Learning English with Second Screen Platforms: A Mixed Method Cross-National Study

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Abstract. Contemporary world has set new stages of technology-driven transformations. Education calls special attention in this matter as digital environments are defining new forms to expand knowledge. Blended learning methods using multiple screens have emerged as new paradigms for facing recent new media appropriation and advancing the learning process in this digital scenario. A study was carried out with 59 students from the penultimate year of high school in Chile and Brazil to address this challenge. For two weeks, they participated in a flipped classroom for practicing basic English, experimenting with Digital Television and smartphone use. Results showed improvement of English skills among students comparing the pre and post-test periods. Also, it was observed that during the activity the students of both countries were mostly focused; however, the percentage of focused students decreased during the second half of the interaction period with the video in Digital Television inside the classroom. It should be mentioned that it was not the aim of this study to compare both countries, but to validate this strategy in two culturally different contexts. The study showed how practicing languages can be benefited with Digital Television use with multiple screens in flipped classrooms situations, being students affected by technology not only in the improvement of their learning but also because it opens opportunities to break down structures rooted in the teaching profession. Future works would be improved by conducting further sessions, amplifying the observation of students' content and characteristics.

Keywords: Teaching method · Learning environment · Multiple screens

1 Introduction

In the last decades, the socioeconomic, political, cultural, and technological transformations have significantly impacted individuals' lives. The appropriation of new media can be observed in work relations and, above all, in the education field, due to the rigidity of its structure [1]. According to Selwyn [2], digital technologies increasingly define education forms today since schools, universities, libraries, and museums have embraced digital artifacts, platforms, and applications, and it is impossible to imagine the future of a non-technology education. Thus, technological resources are progressively incorporated into the teaching-learning process as a way of mediation between

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the individual and knowledge, which helps in the formation and development of the citizen in the context in which it is inserted [3]. Morán [4] reports that there are no two worlds, physical and digital, when it comes to teaching and learning, but an extended space, an increased classroom, which can be merged and hybridized constantly. The COVID-19 pandemic strengthened the relevance of hybrid and active methodologies, stablishing the concatenation of physical and digital worlds the ultimate rule of living in a post-pandemic society.

In this perspective, teachers need to invest in new ways and methodologies of teaching centered in the students, to aid in the motivation and search for more autonomy [5]. In line with this thought, Beserra et al. [6] defend the creation of strategies that bring education and entertainment closer together, and different methods can be articulated to promote greater student engagement. To this end, one option to be considered is the so-called active methodologies, in which students centralize actions and construct knowledge collaboratively, unlike the traditional teaching method, focused on the transmission of knowledge by teachers [1]. Barbosa and Moura [7] corroborate this reasoning and add that in the active methods teachers act as mentors, supervisors, and facilitators since there is the intention to stimulate self-learning and to stimulate students' curiosity in researching solutions and building knowledge without receiving it passively.

Among the active methodologies, it is possible to highlight hybrid teaching, characterized by using technologies as the primary pedagogical resource. Bacich, Neto and de Melo Trevisani [8] affirm that this pedagogical approach presupposes a harmonious coexistence between face-to-face and distance activities, made through Information and Communication Technologies. A proposed hybrid methodology that has drawn attention in recent years is the flipped classroom, which according to Bergmann and Sams [9] can be summarized as "what is traditionally done in the classroom, now runs at home, and what is traditionally done at home, is now carried out in the classroom". Students receive the pedagogical resources of the subjects in advance and study at home; all possible questions or doubts are addressed before or during the lesson and following remedial practical activities with the teacher's assistance supervision. Bergmann [10] was able to observe in his searches a great preference of students for flipped homework assignments, since they can have a greater control of their learning, greater access to teachers and carry out studies in their own time. For Suhr [11], this method allows organizing the didactic activities in a more appropriate way to the student's needs, to reconcile the moments of self-learning with those of face-to-face interaction, regarding the rhythm of each student.

One of the resources used in the flipped classroom model is the audiovisual one. The audiovisual is increasingly present in education, but according to Divardin [12], predominantly in the context of linear learning, as schools do not seem to take advantage of the available technological resources, which diverges from the daily lives of young people and children, who progressively use cinema, television, digital games, the Internet, among other means of communication, to learn. From the perspective of Prata and Chambel [13], the video reveals itself as a tool that can enrich learning in different contexts when integrated with different devices and media. Talbert [14] considers that the cheapness, simplification, and greater access to online video recording and sharing technologies have made it easier to implement the flipped classroom. Also, the author

sees in the application of this model a way to make the classroom more inclusive, active, and focused on the student, since it distances itself from a traditional classroom design, for an entire class, and is based on the assumptions of a personalized education.

Television, as well as other communication media at present, follow the dynamics of digitization, migrating from an analog system to a digital one, with superior image and sound quality, among other benefits. In Latin America, De Grande and Américo [15] show that several countries in the region chose to implement the Digital Terrestrial Transmission model. In 2006, Brazil was the first, while in Chile, the implantation started in 2009 with the same technology.

One of the main reasons for the effort to digitize TV is the growing need for interaction between the user and television programming, pointed out as one of the main positive aspects of Digital Television, which currently divides the audience with other devices, such as smartphones and tablets, called "second screen". This competition has led television (first screen) to invest in complementary content for the user to access simultaneously through other screens, scenario that for Silva et al. [16] strengthens the need to identify solutions that seek a balance between the content of two or more screens to promote public attention.

Bringing the first and second screens to the educational field, since the new media are part of the daily practices of society, many possibilities of integration with the hybrid methodologies can be seen, like the flipped classroom, a model that still lacks further scientific contributions and improvements [17]. In this scenario, the present study, which employs a mixed, quantitative and qualitative approach, aims to measure the impact of the use of Digital Television with multiple screens during a flipped classroom to practice English.

2 Materials and Methods

A quasi-experimental exploratory study was carried out in two public schools: one in Brazil in the city of São Caetano do Sul, and another in Chile in the city of Arica - a total of 59 students, 4 girls and 30 boys (see Table 1); this gender distribution is typical in technical high schools in both countries. It should be mentioned that it was not the aim of this study to compare both schools, but rather, making the proposal of this work valid in two culturally different contexts. Also, considering the limitations of the project, some concerns were taken when selecting schools, for example, a similar number of courses, students, socioeconomic status of students, and representativeness in their contexts. Additionally, gender differences were not considered for data analysis, so the unbalanced gender count in both countries did not impact the scope analyzed.

The participants of both schools were students in their penultimate year of technical electrical high school, aged between 16 and 17 years old, who performed their regular activities in all disciplines, except for the English lessons, which is the subject of this work. For the content of the activities, English was chosen because it is a subject with a similar time load and syllabus/program at this level in both countries. Specifically, the contents related to personal presentation, tourist information, and the use of the verb to be in Simple Present.

The experiment was carried out over a period of two weeks, both in Chile and in Brazil, being structured from four sessions that followed the same protocols in both

Table 1. Class characteristics

Class	Brazil	Chile
Students per class	34	25
Participating students	27	17
Participating girls	3	1
Participating boys	24	16

countries: the first one lasting 60 min, and the other ones 90 min. In the first session, the 15 initial minutes were used to explain the research's objective to each group, and, in the remaining 45 min, the quantitative evaluation instrument (pre-test) described below was applied. At the end of the first session, three video classrooms were made available to the students (see Fig. 1). These video classrooms, lasting less than 10 min each, addressed the content to be learned, and students were instructed to watch at the time and place they consider suitable.

Fig. 1. Captures of content of the three video classrooms available to the students before the experimental work in the classroom.

In the second session, one week after the first, the first 10 min were used to install an application on the students' mobile devices (application described below). The remaining 80 min were focused on the activity itself; that is, clarify doubts and watch the interactive classroom video on Digital Television (see Fig. 2) and, through the mobile application on their devices, interact with the classroom video (both pedagogical tools described below). It is worth mentioning that the students at the end of the activity could continue working with the mobile application to practice the subjects depicted in the video classroom. In the third session, in the school and with the subject's teacher, the students eliminated their doubts and exercised the contents envisioned in the previous activity. For the exercise, the students could use the application in their mobiles or other material of their interest, always with the teacher's accompaniment. Finally, in the last session was divided into two parts; in the first, a quantitative evaluation (post-test) equivalent to the first (pre-test) was applied, that is, different but identical questions in number and level of difficulty. In the second part, a focus group was conducted to determine the degree of appreciation of the students with the set of activities. Figure 3 illustrates the flow of the sessions and their parts.

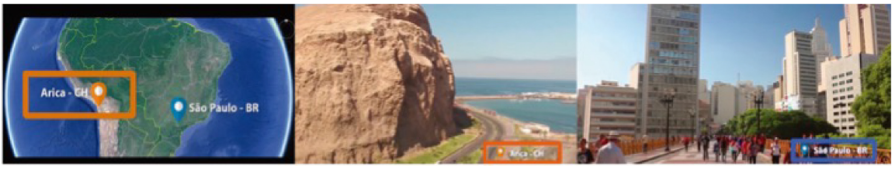

Fig. 2. Scenes from the interactive video presented in the classroom through Digital Television.

FIRST SESSION Duration: 60 minutes	- Initial 15 minutes: research explanation. - 45 minutes remaining: application of the quantitative evaluation instrument (pre-test). - Three video classrooms were made available to the students (to watch at a location of your choice within one week).
SECOND SESSION Duration: 90 minutes	- Initial 10 minutes: installing the application on students' mobile devices. - 80 minutes remaining: clarify doubts and watch the interactive classroom video on Digital Television and, through the mobile application, interact with the classroom video.
THIRD SESSION Duration: 90 minutes	- With the help of the subject´s teacher, the students eliminated their doubts and exercised the contents envisioned in the previous activity.
FOURTH SESSION Duration: 60 minutes	- A quantitative evaluation (post-test) equivalent to the first (pre-test) was applied. - Conducting a focus group.

Fig. 3. Flow of the sessions and their parts

For the analysis, only students who participated in both evaluations (pre and post-test) and attended the face-to-face classroom session were considered ($N = 44$). Table 1 shows the students who performed the pre and post-test along with the corresponding breakdown by gender. The participating teacher was trained for the use of the application for 60 min. Also, to minimize the impact of their skills during the teaching process, a member of the research team was present during the pilot session to ensure that all students received support when faced with difficulties.

2.1 Pedagogical Tools

Two tools were developed for the experiment. The first tool was a set of videos: three classroom videos available to the students after the pre-test and one interactive classroom video used during the classroom-based experimental work.

The videos' format was a formal English lesson delivered by an English teacher on basic English vocabulary. It is worth mentioning that these resources were reviewed and validated by experts in the field in terms of pedagogical content. The group of experts consisted of four professionals: two doctors in education, one doctor with experience in measurement in education and four English teachers (two of them professors of the groups participating in the experiment). Also, two professionals from the multimedia design area were responsible for the production of these resources.

The second pedagogical tool developed was a mobile application (Fig. 4) that allowed students to interact with the Interactive Digital Video classroom. The mobile application was synchronized with the classroom video in seven different moments in the narrative, allowing each student to answer different questions and obtain the corresponding feedback on their devices.

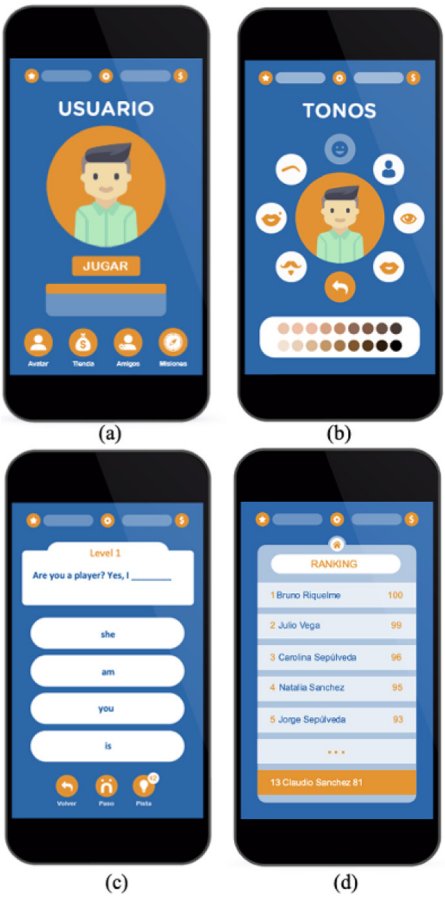

Fig. 4. (a) Main selection module, (b) Avatar configuration interface, (c) Module of questions and alternatives, and (d) Global ranking of student classification.

The application is organized into four modules. The first of them, through a keypad allowing the student to access three other modules: Avatar, Respond and Ranking (see Fig. 4a). In the Avatar module (see Fig. 4b), various elements related to the avatar's appearance associated with the student can be configured, such as the skin color, shape, and color of the eyes, mouth, nose, eyebrows, hair, and beard. In the Respond module (see Fig. 4c), the student can read the question statement, choose one of the five answer alternatives, or use the skip question or request help option. To each correct answer, the student adds 10 points, if it is his first attempt, or otherwise, 5 points. It is worth

mentioning that skipping the questions is a limited resource, as well as asking for help, the latter can be, at random, an explanatory text or the elimination of two incorrect alternatives. Finally, in the last module, Ranking (see Fig. 4d), the students can compare their group's top five scores. It should be highlighted that students could continue employing the application after the experiment to practice. Therefore, their positions in the ranking could be affected. It should be remembered that, during the development of this study, students only used the previously described tool to practice English.

2.2 Evaluations

Quantitative Evaluation

The authors developed a quantitative instrument to identify the level of skills in basic English; such an instrument measured the competence of carrying out a personal presentation and delivering tourist information using the verb to be and the grammatical time Simple Present. This instrument was reviewed and validated by group of experts previously mentioned in terms of its pedagogical content and effectiveness in measuring knowledge acquisition.

In paper format, the quantitative assessment instrument contained 33 questions: the first 4 questions asked to describe a sentence in a line; the following 7 questions asked to re-write short sentences of a statement in the negative form; the next 11 asked to fill in blanks, where they should use verbs in Simple Present; in the following 5 questions, the students choose the written correct option between two sentences; and finally, associate 6 words to 6 images. For example, one of the questions to make a self-description was: "Where are you from?". For sentences in negative form, another example was: "John and Mary have two kids". The questions were arranged by level of difficulty (from easy to difficult), to control the effect of position of the item, the operation of the differential item (DIF) and the measurement bias [18]. Cronbach's alpha was used to guarantee the instrument's reliability [19] in each of the participating groups (see Table 2).

Qualitative Evaluation

To determine if the use of Digital Television with multiple screens during a flipped English classroom was related to the level of student of interest in the activity, two moments were analyzed: during the activity with Digital Television and multiple screens and after that. For this, during the experiment, the behavior and the reactions of each participant were recorded, and after the experiment, a group interview was conducted to the students. For the analysis during the experiment, all participants were evaluated individually and classified according to their attitudes, between engaged and dispersed, which was detailed through three broad categories: focused, dispersed and cooperating, and subdivided into behavioral types for a better analysis. This follows the general principles of usability specification table present in the literature [20].

Regarding the group of the semi-structured interviews, these were accompanied by the teacher of each group, to offer support to the students by sharing their experiences and answering the questions of the interviewer [21], a member of the team. The interviews lasted at most 40 min, with a total of five essay questions to give the interviewer more freedom in compiling what the students said. This decision is fundamental not only to collect the positive feedback that may have occurred but also any information that

comes to the respondent's mind, be it positive feedback or criticism, as Chaer, Diniz and Ribeiro [22] argue. Some of the guiding questions used were: "What did you think of studying at home only with video lessons and in the classroom doing exercises with the teacher?"; "What do you think about using Interactive Digital Television with a mobile device in the classroom?".

3 Results

3.1 Quantitative

Table 2 shows the average and standard deviations of the pre and post-test scores for each class and the Cronbach Alpha [19] associated with the pre-test. The Shapiro-Wilk test confirmed the assumption of the normality of the pre-test [23]. As seen in Table 2, the post-test score was higher than the pre-test score for each group, although there is a small difference, as could be expected considering the pre-test, in the group of Brazilian students, who in some cases reached the maximum score. The above is consistent with effect size (Cohen's d).

Table 2. Characteristics and scores of each class in the pre-test and post-test

Class	*N*	Pre-test		Post-test		Cronbach's Alpha	Cohen's d
		M	*SD*	*M*	*SD*		
Brazil	17	29.38	3.52	30.56	2.30	0.837	0.41 (medium effect)
Chile	27	18.89	5.36	20.83	5.44	0.825	0.36 (small effect)

However, to statistically validate the learning process, first the possible difference of previous knowledge (pre-test) between the two groups (classes) must be validated. Levene's test [24] for equality of variances was applied to verify this assumption, which did not reveal significant differences between groups [$F(2, 42) = 2.837$, $p > .100$]. However, the t-test [25] for equality of means revealed a significant difference [$t(42) = 7.128$, $p < .00$]. The data allows inferring that each group had different levels of knowledge; however, equally distributed. It should be mentioned that it was not the objective of this study to compare differences between groups, though, the different prior knowledge of the groups allows the development of more meaningful analysis since it shows the possibility of using said technology in different contexts of teaching-learning. To validate that in each group, there were significant learning improvements, an analysis of variance (ANOVA) [26] was carried out, using the pre and post-test instruments' results. The results showed that in both groups there were significant differences between the pre and post-test scores [Brazil $F(1, 16) = -1.67$, $p < .057$; Chile $F(1, 26) = -2.06$, $p < .024$]. It is worth mentioning that all statistical analyzes were performed using SPSS, version 24.0.

3.2 Qualitative

Observation

Since the students learned with the use of Digital Television with multiple screens during a flipped classroom, the behavior during that process was studied. For such, the recorded information was analyzed in a range of 10 in 10 s of the video; that interval of time was the longest that allowed discriminating behavior changes. It was observed that the different behaviors (focused, dispersed and cooperating) were grouped in two important events of the activity. The first moment, passive viewer, was characterized by the period where the students watched the video classroom; and the second moment, active viewer, when the student interacted with the classroom video through their mobile device (second screen). Seven moments of active viewer and eight of passive viewer indicated in the figures to be followed were determined.

Figure 5 and 6 show (axis Y) the percentage of the number of categorized behaviors that occurred every 10-s interval (axis X). It can be observed that the levels of concentration, dispersion and cooperation, show that in the moments of Digital Television (DTV), concentration predominates throughout the process, being interrupted by dispersion in most cases. For example, in Chile students were predominantly focused, with a few dispersal behaviors until the first 80 s, when the first moment of interaction with the video begins, which is followed by a predominant behavior change to cooperate. On the other hand, the Brazilian group spent the first 80 s fully focused (see Fig. 6) and then switched to the state mostly cooperating for 20 s until focused with high levels of disruption in the next 20 s.

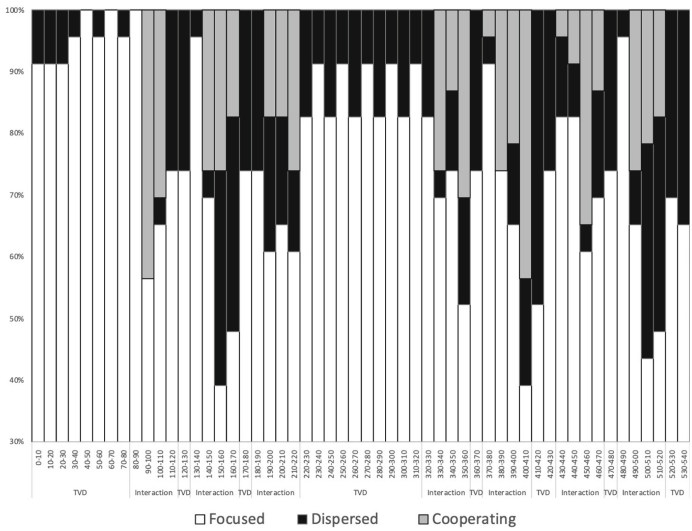

Fig. 5. Focus, dispersion and cooperation levels – Chile

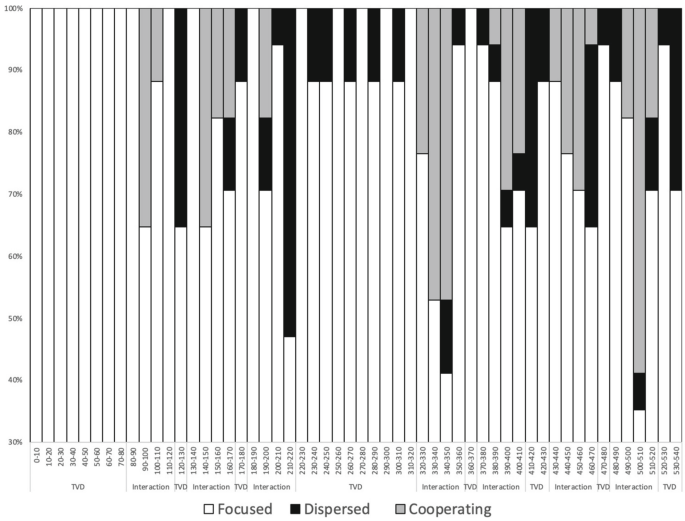

Fig. 6. Focus, dispersion and cooperation levels – Brazil

In summary, the most focused activity can be described during the video on Digital Television (TVD), followed by a transition process from concerted to co-operative or direct during the interaction with Digital Television through the mobile device (Interaction). This transition process can be explained considering the average time needed to answer the questions at each time of interaction. It was observed that as the students answered their questions, the time remaining until resumption of the video classroom, many began to present behaviors of dispersion and/or cooperation. However, it is also possible to highlight, the last 20 s of Chile and 10 s of Brazil, disperse time, for the occasion of the video term, noting that the students with the advance of time in the activity and the increasing complexity of the exercises, they are decreasing their interest.

In summary, Fig. 5 and 6 show that students' engagement during classroom activities was positive. It was possible to verify the predominance of the level of concentration of both Brazilian and Chilean students. In Brazil, 84.2% of students were concentrated, and in Chile, 75.8% were concentrated. Dispersed students accounted for 15.0% in Chile and 7.0% in Brazil. The level of cooperation of Chileans was 9.2% and in Brazilians was 8.8%.

For a more detailed analysis of participants' behaviors during the activity, the focused, dispersed and cooperating categories were subdivided. The first, focused, was divided into: serious, laughing and talking with a classmate (see Fig. 7 and 8, Chile and Brazil respectively). It should be mentioned that serious concentration predominates (Chile: 88.8% and Brazil: 87.4%). Focused laughter was 3.1% in Chile and 2.1% in Brazil. Finally, 10.5% of Brazilians and 8.1% of Chileans participated in a focused conversation with a classmate. It is worth highlighting the difference in the classroom environment between the two countries. In Chile, daily, students are distributed in pairs, which in some way strengthens the collaboration among students, but during this work, this position was not granted; they were distributed individually, this is the most common classroom distribution in Brazil. This fact may explain this result.

Analyzing the predominant types of concentration in Chile and Brazil, we can observe the full dominance of the serious focused behavior throughout the process.

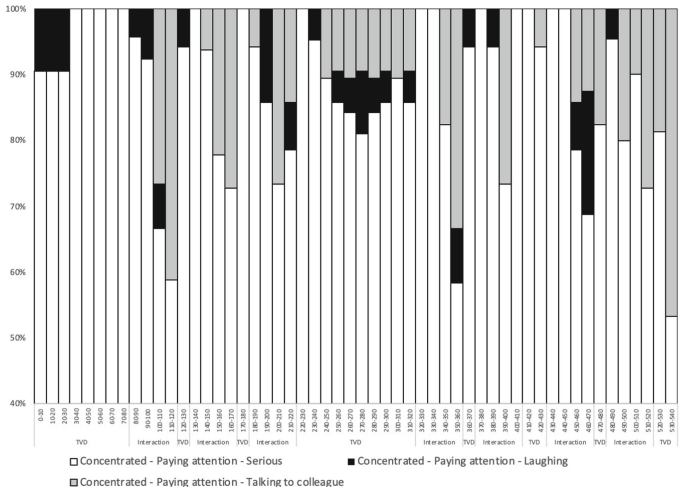

Fig. 7. Types of concentration - students from Chile

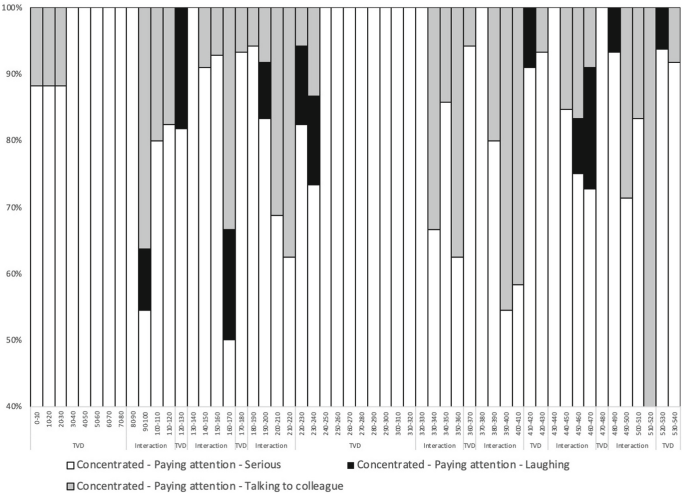

Fig. 8. Types of concentration - students from Brazil

The second category, dispersed, was subdivided into dispersed - talking with a classmate and dispersed - alone. The dispersion was less prevalent, but it occurred and can be observed in Fig. 9 (Chile) and Fig. 10 (Brazil). In Chile, the dispersion was 61% alone and 39% talking with a classmate, that is, there was a predominance of dispersion alone, but in the final part of the activity, it became a dispersion talking with a classmate.

In Brazil, the total predominance was the type talking with a classmate (70%), while 30% of the students were dispersed alone.

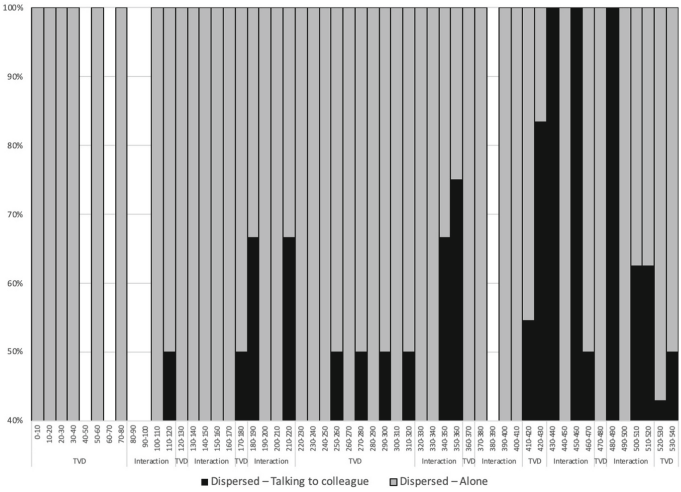

Fig. 9. Types of dispersion - students from Chile

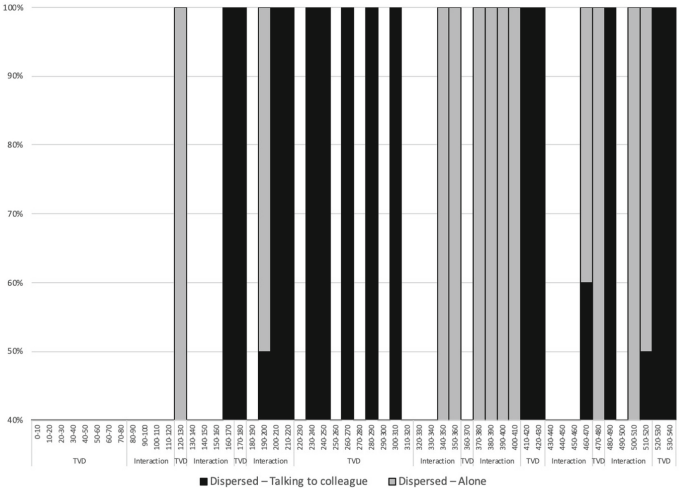

Fig. 10. Types of dispersion - students from Brazil

The third category, cooperating, consisting of the types helping the friend to respond and observing the responding friend, analyzed graphically from Fig. 11 and 12, Chile and Brazil, respectively, indicate the interaction of the students during the activity and its totality represents 8.8% in Chile and 9.2% in Brazil. The predominant result in both countries is that students cooperate more by observing than by helping their classmates

(in Chile, 90.4% of the students observed the classmate respond, in Brazil, 96.3%). Something to consider is that in the case of Chile this help for the classmates occurred in the second moment of interaction with the application, an action that in Brazil is focused only on the end of the activity. Regarding interaction, this can be observed always occurring. However, it is worth mentioning that in Chile and Brazil, student interaction occurs after the first 10 s, in five of the seven moments of interaction with the video lesson. In the fourth interaction, Chilean students continue interacting after the 10 s, while Brazilian students interacted from the beginning; Chileans interacted until the end and Brazilians do not interact in the last 10 s. In the fifth moment, Chilean students interact throughout the process, while Brazilian ones begin interacting after 10 s. Already in the sixth moment, the two groups interact integrally. In the seventh and last interaction, both Chilean and Brazilian students interact from the 10th second and go on to the end.

Regarding the fact that the interaction starts at five moments, after the 10 s, in the two groups, it can be suggested that the students, when assimilating the video, used this time to speculate the answers. Another observed fact is that Chilean students maintained a greater regularity throughout the process, while ones from Brazil, in the initial moments, presented a certain irregularity in the interaction, as in the third moment, in which the students interacted in only 10 s out of a total of 40 s, which characterizes ease in resolving the exercise at that time. However, in the final moments, students from Chile and Brazil displayed a focused behavior on interaction, which may mean the need for collaboration to solve problems, given the higher degree of difficulty.

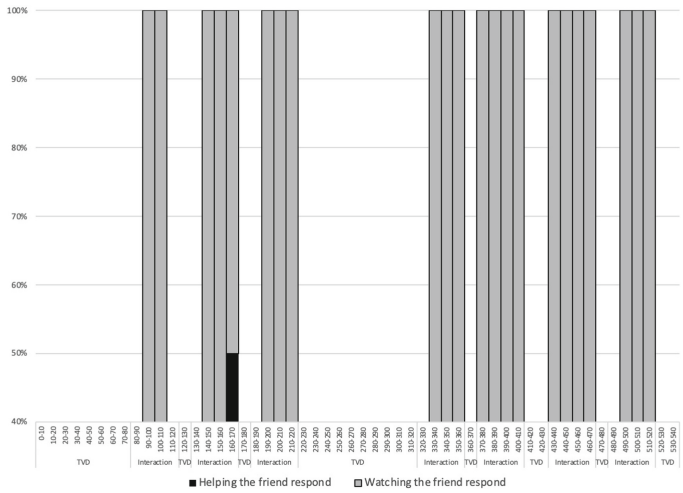

Fig. 11. Types of cooperation - students from Chile

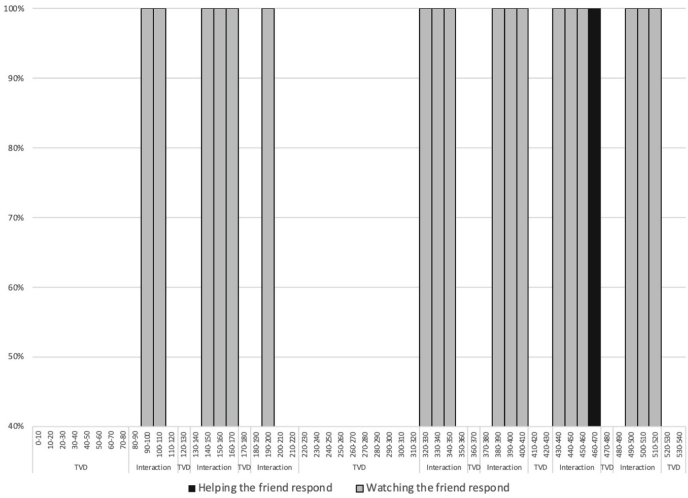

Fig. 12. Types of cooperation - students from Brazil

Interviews

At the end of the multi-screen experience, a group interview was conducted (open interviews). As a result, students' enthusiasm and curiosity about the applied technology can be highlighted, despite an apparent shyness in replying to the investigator's questions. Also, it was possible to observe a predominance of brief answers, not deepened, and the desire for more activities like this in the classroom. About the experience as a whole, the Chilean students considered it "interesting", "flashy", "fun" and "different, but fun", including one of the students pointed out that this method provides greater ease in learning the contents.

Similarly, Brazilian students have described the use of Digital Television with multiple screens as making learning "lighter", "cool", "dynamics", "different and interesting, but it cannot be just that way". In this sense, a student mentioned the supposed need to intercalate the classes with the Digital Television and the normal ones (traditional), but that it would require an adaptation process. An advantage pointed out in one of the comments mentions the possibility that this method would allow the teacher to evaluate the students' performance daily, "being evaluated every day is better than waiting for the result of a test to know where your difficulties lie."

4 Discussion and Future Work

The impact of the use of Digital Television with multiple screens during a flipped English classroom was analyzed for 59 third-year high school students in Brazil and Chile. The participants studied for two consecutive weeks, using the flipped class method with multiple screens. The results showed that all the groups have improved their knowledge of English.

Another observed result was the high degree of student appreciation concerning the use of Digital Television with multiple screens during a flipped English class, a fact that

can be explained by the expectations of today's young people regarding technology, as well as by the strength of the audiovisual and its innovations in the daily lives of this generation. Although flipped learning is not restricted to the use of videos, it was noticed the great influence of these contents on the participants, especially when interacting with the mobile application, which enabled students to exercise autonomy and learn in an active and playful way. Despite the cultural differences, the collaboration and cooperation seen in both countries revealed a common desire among students to have more opportunities to learn using Digital TV and multiple screens. It should be noted that the importance of this study lies in showing that when multiple screens are used, the student is affected by technology not only in the efficiency of their learning but also because it opens opportunities to break down structures rooted in the teaching profession.

Finally, the limitations are part of any research in the classroom and, thus, should be considered. The first limitation of this study comes from the sample's size and representativeness since only two technical high schools and only a portion of the available levels were analyzed; a representative sample (including non-technical schools) would have allowed the generalization and analysis for gender of the results. The second limitation is associated with the reduced number of sessions; a larger number of sessions would have allowed analyzing how the contributions of the application's use in the quality of knowledge and observing student interest over time. Lastly, interview method should be reshaped to evaluate with more precision how flipped classroom influence this kind of scenario, checking more accurately whether behaviors identified were also influenced by the typology of content or learning activity; also, considering the students' background regarding their use of technology and their previous motivations to use it in the classroom, so this information can be compared with the data from the experience itself, gathered during the sessions.

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