Effects of Adding Clickers to Think-Pair-Share for Learning English Grammar

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Think-pair-share (TPS) is a technique used to promote active learning and help deepen understanding of the subject matter. However, one challenge of using TPS in medium or large-sized classes is that it is difficult to give all students the opportunity to share their ideas with the class. For this reason, the study investigated how the use of a clicker application on smartphones (Poll Everywhere) that helps students share responses directly with the class affected their motivational levels and test performance. Participants were 231 Japanese university students learning English grammar. The researchers employed a 2-group experimental design and collected data through weekly quizzes and 2 perception surveys. This data was analyzed to determine the changes in test scores, and *t* tests were used to assess the significance of the difference between the groups. The study showed that practice with clickers had a positive effect on student learning outcomes, satisfaction, and peer cooperation.

シンク・ペア・シェア（TPS）は、アクティブラーニングを促し、学習内容の理解を深める技法である。しかしながら、人数の多い授業にてTPSを使うことで、学生全員に自らの考えを共有する機会を与えることができるかが大きな課題である。そこで、この研究では、学生が応答を直接共有できるスマートフォンのクリッカーのアプリ（Poll Everywhere）を使うことで、学生のやる気と文法テストの結果にどのような影響を与えるかを調査した。参加者は英文法を学ぶ大学生231名で、研究者は2つのグループの実験計画法を用い、毎週行われた小テストと意識調査のデータを収集した。テストスコアの変化を測定するためにデータを分析し、グループ間の違いの有意性を調べるためにt検定を使用した。この研究により、クリッカーの使用は学生の学習成果、満足度、そして仲間との協力において良い効果があることが分かった。

Grammar is an important part of teaching and learning a foreign language. Although some researchers still believe that grammar needs to be explicitly taught using grammar focused lessons and practice activities (Scheffler, 2012; Wang, 2010), there is an increasing awareness of the need to combine these types of grammar activities with some type of active learning (Azar, 2007). Research has shown that active learning activities can increase students' retention of new information, improve their engagement with the course materials, and help them to develop their critical thinking skills (Edwards, 2015; Smith & Cardaciotto, 2011).

Active learning can be defined as "any instructional method that engages students in the learning process" (Prince, 2004, p. 231) and active learning activities are usually classified into one of four categories: individual activities, paired activities, small groups, and student projects (Zayapragassarazan & Kumar, 2012). Of these four categories, paired activities give individual students the greatest amount of speaking time. Think-pair-share (TPS) is one example of a type of paired activity that can be used in the language classroom. TPS was developed by Frank Lyman and his colleagues in Maryland in 1981. In a TPS activity, the teacher first gives students a thought-provoking question and then gives them time to think about the question individually before putting students into pairs and having them share their thoughts on this question with a partner. Finally, the teacher calls for a few pairs of students to share their combined responses in plenary (Lyman, 1981).

One challenge for teachers using TPS is that having groups share their ideas in plenary can take up a lot of class time, especially in large classes. Because of this, teachers often call on only a small percentage of the students. However, there are a number of problems

involved with only asking a small number of groups to share their ideas with the class. First of all, it does not allow for the teacher to hear from all of the students in the class, which makes it difficult for the teacher to ascertain how many of the students actually understand what is being taught. Second, if only a few of the students are required to participate in plenary, it can be more difficult to engage those students who are not given the opportunity to share their ideas with the class.

One possible solution to these issues would be to find a technological solution that allows all of the students in the class to share their ideas with the class in the plenary activity. One example of a technology that makes this kind of sharing possible is clicker technology—a system that combines wireless hardware with presentation software and allows the teacher to easily collect anonymous answers to course-related questions and display those answers to the class. This technology can be implemented in the classroom either through the use of small transmitters purchased by the teacher or the school or by a simple application loaded onto the students' own smartphones. As students submit their answers to questions posed by the teacher using their device, the responses are picked up either by a receiver unit plugged into the teacher's computer or by the application's website. These responses can be then collated and displayed on the screen and the teacher can use these answers to give immediate feedback to individual groups or to the class as a whole.

A number of research studies have shown that clicker technology can increase student engagement and enhance academic performance. Martyn (2007) found that the majority of 45 students using clickers in two sections of a computer information system class perceived increased peer interaction and showed an improved understanding of the content being taught. In another study, more than half of the students enrolled in two mathematics classes reported that they felt that clicker technology helped them to discuss the content of the course (Miller, 2013). Powell, Straub, Rodriguez, and VanHorn (2011) found statistically significant evidence that students who used clickers received better final course grades in a psychology class than those who did not, and all of the 67 students in the clicker group reported that they enjoyed using clickers to respond to questions. More recently, Wang, Chung, and Yang (2014) found that in two high school geometry classes the average scores of the clicker group (19 students) were consistently higher than scores of the nonclicker group (28 students) on three unit quizzes and a California Standardized Testing and Reporting (STAR) benchmark test.

Although the majority of the studies involving clicker technology in the classroom have been positive, not all studies involving the use of clicker technology have shown an improvement in student performance. For example, Morgan (2008) examined the cumulative final course grades across five clicker classes (110 students) and five control classes (127 students) and found no significant differences in the grade distribution between the two types of classes. In another study, Vaterlaus, Beckert, Fauth, and Teemant (2012) compared the results of four test items over two different conditions—clicker review and verbal review—from 287 students in human development courses. They found that there was no significant difference between the mean scores of the students in both conditions (from $p = .15$ to $p = .34$). One potential area of concern when implementing this technology in the classroom is that it could lead teachers to spend less time on lectures (Caldwell, 2007; Morse, Ruggieri, & Whelan-Berry, 2010), which could lead to lower levels of student comprehension of course content.

This study was aimed at exploring the impact of one type of clicker technology, Poll Everywhere (PollEv), a clicker application that was developed for use in the classroom (www.polleverywhere.com), on the academic performance and perceptions of Japanese students enrolled in an integrated English skills course. The study was guided by the following research questions:

RQ1. What is the relationship, if any, between the use of clickers in TPS activities and grammar test scores among the Japanese students in an integrated English skills course?

RQ2. What is the relationship, if any, between the use of clickers in TPS activities and the students' perceptions of learning outcomes, satisfaction, and peer cooperation and interaction?

Method

Subjects

The study took place at a private, technical university in the Hokuriku region of Japan. Two hundred and thirty one 1st year non-English majors took part in this study. Every year the university administers a TOEIC Bridge test and places the students into three different required EFL courses based on their scores. The students in this study scored between 20-90 points on the test, indicating they had a basic proficiency in English language reading and listening. These students were randomly assigned to 10 sections of an integrated English skills course as one of four English classes they were required to take to meet their final degree requirements. The integrated skills course was designed to improve the students' English language proficiency through lessons that combined vocabulary, grammar, listening, conversation, and reading.

Research Design and Instrumentation

The researchers employed a two-group experimental design to discover if the use of the PollEv application adds value to the traditional TPS activity. PollEv is a text messaging application that allows teachers to ask their students a question and students to answer the question using their smartphones. Teachers can then display both the question and the anonymized version of the students' responses live in either Keynote or PowerPoint. This technology is different from traditional clickers as it allows teachers to elicit longer written responses to questions, as opposed to the multiple choice or *yes no* answers that traditional clickers are limited to.

In this study, PollEv was implemented based on recommendations from Martyn (2007) and Poll Everywhere Technology's user guide (www.polleverywhere.com/guide). Before starting to integrate PollEv into the TPS activities, the teacher held a 10-minute introductory session with the students. First, the teacher used a PowerPoint presentation to introduce PollEv to the students. Students were then asked to (a) visit the class's PollEv webpage through their smartphone, (b) write their English name in the text box and send it by touching the submit button, and (c) add the class's PollEv webpage to the home screen of their smartphone so they would be able to quickly access it in subsequent lessons. The teacher had one student model the procedure and monitored and supported the students while they worked through the steps above.

The researchers randomly divided all 10 sections into two groups using a random number generator. Five sections (G1, $n = 124$) with an enrollment of 27, 23, 24, 25, and 25 students respectively used clicker technology, and the other five sections (G2, $n = 107$) with an enrollment of 16, 18, 24, 25, and 24 students did not use it. It was suspected that a cause-effect relationship would exist between the independent variable, the use of PollEv, and the dependent variable, the accuracy by which students applied the English grammar rules they were taught in the course as measured by their performance on standardized weekly grammar tests written by the researchers. These tests were used as a formative assessment tool in the class to ascertain the students' acquisition of the grammar that they were learning in the class. Each test had 10 items, worth one point each. These items were presented in one of two formats: error selection or multiple-choice. A visual analysis was used to measure the effectiveness of the intervention because graphing the data and inspecting the resulting patterns made it easier to describe the changes that occurred or did not occur in both conditions. Finally, *t* tests were used to assess the significance of the difference in student performance between the experimental group and the control group.

This study used an A-B design. The baseline condition is referred to as A and the treatment condition is identified as B (see Table 1). In standard notation, the design is: *O X O1* (*O* = Pretest; *X* = PollEv; *O1* = Posttest).

Table 1. Experimental Condition, Schedule, and Test for Group One

Condition	Week	Test
A	1 2 3 4 5	Pretest (*O*)
B	6 7 8 9 10	Posttest (*O1*)

Data Collection Procedure

The class met once a week for 90 minutes for the course lecture and activities. Each week, the students were given a grammar test immediately after the TPS activities. The tests measured the accuracy with which students made use of the grammatical rules being taught that week. Prior to testing, the classroom teacher implemented a teacher-led session that incorporated TPS active learning activities designed to allow students to practice the target grammar. Each student in the class was given a worksheet containing two open-ended questions. These questions were designed to have students engage in a discussion using that week's grammatical rules. For example, the two questions in the week when the students were introduced to past simple were "Where did you go last summer vacation?" and "What did you do there?" After being given the worksheet by the teachers, students were usually given 2 minutes to individually write their answers using the grammatical rules they had learned in class. Once the students had written their answers, each student was paired with another student. The students were then given 2 minutes to ask their partner the two questions and to listen to and write down their partner's answers. At the end of this activity the pairs were asked to choose who would present their answers to the rest of the class. All of the classes in the study participated in these activities. The only difference between G1 and G2 was the use of clickers. In the G2 classes, the teacher called on students to share their answers with the class aurally. In the G1 classes, the teacher used PollEv to collect all of the students' responses anonymously.

For the purpose of getting a more complete understanding of the students' perception of the benefits that clicker technology could add to a traditional TPS activity, the researchers also administered a six-question bilingual survey twice, first in the 5th week and again in the 10th week, about student perceptions of learning outcomes, satisfac-

tion, and peer cooperation and interaction. The survey used a 5-point Likert scale that ranged from one (*strongly disagree*) to five (*strongly agree*).

Results

Student Test Scores

Because the participants were randomly placed into the course based on their total TOEIC Bridge Test scores instead of their grammar subscores, it was first necessary to establish a baseline measure of the grammatical proficiency of the two groups to better understand the effects of the treatment condition (McMillan, 2004; Morgan & Morgan, 2009). For this reason, PollEv was not implemented in the class until the 6th week of the course. The mean percentage of the baseline measure was approximately 57.48% (range, 47-74) for the experimental group (G1) and 56.04% (range, 43-68) for the control group (G2). Based on these measurements it was possible to determine that the difference between the grammatical abilities of the two groups prior to the treatment condition was not statistically significant ($p = .589$). For the final 4 weeks of the study, the mean for the group using clickers was 70.17% (range, 55-80), more than 10 percent higher than the students who were not using the clicker (58.63%; range, 50-64) (see Figure 1). Furthermore, for G1, the results showed in the intervention condition demonstrated an accelerating trend-line, although only one of the five data points plotted was outside the range of baseline values resulting in a low percentage of nonoverlapping (PND) across the two conditions.

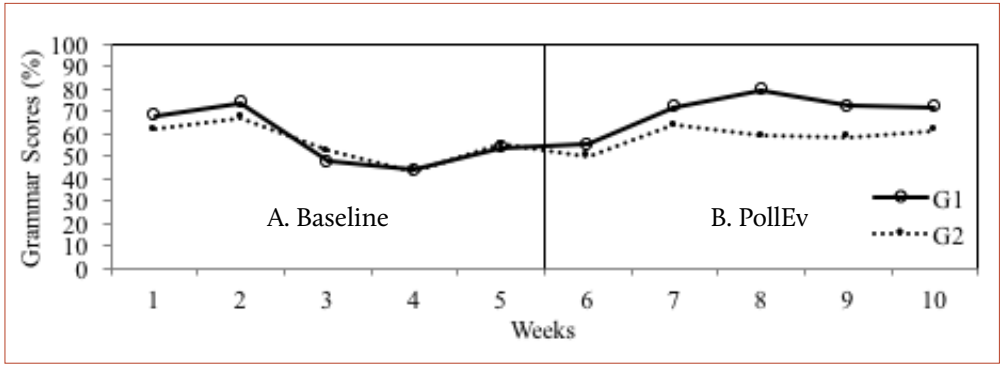

Figure 1. Grammar test scores.

An analysis of variance of the weekly test scores showed that there were significant differences between the two groups (from $p < .001$ to $p < .05$) from the 7th week through the 10th week (see Table 2).

Table 2. Summary of Grammar Scores

	W1	W2	W3	W4	W5	W6	W7	W8	W9	W10
G1%	68.26	73.69	47.83	43.91	53.70	55.43	71.74	79.57	72.39	71.74
G2%	61.85	67.22	52.41	43.33	55.37	50.19	63.89	59.26	58.52	61.29
p	.0477	.0450	.0142	.7602	.4981	.0608	.0150	.0001	.0001	.0053

$p <$ alpha level of .05 declares significant.

Note. W = week; G1 = experimental group; G2 = control group.

Student Perceptions

The survey results showed that the overall impressions about how TPS was used in the course improved in both G1 and G2 (see Table 3). The mean scores for both groups increased in the survey given in the 10th week. However, the percentages of students who agreed or strongly agreed with most of the survey items were higher for students that used clickers than for those that did not. For example, a greater percentage of G1 students reported that they enjoyed TPS (77.42%) and accomplished more in pairs than individually (78.23%). One student's comment provided an explanation of how clickers helped to make these activities more interesting. He stated, "It was fun to see our answers on the big screen."

Table 3. Perception Survey Results

Statement	G	Week 5	Week 10	Likert-scale response, % SD	D	N	A	SA
Think-pair-share is enjoyable.	1	3.39	3.79[C]	0	4.84	17.74	70.97	6.45
	2	3.50	3.91	0	0	34.38	40.63	25.00
Think-pair-share helped me understand English grammar.	1	3.16	3.52[C]	0	4.84	49.19	35.48	10.48
	2	3.23	3.60	0	0	53.13	34.38	12.50
My partner and I contributed to our presentation.	1	3.10	4.01[C]	0	4.84	11.29	62.10	21.77
	2	3.18	4.09	0	3.13	15.63	50.00	31.25
Think-pair-share improved my discussion with my partner.	1	3.06	4.10[C]	0	4.84	8.87	58.06	28.23
	2	3.45	4.22	0	3.13	15.63	37.50	43.75
Think-pair-share improved my feeling of belonging in class.	1	3.25	3.68[C]	0	13.71	17.74	55.65	12.90
	2	3.40	3.84	0	6.25	25.00	46.88	21.88
We accomplished more than we could have individually.	1	3.71	3.83[C]	2.42	4.03	15.32	64.52	13.71
	2	3.68	3.88	0	3.13	34.38	34.38	28.13

Note. [C] = the use of clicker technology; G1 = experimental group; G2 = control group; SD = strongly disagree; D = disagree; N = neutral; A = agree; SA = strongly agree.

Discussion

For the experimental group (G1), the use of clicker technology led to better test scores in the treatment condition than in the baseline condition. The positive effect of clicker technology in this study is also evidenced by the change in trend-line direction before and after the implementation of clickers (from zero to accelerating). The use of clicker technology in conjunction with TPS also resulted in significantly better grammar test results than those of the control group (G2) from the 7th week through the 10th week ($p < .05$). Although the first finding is contradictory to Vaterlaus et al. (2012) who compared the test results of the same student group and found no significant difference over the clicker review and the verbal review condition, the second finding is partially consistent with previous research (Bojinova & Oigara, 2013; Powell et al., 2011; Wang et al., 2014), which found one of the benefits of using clickers was that the clicker group showed a marked improvement in academic performance over the nonclicker group.

One possible reason for these findings is that the use of clicker technology helped students to improve because all of the students had the opportunity to present their answers to the class. This created an environment in which all the students spent more time and effort thinking about and answering the questions posed by the teacher because they knew that their responses would be seen by both the teacher and their peers. Students using clickers were also able to see more examples of responses that were submitted by their peers and to compare those examples with their own answers. Furthermore, having all of the students' responses displayed instantly on PollEv helped the teacher to be more aware of the students' level of understanding with regards to the grammatical forms being taught in the class. This, in turn, enabled the teacher to adapt classroom instructions accordingly, something that has been shown to be effective in other studies (see, for example, Lopez, Love, & Watters, 2014). Another possible reason for the students who were using PollEv scoring higher than the control group on the grammar tests is that most students in the study were technical majors such as engineering or architectural design students, and were, therefore, more likely to engage with the content of a class when this type of interactive technology was involved. Although it is possible that clicker technology alone would not have greatly improved the students' academic performance, it functioned as a tool that helped to facilitate a higher level of participation in the active learning activities employed in the classroom, something that has also been seen in other studies on using clickers in the classroom (Bojinova & Oigara, 2013; Martyn, 2007; Miller, 2013).

The results of our perception survey showed that the students enjoyed using PollEv in the classroom. This aligns with the findings of previous research that found that students considered clickers as "a novel, fun and interactive way of exploring course content" (Miller, 2013, p. 7). However, a few students did report difficulties with using clickers, as one noted "I could not navigate to the website using my phone." Overall, this new format was probably successful because it allowed students to stand up for what they believed in and helped them to feel like they were connected with everyone else in the classroom. It enabled them to make decisions about what they wanted to share and to compare their answers with others through the use of a public screen. It also provided the students with a way to confirm that they were using grammar in the correct way. Most importantly it provided a unique opportunity for students to contribute more and to take more responsibility in the classroom than a more traditional model would have.

Like many other teachers, we recognize that college students have grown up in a world of technology. However, although most students use smartphones outside of the classroom, they are often not familiar with using smartphones in an academic context. In our study, we found that these digital native students enjoyed using clicker technology to practice English because they were able to participate more actively in the class, were given decision-making opportunities, and had more control over their classwork. Likewise, when students changed their role "from a passive observer to an active contributor" (Terrion & Aceti, 2012) or from a less active contributor to a more active contributor with clickers, they were more involved with the course material. Although our study did not attempt to observe actual participation, the teacher noted that generally G1 students responded more consistently in peer discussions, seemed more interested in grammar rules, and were more likely to continue to try until they were able to use the grammar being taught correctly.

A strength of the way that clickers were used in our study was that they were used in conjunction with open-ended, personalized questions that encouraged students to provide answers to grammatical questions in their own words. Several students reported that they liked to see their answers appear on the screen. It may be true that they experienced a feeling of successes through publishing their answers with clickers and may have also felt it was more meaningful than just adding a number or vote to a poll of students' answers to a multiple choice question. However, it should be noted that the amount of effort needed by the teacher who taught the course in the study to digest the different answers to the question that appeared on the screen and give instant feedback was sometimes overwhelming. Hence, special training that prepares teachers to engage in a dialogue around each clicker question would make the implementation of this type of question easier for the teachers involved and more beneficial for the students.

Our study had some limitations. First, we understand the bias that may occur when one of the researchers delivers the instructions to both the experimental group and the control group. However, we felt that this possibility of bias was outweighed by the ability to ensure that the students in both the control and experimental groups received the same materials delivered in a uniform teaching style. Another possible factor affecting research quality is that, although there was no cost for using a higher-education free plan of PollEv, we had to settle for a free version of the application that came with limited functionality. For example, in the free version that we used for our study, the teacher could not connect with more than 30 participants at a time or use specific features such as the moderation feature that allows the teacher to manually approve messages before they appear on the screen. These limitations are resolved in the paid version of the application; however, the cost of the paid version may make using it cost prohibitive for many teachers, especially if it is going to be used for larger classes.

Conclusion

This study provides evidence to support the claim that the use of clicker technology can enhance the effectiveness of TPS activities. The data support our initial hypothesis that the students in the experimental group would see a greater improvement in their grammar test scores through the use of PollEv. The ability of the students in the experimental group to see the work being done by their peers and their increased interest due to the use of technology in the classroom are possible factors that may have contributed to the positive results seen in this study. We also learned that implementing such new technology needs to go beyond simply adding a clicker to existing materials. Both teachers and material developers need to prepare and use it with caution. Failure to do so may result in the technology becoming a distraction that could potentially hinder student learning. However, when implemented correctly this technology can be an asset that can be used to help improve student engagement and facilitate active learning.

Although the results of this study show the benefits of using clicker technology in the classroom, future research needs to be done to determine the effects of clicker technology using different types of questions in class activities, for example multiple choice versus open ended. It would also be beneficial to look at the long-term effect of clickers on student achievement and perception in EFL or other subject areas. Moreover, specific clicker features such as team competitions or text moderation could be explored to see if and how they improve student engagement and/or performance. Combining clicker technology with different types of active learning activities also deserves further attention and examination.

Bio Data

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