Application of a Gamified Interactive Response System to Enhance the Intrinsic and Extrinsic Motivation, Student Engagement, and Attention of English Learners

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ABSTRACT
This study combined the gamification element and an interactive response system (IRS) in the development of a gamified IRS, and examined its effects on the intrinsic and extrinsic motivation, engagement, and attention of junior high school students when learning English. The quasi-experimental research method comprised the scales for measuring intrinsic and extrinsic motivation, student engagement, and attention, as well as an open-ended questionnaire to collect quantitative and qualitative data for analysis. The study involved 144 seventh-grade students who were divided into three groups to learn English using different polling tools. The results indicated that when the gamified IRS was used for polling activities in the classroom, the fun, interactive, competitive, and novel nature of the system helped improve the students’ levels of intrinsic motivation, overall engagement, emotional engagement, and focused attention. The use of clickers for polling leads to significant intrinsic motivation compared to using small whiteboards. This study suggests integrating the gamification element with classroom teaching to make English classes more interesting and attractive to learners. In addition, tools that are highly interactive, challenging, and competitive make students pay more attention in the classroom, and so are more helpful to them when learning English.

Keywords
Gamification, IRS, Intrinsic and extrinsic motivation, Student engagement, Attention

Introduction
In recent years, interactive response systems (IRSs) have gradually become a common tool for teachers’ use in the classroom. Some past studies have pointed out that IRSs have a positive effect on learning and can effectively trigger students’ learning motivation (Trees & Jackson, 2007), promote deeper engagement and classroom participation (Chien, Chang, & Chang, 2016; Sun, Martinez, & Seli, 2014), maintain students’ attention, and improve learning outcomes (Kay & LeSage, 2009; Sun, 2014). At the same time, other studies have highlighted the inadequacies of IRSs. For example, Aljaloud, Gromik, Billingsley, and Kwan (2015) found that sometimes, students would still participate and provide answers despite not having fully understood the topic. From the teachers’ perspective, additional time costs are incurred because they have to prepare questions on the topic in advance (Kay & LeSage, 2009). A factor frequently raised in studies related to IRSs is peer interaction (Chien et al., 2016). The finding was that peer discussions and interactions led to deeper understanding of knowledge and stronger learning motivation on the part of the students (Kay & LeSage, 2009). As such, in this study, we wanted to establish an IRS that could address the aforementioned inadequacies, enhance teacher-student and peer-to-peer interactions, and give students more autonomy for independent decision-making. The aim was to improve students’ concentration and focus in the classroom, thereby creating a positive effect on their learning motivation, engagement, and attention.

Gamified learning has been the focus in the educational field over the past few years. It emphasizes that the integration of the gamification element in non-game domains is to stimulate students’ motivation and interest (de-Marcos, Garcia-Lopez, & Garcia-Cabot, 2016; Deterding, Dixon, Khaled, & Nacke, 2011; Dichev, Dicheva, Angelova, & Agre, 2014). The purpose is for learning to be student centric so that learning becomes interesting and highly interactive. In his study on the integration of gamification with instant feedback systems, Wang (2015) found that the competitiveness of games helped students maintain attention during classes. However, the study only integrated the competitive mechanisms of gamification in the instant feedback system—it lacked the enriching elements of gamification, and the system did not include features to allow students to express themselves. In this study, we argue that when it comes to instant feedback systems, a design that has diverse gamification elements and interaction mechanisms as features can break out of the unidirectional communication of teachers asking and students answering, thereby promoting teacher-student and student-student interactions. Since gamification, with its mechanism and diverse elements, can promote both students’ learning interest and classroom interactions, we wanted to combine it with an IRS and examine the resultant effect on students’ learning.
Although due emphasis has been placed on the learning of English in Taiwan, classroom teaching on the subject nowadays is still unidirectional, with the teacher basically adopting the style of verbal instruction. The motivation for junior and senior high school students to learn English remains low, despite the availability of various English-related extracurricular activities (Shih, 2016). Past studies have shown that students’ intrinsic motivation for learning gradually decreases with age as they advance from elementary to high school (Gottfried, Marcoulides, Gottfried, & Oliver, 2009). Junior high school is a good time for students to develop a strong motivation for learning English, which will be helpful in sustaining their commitment to learning in the future. So far, the majority of studies on the application of IRSs have been limited to college classes (Aljaloud et al., 2015), with a relative lack of literature on their application in junior high schools and other stages of the education process. As such, this study aimed to develop a gamified IRS for application to the learning of English in junior high school classrooms and to examine whether the use of such a system can enhance students’ intrinsic and extrinsic motivation, engagement, and attention.

In conclusion, many studies have confirmed that an instant feedback system has positive effects on learning motivation, learning engagement, attention, and learning performance (Aljaloud et al., 2015; Chien et al., 2016). On the other hand, gamified learning can increase student interest in learning while at the same time promoting learning motivation (de-Marcos et al., 2016; Dichev et al., 2014). Wang (2015) applied the gamified element of competition to an instant feedback system and, using the conventional question and answer feedback system functionality, discovered that the system could help students maintain their attention while learning. However, we believe that making a high degree of interactivity the core of gamified learning would help to design a more interactive and instantaneous instant feedback system. Through the use of gamified elements and interaction mechanisms, a learning environment that helps students become more engaged and motivated can be created. Therefore, the goal of this study is to explore the effect that a gamified instant feedback system for English learning has on intrinsic and extrinsic motivation, learning engagement, and attention.

**Literature review**

**Gamified IRS**

IRSs have often been used to investigate students’ current level of knowledge and to assess their learning situations (Stowell, 2015). These systems have an interesting and attractive mode of operation, and can create a pleasant and positive classroom atmosphere (Johnson & Lillis, 2010). However, many past studies have pointed out the shortcomings of IRSs (Aljaloud et al., 2015; Kay & LeSage, 2009), or have found that the tool was more effective when combined with other teaching strategies such as peer interactions (Chien et al., 2016). Since gamified learning can stimulate students’ interest and promote classroom interactions, we decided to combine it with an IRS in the hope that the advantages of both methods could enhance students’ learning outcomes. It should be noted that gamified learning is not simply the use of the game format to present learning content. Rather, it is using the gamification element to stimulate students’ learning motivation and interest (de-Marcos et al., 2016; Dichev et al., 2014). According to Malone and Lepper (1987), the main features of learning games include challenge, fantasy, curiosity, and control. A game is a challenge because it has a specific goal. Indeterminate results, produced through hidden clues and different levels of difficulty and randomness, trigger the players’ competitive spirit. It is a fantasy because it contains events that do not exist in reality. It focuses on piquing the players’ sensory and cognitive curiosities. During the game, players experience independent decision-making and the giving of instructions. In this study, we used the aforementioned four features of the game mechanism (Malone & Lepper, 1987) as the core elements in designing the interface of the gamified IRS. In so doing, the gamification mechanism was used to enhance students’ learning motivation and attention when they took the initiative to participate in activities involving interactive responses.

Recent studies have combined interactive feedback systems with gamification designs and applied them in the field of education. Wang (2015) had previously used the gamified IRS named Kahoot! as a research tool and found that the competitiveness of the game effectively helped students pay attention in class. Kahoot! applies the polling format to competitions among large and small groups, and has functions such as sound effects and countdown timers for the games. However, teacher-student interactions remain unidirectional, with the teacher setting the questions and the students answering them. This study wanted to promote greater levels of student participation in the classroom through the introduction of other game functions, such as having the students submit options for multiple-choice questions and make bets on the correct answer. Thus, it was important to develop a new type of gamified IRS and test its effectiveness.
Effect of IRSs on intrinsic and extrinsic motivation

Intrinsic motivation refers to a particular person having the interest to participate in an activity, and deriving inner pleasure from doing so. However, it is extrinsic motivation if the person participates in the activity because he/she is attracted by external factors (e.g., getting good grades, doing schoolwork to get rewards and special privileges) rather than the activity itself (Ryan & Deci, 2000a). Students were found to be more proactive and focused when they undertook tasks with intrinsic value (Wigfield & Eccles, 2000). They were also able to gain a more in-depth understanding of the content and concepts of the teaching materials, and the information learned was retained for a longer period (Vansteenkiste, Lens, & Deci, 2006). Extrinsic motivation is especially important when students lack personal interest; the use of extrinsic incentives to increase participation can help promote interest in learning (Hidi & Harackiewicz, 2000). Intrinsic motivation plays an essential motivating role in personal development, adaptation, and the learning process (Ryan & Deci, 2000b). However, the English learning motivation of Taiwanese junior and senior high school students tends to be low (Shih, 2016), so this study included intrinsic and extrinsic motivation in the scope of exploration.

Past studies have shown that teachers can use IRSs to make lessons richer and more interesting. This would stimulate the interest of students to learn, increase teacher-student interaction, and make the classroom atmosphere more harmonious (Chien et al., 2016). Past studies have shown that choice affects intrinsic motivation (Ryan & Deci, 2000b). Students who can choose their own goals, tasks, and problems have a higher intrinsic motivation to complete their activities (Schunk, Meece, & Pintrich, 2012). The interactivity of instant feedback systems provides students with the opportunity to choose classes by polling, which helps to enhance learning motivation. Additionally, the competitive effect brought about by the games and the friendly interactions among peers can make students more interested in the lesson, leading to stronger learning motivation and improved learning outcomes (Burguillo, 2010). Lepper and Hodell (1989, as cited in Schunk et al., 2012) discovered that the four main sources of intrinsic motivation were challenge, curiosity, control, and fantasy. These coincided with the four elements that a gamified mechanism should have. It then follows that the combination of an IRS with the gamification element can enhance students’ intrinsic interest, which would in turn increase learning motivation. Therefore, this study wanted to explore whether a gamified IRS could significantly increase students’ intrinsic and extrinsic motivation.

Effect of IRSs on student engagement

Student engagement refers to their level of participation in teaching activities (Sun & Rueda, 2012). When they are engaged in learning activities, there will be continued participation and exhibition of more positive emotions (Skinner & Belmont, 1993). Using past scholars’ definition of student engagement as the basis, Fredricks, Blumenfeld, and Paris (2004) divided engagement into three types: behavioral, emotional, and cognitive. Behavioral engagement refers to students being actively involved in learning tasks, complying with classroom rules, and being involved in school activities. Emotional engagement refers to students’ emotional responses to the class or to their peers and teachers (Hu, Ching, & Chao, 2012). Cognitive engagement emphasizes the cognitive and psychological efforts made, which includes the emotional state during the learning process and learning strategies employed (Fredricks et al., 2004).

Many past studies have verified that classroom usage of IRSs improved student engagement (Chien et al., 2016; Sun et al., 2014; Trees & Jackson, 2007). By promoting teacher-student interaction, the instant feedback system helps to enhance students’ learning engagement. The research of Sun et al. (2014) found that online polling can effectively increase cognitive and emotional engagement. Thus, the instant feedback system can foster teacher-student and student-student exchanges and promote cooperation and discussions. Not only can it help students understand the teaching content, but it can also improve students’ classroom participation (Blasco-Arcas, Buil, Hernández-Ortega, & Sese, 2013). At the same time, gamification, which combines games and learning content, was also found to have an effect on student engagement. It can effectively enhance student engagement and participation. Sun and Rueda (2012) also pointed out that emotional engagement is promoted when elements that students are interested in have been added to the course. A game that is challenging can attract students to participate in the learning process (Hung, Sun, & Yu, 2015; Wang & Chen, 2010). Goehle (2013) used a gamified online learning platform to design an incentive mechanism for take-home assignments and found that students expressed that when they spent time and effort to master the concepts and repeatedly tried to complete difficult tasks, receiving a reward gave them a sense of accomplishment. Thus, gamified learning has a certain degree of influence on behavioral, emotional, and cognitive engagement. To sum up, both IRSs and gamification have positive effects on increasing student engagement. Hence, this study combined the two methods to make students more engaged in the learning process.
Effect of IRSs on attention

Attention refers to the concentrating and focusing of one’s consciousness (James, 2007). Sohlberg and Mateer (1987) used past literature related to attention therapy as the basis of their study, and proposed that attention can be divided into five levels: selective, divided, sustained, focused, and alternating. When there is focused attention, a person will have visual, auditory, tactile, or other responses to definite objects, meaning that he/she is able to respond to changes in the surrounding environment. When learners cannot concentrate on learning, the success rate of the learning task is significantly reduced (Foulsham, Farley, & Kingstone, 2013). Hence, the type of attention being investigated and measured in this study was focused attention. In the past, many scholars applied IRSs in the classroom to enhance students’ attention during the learning process, and obtained significantly positive results (Kay & LeSage, 2009; Sun, 2014; Sun, Chen, Yeh, Cheng, & Lin, 2018a; Sun et al., 2018b). Games are also helpful in attracting players’ attention (de-Marcos et al., 2016). As such, when this study applied an actual gamified IRS to the classroom, the research scope was its effect on focused attention to understand whether students’ attention could be made more focused.

In summary, current studies have confirmed that instant feedback systems and gamified learning yield benefits in terms of learning motivation, learning engagement, and attention. When past studies integrated game elements into instant feedback systems, they did not divert from the conventional one-way interaction of the question-and-answer method (Wang, 2015). Based on these results, this study attempted to integrate enriching game mechanisms into an instant feedback system in the hope of creating a learning environment that can effectively improve learning motivation, engagement, and attention. The goal of this study is to explore the effect that a gamified instant feedback system for English learning has on intrinsic and extrinsic motivation, learning engagement, and attention. The research model of the study is shown in Figure 1.

![Research model](image)

**Figure 1.** Research model

Research methods

Participants

The research was conducted in spring 2017 and involved two teachers and a total of 144 seventh-grade students in six English classes from a public junior high school located in northern Taiwan. All classes were organized using normal class grouping. After eliminating the invalid samples (for not filling in the questionnaire properly or for being absent from class), 118 valid samples remained. There was an equal distribution between the two genders, with the average age being 13.03 years (SD = 0.47).

The six classes were equally divided into three groups: one control and two experimental groups. The control group had a valid sample of \(N = 43\) (24 males, 19 females). Its participants underwent the traditional teaching and polling mode using a small whiteboard. Experimental Group A (valid sample \(N = 39\), 19 males, 20 females) used a general IRS with clickers, which are commonly seen in classrooms. Each participant had a clicker for polling. Experimental Group B (valid sample \(N = 36\), 16 males, 20 females) used a gamified IRS that was proposed and developed for this study, called the Interactive, Feedback-based In-class Teaching System 3 (iFIT3). Each participant was given either a tablet or a mobile phone for polling.
Methods and instructional design

The experimental process of this study is shown in Figure 2. Four sessions were held within 2 weeks. During Session 1, the experimental content was explained to the participants, and notices to inform parents of the experiment were issued. The students were then given 15 minutes to complete the pre-test form for measuring learning motivation. The course content was then taught. Sessions 2–3 focused on the teaching of the course content. Three sets of materials form Unit 8, “How Much Pork Do We Need?” of the first-year junior high school textbook of a particular publisher. The teaching content teaches learners to distinguish between countable and uncountable nouns and the difference in the usage of “how many” and “how much.” Teaching activities arranged by the teacher include listening to the dialogue on the CD, listening to the answer, reading along, grammar explanations, sentence forming, and cloze tests. During each session, at least five questions requiring interactive responses from the students were posed.

![Figure 2. Experimental design](image)

The polling situations in the classrooms for the three groups are shown in Figure 3. Participants in the control group and Experimental Group A wrote their answers on the small whiteboard or used the clickers, respectively. Those in Experimental Group B used the iFIT3 to bet on possible answers using game tokens. Alternatively, some students posed questions to the teacher while their peers submitted options for the multiple-choice questions. There was also a leaderboard function, which encouraged friendly competition among students. The screenshots of the various system functions of iFIT3 are shown in Figures 4–6.

![Figure 3. Polling situations of the various groups](image)
The design of the game functions is shown in Table 1. Gamification elements were added to the polling process, such as background sound effects and countdown timers. The iFIT3 function developed in this study used the four game elements of challenge, fantasy, curiosity, and control (Malone & Lepper, 1987) as the core design concepts. The operating system language of the iFIT3 system is Mandarin, which is the native language of the learners, to avoid issues when operating the system, while the learning content is in English. During the last 15 minutes of Session 3, the participants in all three groups were asked to complete post-test forms for measuring their intrinsic and extrinsic motivation, student engagement, and focused attention. Since intrinsic and extrinsic motivation can be measured through an individual’s attitude and intentions on the rating scale for motivation, surveys were conducted before and after the experiment to evaluate the learning intent of students regarding...
English lessons. Engagement and attention were measured through the assessment of the learning experience; it had to be conducted after the conclusion of the English class so that students would be able to recall the experiences and feelings that were the results of the class taken. For Session 4, each student was asked to complete an open-ended questionnaire after the class was concluded.

Table 1. Functional design of the iFIT3 and design focus of the corresponding gamified elements

<table>
<thead>
<tr>
<th>Game functions</th>
<th>Design focus for gamification</th>
<th>Design ideas</th>
</tr>
</thead>
<tbody>
<tr>
<td>Make bets (using game tokens)</td>
<td>Challenge; Control</td>
<td>By moving from single answers to the option to bet, students have more flexible choices, and the interest and uncertainty can be increased, which in turn makes the game more challenging.</td>
</tr>
<tr>
<td>Game points; Leaderboard</td>
<td>Challenge; Fantasy</td>
<td>By applying fantasy elements to designing virtual game points and leaderboards, the competitiveness for ranking on the leaderboard prompts students to challenge themselves while playing the game.</td>
</tr>
<tr>
<td>Countdown timers; Sound effects</td>
<td>Challenge; Fantasy; Curiosity</td>
<td>By using time limits and sound effects to create the in-game atmosphere, the game can trigger students’ curiosity and increase the thrill and challenge of the game.</td>
</tr>
<tr>
<td>Submit options for multiple-choice questions; Make bets on options provided by peers</td>
<td>Control</td>
<td>By giving students a high degree of autonomy in learning, they can freely provide answers, and their bets would not be limited to options that the teacher(s) has provided.</td>
</tr>
</tbody>
</table>

Instruments

The scale for measuring intrinsic and extrinsic motivation was adapted from the Motivated Strategies for Learning Questionnaire (MSLQ) compiled by Pintrich, Smith, Garcia, and McKeachie (1991). The original scale was revised to a 6-point Likert scale. There were eight questions in total, with four questions for each construct. An example of a question on intrinsic motivation is, “In English class, I prefer content that challenges me in order to learn new things.” An example of a question on extrinsic motivation is, “One of the things I am most
The scale for measuring student engagement was translated and adapted from the scale compiled by Fredricks, Blumenfeld, Friedel, and Paris (2005), with reference to that of Sun et al. (2014). The modified version was a 6-point Likert scale. There were five, six, and eight questions on behavioral, emotional, and cognitive engagement, respectively. An example of a question on behavioral engagement is, “I will follow the rules of this English class.” An example of a question on emotional engagement is, “I like to participate in this English class.” An example of a question on cognitive engagement is, “I will check whether my answer is wrong.” In terms of reliability of the post-test scores, the Cronbach’s alpha value for the scale was .95, while the reliability of the constructs had scores of .89–.94. Overall, the internal consistency was good (Nunnally & Bernstein, 1994). Further, validity review of the scale was done by experts with educational backgrounds.

The scale for measuring focused attention was translated and adapted from the scale for measuring fun during Internet and multimedia learning experiences, which was proposed by Lin, Gregor, and Ewing (2008). Questions on the construct of focused attention from the scale were used as the measuring tools in this study. The original scale was revised to a 6-point Likert scale with a total of four questions. An example of a question on focused attention is, “This class lets me focus entirely on learning.” In terms of reliability of the post-test scores, the Cronbach’s alpha value for the overall scale was .96, indicating good internal consistency in terms of reliability (Nunnally & Bernstein, 1994). Experts with educational backgrounds reviewed the validity of the scale.

The open-ended questionnaire was designed by the researcher. Its main purpose was to understand students’ experiences of using the various tools and to serve as qualitative information to provide additional information to supplement the quantified results. The questions included whether the students liked the teaching method after having attended the course, the differences they found between this and previous English classes, whether the system challenged them and stimulated their curiosity for learning English, and how the polling tools that they had used could be improved. The content of the open-ended questionnaires can be found at http://iltm.nctu.edu.tw/additional_info.

Research results

Analysis of results for intrinsic and extrinsic motivation

For intrinsic motivation, the effect of interaction between the covariates and variables was not significant ($F = 2.13, p = .12$) and neither was the homogeneity hypothesis test result for intra-group variance ($F = .95, p = .39$). The results of the ANCOVA analysis are shown in Table 2. The adjusted mean post-test values for the control group and Experimental Groups A and B were 15.04, 17.14, and 16.68, respectively. This meant that for intrinsic motivation, the post-test results of students who had undergone the three different teaching methods were significantly different ($F = 6.33, p < .05$). Post-hoc comparisons revealed that the respective values for both experimental groups were significantly different from that of the control group.

<table>
<thead>
<tr>
<th>Source of variance</th>
<th>SS</th>
<th>df</th>
<th>MS</th>
<th>$F$</th>
<th>$p$</th>
<th>Partial $\eta^2$</th>
<th>Post-hoc</th>
</tr>
</thead>
<tbody>
<tr>
<td>Covariates</td>
<td>1309.83</td>
<td>1</td>
<td>1309.83</td>
<td>164.57</td>
<td>&lt; .001</td>
<td>59.1%</td>
<td></td>
</tr>
<tr>
<td>Inter-group</td>
<td>100.80</td>
<td>2</td>
<td>50.40</td>
<td>6.33</td>
<td>.002</td>
<td>10%</td>
<td>A &gt; C</td>
</tr>
<tr>
<td>Intra-group</td>
<td>907.36</td>
<td>114</td>
<td>7.96</td>
<td></td>
<td></td>
<td></td>
<td>B &gt; C</td>
</tr>
<tr>
<td>Overall</td>
<td>2318</td>
<td>117</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Note. A and B = Experimental Groups A and B, respectively; C = control group.

For extrinsic motivation, the effect of interaction between the covariates and variables was not significant ($F = 1.842, p = .163$) and neither was the homogeneity hypothesis test result for intra-group variance ($F = .33, p = .72$). The results of the ANCOVA analysis are shown in Table 3. The adjusted mean values for the control group and Experimental Groups A and B were 15.78, 17.18, and 16.68, respectively, indicating that the post-test results of students who had undergone the three different teaching methods were not significantly different in terms of extrinsic motivation ($F = 1.34, p = .27$).
Table 3. Summary of covariance analysis for extrinsic motivation

<table>
<thead>
<tr>
<th>Source of variance</th>
<th>SS</th>
<th>df</th>
<th>MS</th>
<th>F</th>
<th>p</th>
<th>Partial η²</th>
</tr>
</thead>
<tbody>
<tr>
<td>Covariates</td>
<td>792.06</td>
<td>1</td>
<td>792.06</td>
<td>52.33</td>
<td>&lt; .001</td>
<td>31.5%</td>
</tr>
<tr>
<td>Inter-group</td>
<td>40.45</td>
<td>2</td>
<td>20.23</td>
<td>1.34</td>
<td>.27</td>
<td>2.3%</td>
</tr>
<tr>
<td>Intra-group</td>
<td>1725.45</td>
<td>114</td>
<td>15.14</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Overall</td>
<td>2557.96</td>
<td>117</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Analysis of results for student engagement

The analytical results for overall student engagement are shown in Table 4. The mean values for the three groups were 70.73 (SD = 17.14), 75.56 (SD = 21.77), and 84.45 (SD = 14.81), respectively. Levene’s test for homogeneity hypothesis of variance was established (F = 1.49, p = .23). The effect of the inter-group factor was significant (F = 5.66, p < .05), showing that students using the various types of polling tools had significantly different post-test scores for overall student engagement. The results of post-hoc comparisons indicated that the students in Experimental Group B scored significantly better than those in the control group for overall student engagement.

Table 4. Summary of single-factor variance analysis for overall student engagement

<table>
<thead>
<tr>
<th>Source of variance</th>
<th>SS</th>
<th>df</th>
<th>MS</th>
<th>F</th>
<th>p</th>
<th>Partial η²</th>
<th>Post-hoc</th>
</tr>
</thead>
<tbody>
<tr>
<td>Inter-group</td>
<td>3740.48</td>
<td>2</td>
<td>1870.24</td>
<td>5.66</td>
<td>.01</td>
<td>8.96%</td>
<td>B &gt; C</td>
</tr>
<tr>
<td>Intra-group</td>
<td>38028.23</td>
<td>115</td>
<td>330.68</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Overall</td>
<td>41768.70</td>
<td>117</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Note. A and B = Experimental Groups A and B, respectively; C = control group.

Further analysis was conducted of the three constructs of behavioral, emotional, and cognitive engagement, with the results shown in Table 5. In terms of emotional engagement, the mean value for Experimental Group B (M = 29.70, SD = 5.91) was significantly higher than for both the control group (M = 22.49, SD = 6.78) and Experimental Group A (M = 25.15, SD = 8.24). Compared to students who used the general IRS or traditional polling method, those who used the gamified IRS had a significantly higher level of emotional engagement.

Table 5. Summary of variance analysis for the various constructs of student engagement

<table>
<thead>
<tr>
<th>Construct</th>
<th>F</th>
<th>p</th>
<th>Post-hoc</th>
</tr>
</thead>
<tbody>
<tr>
<td>Behavioral engagement</td>
<td>2.89</td>
<td>.06</td>
<td></td>
</tr>
<tr>
<td>Emotional engagement</td>
<td>10.33</td>
<td>&lt; .001</td>
<td>B &gt; C</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>B &gt; A</td>
</tr>
<tr>
<td>Cognitive engagement</td>
<td>2.28</td>
<td>.107</td>
<td></td>
</tr>
</tbody>
</table>

Note. A and B = Experimental Groups A and B, respectively; C = control group.

Analysis of results for attention

The analytical results for attention are shown in Table 6. The mean values for the three groups were 14.48 (SD = 4.61), 16.54 (SD = 5.46), and 17.97 (SD = 4.61), respectively. Levene’s test for homogeneity hypothesis of variance was established (F = 51, p = .61). The effect of the inter-group factor was also significant (F = 5.08, p < .05). This showed that for students using various types of polling tools, their post-test scores for attention were significantly different. In addition, the results of post-hoc comparison revealed that students in Experimental Group B scored significantly better on attention than those in the control group.

Table 6. Summary of single-factor variance analysis for attention

<table>
<thead>
<tr>
<th>Source of variance</th>
<th>SS</th>
<th>df</th>
<th>MS</th>
<th>F</th>
<th>p</th>
<th>Partial η²</th>
<th>Post-hoc</th>
</tr>
</thead>
<tbody>
<tr>
<td>Inter-group</td>
<td>244.81</td>
<td>2</td>
<td>122.40</td>
<td>5.08</td>
<td>.008</td>
<td>8.12%</td>
<td>B &gt; C</td>
</tr>
<tr>
<td>Intra-group</td>
<td>2771.16</td>
<td>115</td>
<td>24.10</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Overall</td>
<td>3015.96</td>
<td>117</td>
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Note. A and B = Experimental Groups A and B, respectively; C = control group.
Discussion

Students who used either the general or gamified IRSs for classroom polling had significantly greater intrinsic motivation for learning English than those who used the whiteboards. This could be because the operating methods of the IRSs were attractive to the students and created a pleasant classroom atmosphere (Johnson & Lillis, 2010). Following this, the teachers were able to plan richer and more interesting course content to stimulate the students’ interest in learning and to promote classroom interactions (Chien et al., 2016). Intrinsic motivation to learn might be triggered when students experience fun during the process (Ryan & Deci, 2000a; Ryan & Deci, 2000b). The qualitative data indicated that, to the students, both general and gamified IRSs were novel and interesting tools to use. Their comments were as follows:

“Because answers could be selected using the clickers, and everyone could make their own choices.” (Student 1, Experimental Group A)

“It was more fun to poll with the clickers.” (Student 2, Experimental Group A)

“The learning process felt very easy and relaxed.” (Student 1, Experimental Group B)

In addition, the IRSs and gamification element did not result in any significant difference in terms of extrinsic motivation. Past studies have found that extrinsic motivation is particularly important when students do not have any personal interest in the topic (Hidi & Harackiewicz, 2000). The qualitative data showed that for the control group, 56.3% of the students felt that using the whiteboard made them more motivated to learn and that the process was interesting. This study indicated that regardless of the polling tool used (small whiteboards, clickers, or iFIT3), the design of the polling activity itself was inherently interesting to the students. We speculate that this is because the three types of polling strongly stimulated the students’ intrinsic motivation; it can also be seen from the open-ended questionnaire that the students found the use of the new learning tools to be very interesting. Therefore, the polling method of this study may be less related to extrinsic motivation, which led to this experiment not finding a significant improvement due to the effect of extrinsic motivation.

The study also found that classroom usage of gamified IRS can significantly enhance student engagement. It was also ascertained that the provision of the gamification element was effective in facilitating emotional engagement. Students’ opinions revealed that 91.3% of them liked classes that made use of the gamified IRS.

The following qualitative data from the open-ended questionnaire corroborated these results:

“It was challenging.” (Student 2, Experimental Group B)

“It was the interactivity that made it fun.” (Student 3, Experimental Group B)

“It was more enjoyable, and it was competitive.” (Student 4, Experimental Group B)

Additionally, 76.1% of the students confirmed that they felt a stronger sense of participation in the class because they were able to contribute their own answers and had the option to bet on answers for the multiple-choice questions. From a comparison of the quantitative results and the information from the open-ended questionnaire, it was found that the functional design of the gamified IRS could promote classroom interaction and increase student engagement during classroom learning. This study also confirmed the findings of past scholars: that the provision of IRSs could definitely enhance student engagement (Chien et al., 2016; Sun et al., 2014; Trees & Jackson, 2007). This study further found from some students’ opinions that a challenging game can arouse students’ interest and promote their participation and interaction in class (Hung et al., 2015; Wang & Chen, 2010). After analyzing the three constructs of engagement, it was determined that when the gamification element (which the students were interested in) was included in the course, students’ emotional engagement increased (Sun & Rueda, 2012). In summary, the iFIT3 can be put to actual use in the classroom to effectively increase student engagement when learning English.

For the aspect of attention, students who used the gamified IRS for classroom polling performed better than those who used the small whiteboards. According to the results of the open-ended questionnaire, 13% of the students in Experimental Group B stated that they were more attentive in class because the questions and options for game betting appeared in the content that the teacher taught. The following qualitative data from the open-ended questionnaire corroborated these results:

“I paid attention in class because I wanted to win more tokens and be at the top of the leaderboard.” (Student 5, Experimental Group B)

“I was very attentive because all the quiz questions involved information taught during the class.” (Student 6, Experimental Group B)
This qualitative finding was consistent with the research finding of Wang (2015), specifically that the competitive element of the gamified IRS can effectively sustain students’ attention in class. During the teaching activities, some of the students really felt a sense of competition brought about by the gamified IRS. The competitive spirit of the game in turn made them pay more attention during the classroom teaching preceding the polling activity. This study further confirmed that the attention of students who used the gamified IRS was more focused compared to those in the control group, who used small whiteboards without any competitive element of gaming or polling functions. When this finding is applied to English classes (i.e., teachers create an interesting classroom atmosphere with a spirit of healthy competition), students’ level of focused attention will be elevated.

To sum up, this study verified that the use of novel IRSs and teaching methods can effectively increase students’ interest in learning and their intrinsic motivation, emotional engagement and attention. Students’ interest in the class definitely contributed more to the learning process. The results of this study show that general interactive feedback systems and gamified instant feedback systems only differ regarding emotional engagement. With the features of stimulating students’ interest and enhancing the classroom interactions, both general interactive feedback systems and gamified instant feedback systems can effectively increase students’ intrinsic motivation. Lastly, compared to small whiteboards, using gamified instant feedback systems can better help students engage in and concentrate on the learning process.

**Conclusion, limitations, and implications**

The aim of this study was to combine the IRS with the gamification element and then put it to actual use in the classroom to examine the system’s effects on intrinsic and extrinsic motivation, engagement, and attention of junior high school students when learning English. The results showed that the proposed gamified IRS could effectively stimulate their interest and intrinsic motivation during English class. There were also positive effects on their levels of emotional engagement and focused attention during class. This study proposes that gamified IRS is a teaching tool that can promote learning motivation. Based on the findings, this study recommends that using an instant feedback system can be beneficial for enhancing the intrinsic motivation for learning English, while a gamified instant feedback system can further enhance emotional engagement and provide students with more satisfying and exciting learning experiences. Further, when tools that are highly interactive, challenging, and competitive (such as the iFIT3) are used, the students will be more focused during the class, which will in turn benefit their learning of English.

It should be noted that this study faced some limitations. Since the entire experiment lasted only 2 weeks, it could not be determined whether long-term usage of the tools would reduce students’ sense of novelty (leading to the onset of boredom). Another issue was whether there would be any negative effect on students (for example, increased anxiety) if they were immersed in the competitive gaming atmosphere over a long period of time. In terms of equipment, there must also be sufficient mobile devices for every student in class. These various environmental factors should be noted and attended to prior to implementation.

Lastly, for future studies, other types of IRSs combining the gamification element or questioning should be developed, which would introduce diverse gamified IRSs. In this way, the novelty of the tool would be maintained. Separately, the gamification element can be combined with other teaching tools (such as gamified e-books or class management platforms) or incorporated into existing teaching strategies. This would further expand the advantages of gamified learning.

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