Collection

In the application, two colors of buttons were designed to represent different genders, blue for male users and pink for female users. Each color contained eight buttons, including Game, Instant Communication, Video, Social Media, Phone Call, Information Browsing, Photo, and Audio. The researcher was required to choose a bundle of five buttons to record the nearest five smartphones' uses and then submit for each data delivering back to server. Apart from the smartphone use and the gender, the server also recorded the date, the time, and the GPS location, without any individual or personal identities. The database would automatically update and immediately generate the real-time generated graphs (SY MediaLab, 2016). The project website provided the raw data for the public for analyzing by their own so that this project achieved the goal of data and knowledge sharing.

2.4 Rationale to Data Collection Method

This project provided an alternative way to collect data through simple observation in different real-time, continual dates and live places. With sufficient research, the collected data are able to reflect the accurate behavior of the public. This collecting method could deal with the problem occurring in questionnaire survey and company's database. In questionnaire, respondents are possible to provide inaccurate answers due to their limited memory and misperceived time of smartphone use. In the company's database, it is precise result by its original data, but those data are usually used for its marketing purpose with reluctant attitude toward sharing.

2.5 Classification of Smartphone Use

In this study, smartphone uses were classified into eight different uses, including Game, Instant Communication, Video, Social Media, Phone Call, Information Browsing, Photo, and Audio. These eight measurement items were following four levels of smartphone use function. Firstly, Phone Call is the original and fundamental function of mobile phone. Secondly, people would use some multimedia features such as Photo, Audio, and Video for further use. Thirdly, Game is capable of satisfying the user's entertainment requirement on cell phone. Furthermore, due to the media richness theory (Daft & Lengel, 1986), the richness of a medium regards on four abilities, including the rapid feedback, the number of information handling, personalization, and language diversity. Three functions were classified in smartphone, Information Browsing, Social Media, and Instant Communication, which based on that four abilities of media richness. The above eight categories covered most of smartphone use. The data collection aims to determine distinguished data set instead of deepen studies of each behavior.

3 Findings

3.1 Descriptive Statistics of Data

In the first data collection (T1), there were 1265 data set, consisting of 604 males and 661 females. The weekday of data collection ranged from 60 to 425. In the second data collection (T2), there were 3780 data set, including 1943 males and 1837 females. The weekday of data collection ranged from 355 to 755. In the third data collection (T3), there were 3883 data set, containing 1882 males and 2001 females. The weekday of data collection ranged from 395 to 720. The details of gender and weekday were summarized below (see Table 1a and 1b).

Table 1a Gender distribution at T1, T2, and T3

	T1		T2		T3	
	f	%	*f*	%	*f*	%
M	604	47.7	1837	48.6	1882	48.5
F	661	52.3	1943	51.4	2001	51.5
Total	1265	100.0	3780	100.0	3883	100.0

Table 1b Weekday distribution at T1, T2, and T3

	T1		T2		T3	
	f	%	*f*	%	*f*	%
Mon	130	10.3	755	20.0	720	18.5
Tue	270	21.3	625	16.5	680	17.5
Wed	95	7.5	640	16.9	395	10.2
Thu	120	9.5	405	10.7	568	14.6
Fri	425	33.6	335	9.4	685	17.6
Sat	165	13.0	600	15.9	400	10.3
Sun	60	4.7	400	10.6	435	11.2
Total	1265	100.0	3780	100.0	3883	100.0

Table 2 Smartphone application ranking at T1, T2, and T3 (from high to low)

T1			T2			T3		
	f	%		*f*	%		*f*	%
Game	260	20.6	Social media	819	21.7	Instant comm.	889	22.9
Info browsing	217	17.2	Instant comm.	806	21.3	Social media	640	16.5
Instant comm.	200	15.8	Audio	612	16.2	Game	614	15.8
Social media	195	15.4	Phone	540	14.3	Audio	528	13.6
Audio	135	10.7	Game	414	11.0	Info browsing	517	13.3
Phone	125	9.9	Info browsing	332	8.8	Phone	362	9.3
Video	116	9.2	Video	181	4.8	Video	244	6.3
Photo	17	1.3	Photo	76	2.0	Photo	89	2.3
Total	1265	100.0		3780	100.0		3883	100.0

3.2 Smartphone Application Ranking

In the first data collection (T1), after the ranking of eight measurement items, the top three ranking of smartphone uses were Game (260, 20.6%), Information Browsing (217, 17.2%), and Instant Communication (200, 15.8%). In the second data collection (T2), the top three ranking of smartphone uses were Social Media (819, 21.7%), Instant Communication (806, 21.3%), and Audio (612, 16.2%). In the third data collection (T3), the top three ranking of smartphone uses were Instant Communication (889, 22.9%), Social Media (640, 16.5%), and Game (614, 15.8%) (see Table 2). The different smartphone uses at the three time points are shown below (see Fig. 1).

3.3 Chi-Square Test

The chi-square tests were used to test for a statistically significant relationship between smartphone use and gender, respectively, at T1 (χ^2 = 49.766, df = 7, $p < 0.001$), at T2 (χ^2 = 134.697, df = 7, $p < 0.001$), and at T3 (χ^2 = 207.352, df = 7, $p < 0.001$) (see Table 3a, 3b and 3c). The male-female ratio of each measurement item, in order to compare the change of smartphone use at T1, T2, and T3, were shown in Table 4. Two figures were drawn to show the change of smartphone use in gender at T1, T2, and T3 (see Fig. 2a and 2b).

A chi-square test was used to determine a statistically significant relationship between smartphone use and weekday, respectively, at T1 (χ^2 = 200.424, df = 42, $p < 0.001$), at T2 (χ^2 = 217.689, df = 42, $p < 0.001$), and at T3 (χ^2 = 110.398, df = 42, $p < 0.001$) (see Table 5a, 5b, and 5c).

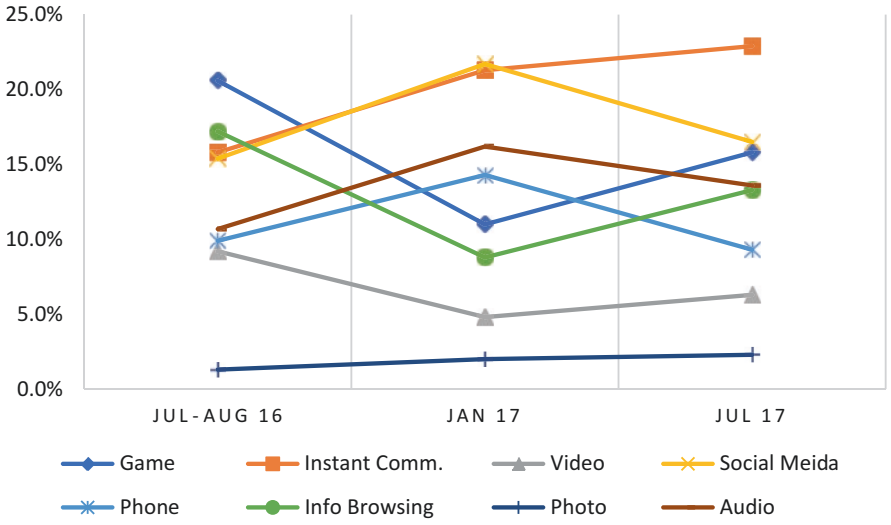

Fig. 1 Change of smartphone use across T1, T2, and T3

Table 3a Gender against smartphone use bivariate table at T1

	Smartphone use								
	Game	Instant comm.	Video	Social media	Phone	Info browsing	Photo	Audio	Total
M	169[1]	83[3]	38	85	51	110[2]	7	61	604
	28.0%	13.7%	6.3%	14.1%	8.4%	18.2%	1.2%	10.1%	100.0%
F	91	117[1]	78	110[2]	74	107[3]	10	74	661
	13.8%	17.7%	11.8%	16.6%	11.2%	16.2%	1.5%	11.2%	100.0%

Note: [1, 2, 3] refer to ranking (from high to low)

Table 3b Gender against smartphone use bivariate table at T2

	Smartphone use								
	Game	Instant comm.	Video	Social media	Phone	Info browsing	Photo	Audio	Total
M	302	336[2]	89	355[1]	247	154	28	326[3]	1837
	16.4%	18.3%	4.8%	19.3%	13.4%	8.4%	1.5%	17.7%	100.0%
F	112	470[1]	92	464[2]	293[3]	178	48	286	1943
	5.8%	24.2%	4.7%	23.9%	15.1%	9.2%	2.5%	14.7%	100.0%

Note: [1, 2, 3] refer to ranking (from high to low)

Table 3c Gender against smartphone use bivariate table at T3

	Smartphone use								
	Game	Instant comm.	Video	Social media	Phone	Info browsing	Photo	Audio	Total
M	442[1]	352[2]	114	260	165	283[3]	24	242	1882
	23.5%	18.7%	6.1%	13.8%	8.8%	15.0%	1.3%	12.9%	100.0%
F	172	537[1]	130	380[2]	197	234	65	286[3]	2001
	8.6%	26.8%	6.5%	19.0%	9.8%	11.7%	3.2%	14.3%	100.0%

Note: [1, 2, 3] refer to ranking (from high to low)

Table 4 Smartphone use at T1, T2, and T3 bivariate table

	Game	Instant comm.	Video	Social media	Phone	Info browsing	Photo	Audio
T1	2.03	0.77	0.53	0.85	0.75	1.12	0.8	0.90
T2	2.70	0.76	1.02	0.81	0.89	0.91	0.6	1.20
T3	2.73	0.70	0.94	0.73	0.90	1.28	0.41	0.90

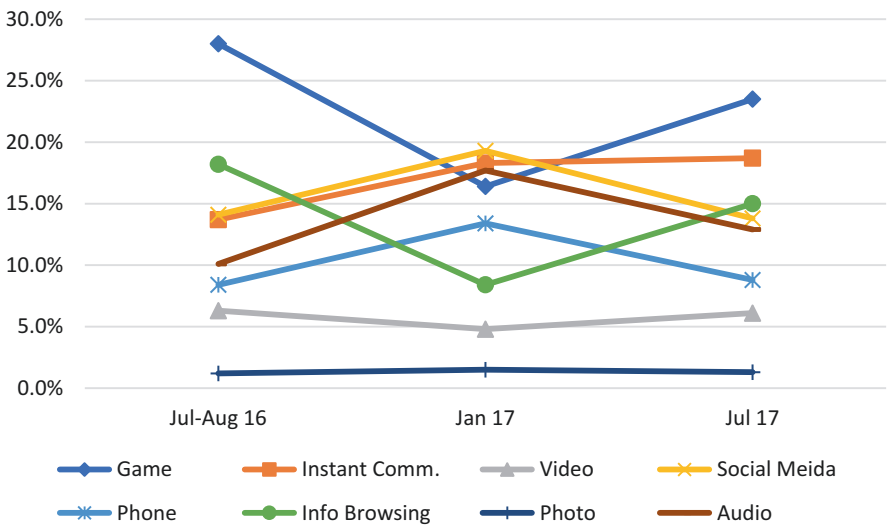

Fig. 2a Male use of smartphone

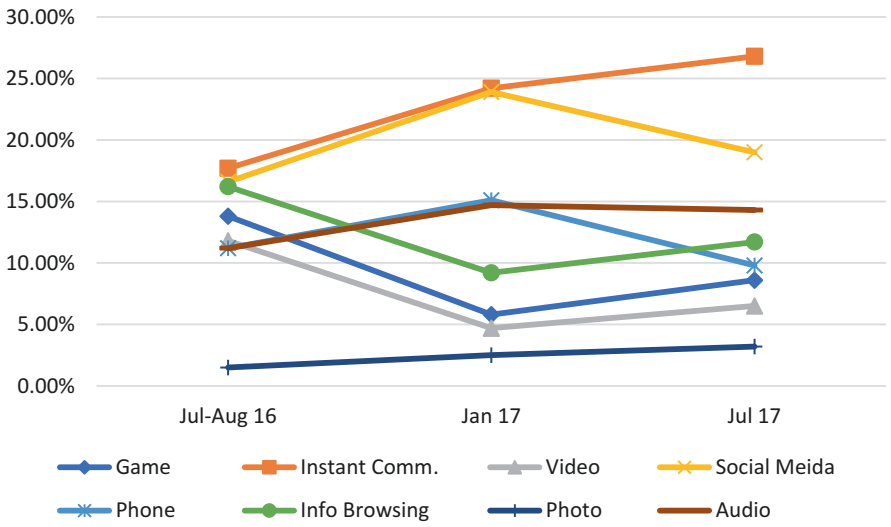

Fig. 2b Female use of smartphone

Table 5a Weekday and smartphone use bivariate table at T1

	Game	Instant comm.	Video	Social media	Phone	Info browsing	Photo	Audio	Total
Mon	21	23[2]	15	22[3]	15	27[1]	0	7	130
	16.2%	17.7%	11.5%	16.9%	11.5%	20.8%	0.0%	5.4%	100.0%
Tue	40	15	35	55[1]	35	46[2]	0	44[3]	270
	14.8%	5.6%	13.0%	20.4%	13.0%	17.0%	0.0%	16.3%	100.0%
Wed	27[1]	15[3]	6	12	6	18[2]	0	11	95
	28.4%	15.8%	6.3%	12.6%	6.3%	18.9%	0.0%	11.6%	100.0%
Thu	38[1]	6	17	28[2]	1	26[3]	0	4	120
	31.7%	5.0%	14.2%	23.3%	0.8%	21.7%	0.0%	3.3%	100.0%
Fri	91	94[1]	30	56[3]	43	55	2	54	425
	21.4%	22.1%	7.1%	13.2%	10.1%	12.9%	0.5%	12.7%	100.0%
Sat	33	30[3]	10	12	20	38[1]	11	11	165
	20.0%	18.2%	6.1%	7.3%	12.1%	23.0%	6.7%	6.7%	100.0%
Sun	10	17[1]	3	10[2]	5	7	4	4	60
	16.7%	28.3%	5.0%	16.7%	8.3%	11.7%	6.7%	6.7%	100.0%
Total	260	200	116	195	125	217	17	135	1265
	20.6%	15.8%	9.2%	15.4%	9.9%	17.2%	1.3%	10.7%	100.0%

Note: [1, 2, 3] refer to ranking (from high to low)

Table 5b Weekday and smartphone use bivariate table at T2

	Game	Instant comm.	Video	Social media	Phone	Info browsing	Photo	Audio	Total
Mon	65	148[2]	47	193[1]	91[3]	59	8	144	755
	8.6%	19.6%	6.2%	25.6%	12.1%	7.8%	1.1%	19.1%	100.0%
Tue	63	117[2]	41	156[1]	71	63	3	111[3]	625
	10.1%	18.7%	6.6%	25.0%	11.4%	10.1%	0.5%	17.8%	100.0%
Wed	90	130[2]	32	147[1]	70	71	8	92[3]	640
	14.1%	20.3%	5.0%	23.0%	10.9%	11.1%	1.3%	14.4%	100.0%
Thu	52	93[1]	16	85[2]	64[3]	32	6	57	405
	12.8%	23.0%	4.0%	21.0%	15.8%	7.9%	1.5%	14.1%	100.0%
Fri	29	80[2]	13	64[3]	55	22	3	89[1]	355
	8.2%	22.5%	3.7%	18.0%	15.5%	6.2%	0.8%	25.1%	100.0%
Sat	69	138[1]	22	111[2]	107[3]	46	18	89	600
	11.5%	23.0%	3.7%	18.5%	17.8%	7.7%	3.0%	14.8%	100.0%
Sun	46	100[1]	10	63[3]	82[2]	39	30	30	400
	11.5%	25.0%	2.5%	15.8%	20.5%	9.8%	7.5%	7.5%	100.0%
Total	414	806	181	819	540	332	76	612	3780
	11.0%	21.3%	4.8%	21.7%	14.3%	8.8%	2.0%	16.2%	100.0%

Note: [1, 2, 3] refer to ranking (from high to low)

Table 5c Weekday and smartphone use bivariate table at T3

	Game	Instant comm.	Video	Social media	Phone	Info browsing	Photo	Audio	Total
Mon	131[2]	169[1]	44	113[3]	65	75	18	105	720
	18.2%	23.5%	6.1%	15.7%	9.0%	10.4%	2.5%	14.6%	100.0%
Tue	112[2]	165[1]	48	94[3]	60	93	11	97	680
	16.5%	24.3%	7.1%	13.8%	8.8%	13.7%	1.6%	14.3%	100.0%
Wed	70[3]	106[1]	17	73[2]	22	46	9	52	395
	17.7%	26.8%	4.3%	18.5%	5.6%	11.6%	2.3%	13.2%	100.0%
Thu	68	122[1]	35	100[2]	62	77	11	93[3]	568
	12.0%	21.5%	6.2%	17.6%	10.9%	13.6%	1.9%	16.4%	100.0%
Fri	101	134[1]	43	113[3]	61	124[2]	6	103	685
	14.7%	19.6%	6.3%	16.5%	8.9%	18.1%	0.9%	15.0%	100.0%
Sat	68[2]	89[1]	33	66[3]	34	57	10	43	400
	17.0%	22.3%	8.3%	16.5%	8.5%	14.3%	2.5%	10.8%	100.0%
Sun	64[3]	104[1]	24	81[2]	58	45	24	35	435
	14.7%	23.9%	5.5%	18.6%	13.3%	10.3%	5.5%	8.0%	100.0%
Total	614	889	244	640	362	517	89	528	3883
	15.8%	22.9%	6.3%	16.5%	9.3%	13.3%	2.3%	13.6%	100.0%

Note: [1, 2, 3] refer to ranking (from high to low)

4 Discussion

This project examined the collected data, and the results showed the different patterns of smartphone use in three stages. Significant relationships were found between smartphone use and gender, and smartphone use and weekday. Four phenomena or trends were analyzed.

4.1 Instant Message Gently Leading the Smartphone Use

After drawing the trend line (see Fig. 1) of smartphone use in three data collections, Instant Communication has become more and more popular gradually among other types of applications, from the third place in 2016 (15.8%) to the top in 2017 (22.9%). Similarly, the popularity of Social Media was preceded only by Instant Communication, from the fourth place in 2016 (15.4%) to the second in 2017 (16.5%). These two smartphone uses occupied 31.2% in 2016 to 39.4% in 2017 over all usages, which indicated social networking features was in a leading position continuously, and the demand for this feature was increasing. It is noteworthy that the growth of Instant Communication was apparently more than Social Media, which needed to be further studied whether mobile users tend to interact with a few intimate members than "friends of friend."

4.2 Audio Function Getting More Important

The usage amount of Audio was moderately increasing, from 10.7% in 2016 to 13.6% in 2017. In fact, this measurement item was logically difficult to be collected because Audio data usually yielded to another application in use. It could be explained by citizens' earphone-wearing habit. They might wear an earphone in order to deal with any auditory requirements in public place, such as message notification, phone call, video, listening, or even without any sound, for multitasking purpose. Therefore, people are able to isolate from the real world and to focus on the mobile affairs. Audio function in smartphone acts a significant role to social interaction.

4.3 Female Engaging in More Social Networking Interaction

The male-female ratio (see Table 4) demonstrated that the leading position of women using Instant Message and Social Media was increased, from 29.9% more than men to 43% and from 17.6% more than men to 37%, respectively, over a year.

Women also generally preferred using Phone Call and Listening to men. On the other hand, men played more Game, as 2.03 times to 2.7 times than women, and browsed more Information. The results mainly kept consistent with the previous data collections, with men using smartphone for self-satisfaction while women adopting smartphone for social connection. In addition, to explain the dramatic changes of Game use, it should attribute to the release of augmented reality game Pokémon GO. This game was all the rage during the data collection period in 2016 summer, but then cooled down hastily within a few months. It indicated that this game drew the attraction of women, hence narrowing down the gap of playing Game between male and female in 2016.

4.4 Diverse Smartphone Interaction During Weekend

People preferred using smartphone with diversified functions during the weekend which was possibly for contact with a close person. In spite of growth in Instant Message, there was a gradual drop in the usage rate (from 28.3% to 23.9%) on Sunday. Oppositely, the demand of Phone Call was increasing (from 6.7% to 13.3%). Another phenomenon was Audio being kept at large amounts of use on Friday but significantly at smaller amount of use during the weekend. It was suggested that people choose listening to music on the last working day of a week and going out with their friends, so they accustomed to put down the earphone. People were willing to chat with others through mobile phone without face-to-face contact.

4.5 Limitations and Further Studies

Due to the observation-based collection method, researchers were able to simply and immediately record the monotonic data from people quickly walking by them. In the future, it is possible to supplement other measurement items for advanced research objective. In the long term, it could analyze the trend for more than a year when researchers conduct continuously.

Some biased results were recorded possibly due to the disequilibrium of time and place by a small-scale research team. To solve this problem, it is suitable to choose a random sampling process in particular number of data, by day or by place, from each researcher. Moreover, the extension of research team could eliminate a lot of potential problems.

5 Conclusion

This project, in three stages of data collection over a year, has some pilot results which found significant relationship among gender, weekday, and smartphone use. Four phenomena or trends of smartphone use between 2016 and 2017 were discussed after analysis. Because of the great influence of smartphone in our daily lives, it is suggested to continuously observe and analyze the change of tendency so as to provide the foundation of smartphone use to other studies. This project aims to construct a collaborative work all over the world, which welcomes every mobile user to participate in the research team by downloading the mobile app from App Store and Google Play. All real-time raw data are provided freely on the project platform so that any researcher could make analysis in their own way. Therefore, this open-source database is able to share the collaborative knowledge of smartphone use.

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