The perceptions of using instant interaction applications for enhancing peer discussion in a flipped classroom

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Abstract: This study attempted to use the application software installed on students’ smartphones as an instant interactive tool in the classroom in a university course on basic computer science concepts. This study compared two different systems. One instant interaction application provided the students with multimedia feedback in time sequence, while the other showed the students’ responses ranked by the number of students who ‘liked’ them. The students were divided into verbalisers and visualisers using a learning style questionnaire for comparison of students with different learning styles using the two systems. The results showed no significant difference between the two systems in terms of perceived usefulness, ease-of-use or enjoyment. The average frequency of the messages produced by the students using the multimedia-oriented system was higher than that for the like-ranking system on average at the beginning. However, the average frequency of messages produced by the students using the multimedia-oriented system decreased considerably week by week, and was fewer than those produced by the students using the like-ranking system in the fourth week. The results also showed that the visualisers perceived higher enjoyment than the verbalisers when using the interactive system showing responses in like-ranking sequence.

Keywords: interactive response system; learning style; perceived ease-of-use; perceived usefulness; perceived enjoyment.

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Biographical notes: Ting-Chia Hsu is currently an Associate Professor in the Department of Technology Application and Human Resource Development,
1 Introduction

With the recent revolution in education, an increasing number of teachers are conducting flipped teaching so that their students have more time to interact and communicate with each other in the classroom (Tucker, 2012). Scholars have indicated that the most important work of flipped teaching is not only to provide students with pre-study materials such as video lectures at home, but to design interactive and discussion activities for when they are in the classroom (Sams and Bergmann, 2013). When the students are autonomously learning from the material or the lecture at home before class, the face-to-face lecture time in the classroom will be reduced, and the teachers can become facilitators in the classroom (Baker, 2000). From the students’ discussion and feedback, it is more feasible for the teachers to observe their progress and further guide them to solve problems (Tucker, 2012). Peer feedback is not only contributive to knowledge construction, but is also beneficial for the improvement of skills, for example, dance (Hsia et al., 2016). On the other hand, instant feedback is helpful for students’ thinking and thus improves their performance (Wu et al., 2012). Therefore, increasing the opportunities for students to interact, communicate and discuss in the classroom has become essential in the design of classroom activities. This study attempted to appropriately include mobile technology in classroom activities so as to promote the students’ interactive behaviour.

In traditional teaching activities, teachers give lectures and students take paper-based tests at the end of the course. Through these tests, the teachers evaluate students’ learning performance. The traditional teaching process lacks opportunities for students to participate, and also greatly reduces the teacher-student interaction. Thus, teachers cannot immediately identify and evaluate students’ learning situation or outcomes in the teaching activities. They can only gain and assess the students’ learning performance through the final test results. In face-to-face classrooms, the teachers give lectures, which is a form of teacher-centred instruction; on the contrary, students engage in interactions and discussion in the flipped-teaching classroom, which is thus a form of student-centred instruction (Anderson and Krathwohl, 2001). Moreover, the existing teaching activities suffer from the stress of class size because school teachers have only a limited amount of time to teach, resulting in not being able to fully control most students’ learning in the classroom. The students are also unable to express their ideas during teaching activities, thus hindering the interaction between teachers and students.

Nowadays the rapid development of technology is significantly impacting education (Kinshuk, 2003). Technology not only brings changes to the traditional classroom, but
also improves the interaction between teachers and students. For example, a current popular teaching aid, the Interactive Response System (IRS), is able to overcome the limitations of traditional classroom teaching methods.

Even though IRS are widely used, they raise a number of problematic issues (Hoffman, 2012; Mayer et al., 2009) including their price, the learning curve for some teachers, and teachers and students’ unfamiliarity with the system. Moreover, the school needs to spend time maintaining and managing the IRS equipment. Today, however, in addition to the existing hardware-based IRS, mobile apps are becoming more prevalent due to the advancements in mobile devices and cloud-based technology (Han, 2014; Morais et al., 2015).

The different application stores offer a large number of real-time interactive feedback software applications, yet few studies have explored their significance in education. Therefore, this research aimed to replace IRS with mobile learning devices and software applications so as to reduce the abovementioned barriers. In addition to maintaining the characteristic of enhancing the interaction between teachers and students, the feedback application for smartphones can also reduce the school’s financial burden. A previous study has integrated mobile learning and learning style to enhance students’ reflection level (Hsieh et al., 2011). As a result, this study explored the students’ perceptions of the usefulness, ease-of-use, and enjoyment of their use of two different smartphone applications for classroom feedback and interaction so as to further analyse and compare the impacts of the time serial affective-oriented and the like-ranking-oriented interactive multimedia applications on peer feedback in the classroom. The research questions of this study are as follows:

1. Did students’ perceived usefulness, ease-of-use and enjoyment of the two real-time interactive applications differ?
2. Did visualisers’ and verbalisers’ perceived usefulness, ease-of-use and enjoyment of the two real-time interactive applications differ?
3. What is the average number of student interactions when using the two real-time interactive applications?

2 Literature review

2.1 Interactive response system

The IRS originated from IBM’s internal education and training system. It first appeared in the Advanced Technology Classroom project in 1985 (Horowitz, 1988). At that time, the system was not called the IRS but the Student Response System (SRS). The main purpose of establishing the SRS was to overcome the limitations of time and space in traditional teaching, and to enhance learners’ interaction to further improve the learning outcomes (Hiltz and Wellman, 1997).

Note that the IRS is also known as the Classroom Response System (CRS), the Learner Response System (LRS), the Audience Response System (ARS) and the Students Response System (SRS) in the literature. It uses electronic devices such as mobile phones, personal digital assistants (PDAs) or feedback remote controls, teachers’ receiver remote control devices, and a computer, so that students can instantly and
anonymously express their opinions or feedback to teachers (Abramson et al., 2013; Karakostas et al., 2014; Bonaiuti et al., 2015). Therefore, it can promote students’ reactions and group discussion, and also facilitate teacher-student interaction. Apart from this, teachers can provide more interactive quizzes or teaching, so as to better understand students’ learning process or conditions (Mayer et al., 2009). Consequently, the learning effectiveness of classroom teaching can be strengthened. The IRS is already quite popular and an important teaching aid used to raise teaching and learning quality and to improve communication between the teacher and the students or among the students (Caldwell, 2007; Adam et al., 2014). In addition, a previous study found that students learning with a response system in one class scored more highly on tests than those learning without a response system in a similar class (Lantz and Stawiski, 2014).

In a typical IRS, hardware (e.g., clickers) or software (e.g., applications) components need to be deployed in the classroom and distributed to students. Then, the teacher presents the contents through the projector or the electronic whiteboard and quizzes the students. The students then press a button on the clicker or in the application to submit their answers. When the teacher’s receiver gets the signal, it will identify the remote control signal and further send it back to the server, and the system will then display all the instant results on the screen in front of the teacher and students.

Interactive Response Systems have been applied to teaching in the classroom for quizzes, eliciting answers, asking toss-up questions, voting, and many other applications. Additionally, the adaptation of web-based response systems has led to the development of such systems as Socrative (www.socrative.com), Piazza (https://piazza.com), Poll Everywhere (www.polleverywhere.com) and GoSoapbox (www.gosoapbox.com) (Carroll et al., 2014). However, some critical problems have arisen; for example, such systems are expensive for schools, and the teachers and students may not be familiar with the operation of the system. Today, in addition to the existing Interactive Response Systems, mobile carrier applications are also booming in this era of the smartphone. The application stores now have a large number of real-time interactive feedback software available, yet few studies have explored their significance in education. In order to fill this gap, this study explores the students’ perceived usefulness, ease-of-use, and enjoyment when using two different smartphone applications for classroom feedback and interaction.

2.2 Verbalisers and visualisers

Owing to individual differences, people process messages in different ways depending on their personal preferences. Scholars have indicated that considering the learning styles of students in the development of adaptive learning systems is necessary (Hwang et al., 2013). In the current study, visualisers are defined as those students who prefer to deal with visual information, whereas verbalisers represent a preference for processing text or verbal information (Grabowski and Jonassen, 1993). Visualisers prefer learning through tables, graphs or other visual illustrations for information processing, while verbalisers prefer processing messages through reading or listening to information. Childers et al. (1985) indicated that the differences between processing textual and visual information are probably caused by individuals’ different processing capabilities or preferences.

In contrast, visualisers prefer “looking” to absorb information, and their thinking is more specific than that of verbalisers. Visualisers perform better in the interpretation of graphics, visual forms, or other kinds of visual messages. On the other hand, verbalisers
prefer “reading” or “listening” to receive messages. Text contributes greatly to the learning process of verbalisers. Verbalisers suit text-based professions; for example, they can specialise in semantic analysis (Grabowski and Jonassen, 1993; Kirby et al., 1977). By definition, Richardson (1977) called those people who tend to deal better with text “Verbalisers,” while those who outperform in processing image-based information are called “Visualisers”. An understanding of the way in which individuals process information and the manner in which multimedia materials are presented can facilitate the effective design of teaching materials to suit students’ preferences (Greenberg et al., 2014).

2.3 Perceived enjoyment, usefulness, and ease of use

The Theory of Reasoned Action (TRA) was developed by Fishbein and Ajzen (Ajzen and Fishbein, 1975) in order to understand the motivation of system users. However, the theory could only predict users’ behavioral intentions, but failed to provide a profound or specific perspective on certain behaviors. As a result, based on the Theory of Reasoned Action, Davis (1989) developed the Technology Acceptance Model which deals more specifically with the prediction of the acceptability of an information system. According to Davis, the Attitude Toward Using (A) is determined by two main factors: Perceived Usefulness (PU) and Perceived Ease of Use (PEOU). Moreover, the attitude of an individual is not the only factor that determines his/her use of a system; it is also based on the impact that the system may have on his/her performance. Attitude toward using means that the users’ attitudes have impacts on their behavioural intentions to use the information technology. Perceived usefulness is defined as being the degree to which a person believes that the use of a system will improve his/her performance, while perceived ease of use refers to the degree to which a person considers that the use of a system will be effortless (Davis, 1989).

![Figure 1 Technology acceptance model with perceived enjoyment (van der Heijden, 2004)](image)

In addition, perceived usefulness (PU) correlates with perceived ease of use (PEOU). The easier the system is to use, the more useful it is. Thus, perceived ease of use (PEOU) may be the mediating variable of perceived usefulness (PU) (Davis et al., 1989). On the contrary, if we only focus on the features of PU and PEOU, we can hardly get the whole picture of a user’s motivation (Moon and Kim, 2001). Therefore, the motivation of the Technology Acceptance Model was divided into two forms in 1992 by Davis et al. (1992), inclusive of external and intrinsic motivation. It was advocated that external
motivation is perceived usefulness (PU), while intrinsic motivation is Perceived Enjoyment (PE). PE is defined as the extent to which the activity of using a new technology is perceived to be enjoyable in its own right, apart from any performance consequences that may be anticipated by use of the information technologies. With regard to a possible relationship between PEOU and PE, the literature review indicated two possible relationships, either PE influences PEOU, or PEOU influences PE and PU (Van der Heijden, 2004). Van der Heijden found rather strong support for the impacts of PE, PEOU and PU on attitude towards using, as Figure 1 shows.

3 Method

3.1 System framework

This study adopted two kinds of instant interactive tools using mobile devices to provide teaching feedback, and analysed the feedback messages quantitatively. The undergraduates in the control group used the instant interactive system with affective-oriented multimedia feedback in time sequence, while those in the experimental group used the instant interactive system showing responses in like-ranking sequence. For research questions 1 to 3, two different models of mobile phone applications are compared in Table 1.

<table>
<thead>
<tr>
<th>Feature comparison</th>
<th>Control group</th>
<th>Experimental Group</th>
</tr>
</thead>
<tbody>
<tr>
<td>Anonymous</td>
<td>no</td>
<td>yes</td>
</tr>
<tr>
<td>Affective facial expressions</td>
<td>yes</td>
<td>no</td>
</tr>
<tr>
<td>The ranking of like/dislike numbers</td>
<td>no</td>
<td>yes</td>
</tr>
</tbody>
</table>

As shown in Table 1, we can observe the details of these two types of interactive feedback systems. The focus of the function developed for the instant interactive system with affective-oriented multimedia feedback in time sequence is that it can provide emotion symbols along with the messages transmitted. Therefore, the learners can not only convey their text messages, but can use interesting icons with different styles to illustrate their feelings. What’s more, they may get feedback from their peers with the vivid icons as well. Figure 2 displays an example.

On the other hand, the instant interactive system showing responses in like-ranking sequence also allows users to convey text messages. When it comes to voting in the instant interaction group, the system will provide users with “Like” or “Dislike” icons to press (Holzer et al., 2013; Holzer et al., 2014). In this way, we can see how popular an idea is by checking the like-ranking results. In addition, users can use the application to leave messages and to vote anonymously, which may lead to different learning effects for peer feedback in the activity. A screenshot is shown in Figure 3.
The perceptions of using instant interaction applications

Figure 2  The control group

Figure 3  The experimental group
3.2 Experimental design

The participants of the experiment were freshmen of a department of science and technology in a national university in Taiwan, 25 of whom were assigned to be the experimental group, while the other 26 constituted the control group. The measuring tools were the Style of Processing Scale (SOP), and the Technology Acceptance Model (TAM) and Perceived Enjoyment (PE) questionnaires. The Style of Processing scale contains 22 items about study styles: 11 about visual message processing preference evaluation, and 11 about text message processing preference evaluation (Childers et al., 1985; Richardson, 1977). Furthermore, the questionnaire for TAM contains 12 items about perceived usefulness and perceived ease of use (Davis, 1989), and three about perceived enjoyment (Venkatesh, 2000).

Figure 4 shows the experimental design of this study. To categorise the students into visualisers and verbalisers, we performed the Style of Processing Scale evaluation before conducting the experiment. The Style of Processing (SOP) Scale indicated that the coefficient alpha was 0.81 for the verbal component and 0.86 for the visual component (Childers et al., 1985). Also, we explained clearly the whole process and the function of the system in advance. There was a group of three students reporting on stage once a week. The others gave instant feedback with the smart phone application as they listened to the report. The students in the control group used the instant interactive system with affective-oriented multimedia feedback in time sequence, while the students in the experimental group used the instant interactive system showing responses in like-ranking sequence. Four weeks later, all of the students completed the questionnaires for TAM and for Perceived Enjoyment. Lastly, the number of interactions was analysed quantitatively by the researcher.

In sum, one week was spent preparing and measuring SOP before the experiment. Then, the experiment lasted for four weeks. Finally, the surveys were administered after the experiment. Therefore, the entire process took a total of six weeks.
4 Results

4.1 Comparison of the acceptance of the two systems

The technology acceptance model questionnaire utilised a 5-point Likert scale where “1” means strongly disagree, while “5” means strongly agree. This study compared the students’ acceptance and usage attitudes toward the two instant interactive smartphone applications. The results showed that the mean for perceived usefulness in the experimental group was 3.37 (SD = 0.64) while for the control group it was 3.66 (SD = 0.87). There is no significant difference between the two groups’ perceived usefulness ($t = 1.36; p > .05$). Consequently, the students thought the two systems have a similar effect on their performance (feedback). As for perceived ease-of-use, the mean of the experimental group was 3.50 (SD = 0.69) while that of the control group was 3.85 (SD = 0.71). There is no statistical difference between perceived ease-of-use for the two groups ($t = 1.77; p > .05$). Accordingly, the students felt that it is similarly easy for them to use the two systems. In terms of perceived enjoyment, the mean of the experimental group was 3.55 (SD = 0.72) while that of the control group was 3.85 (SD = 0.81). The results showed no significant difference between the perceived enjoyment of the two groups ($t = 1.40; p > .05$). Therefore, the two different orientation feedback systems were equally enjoyable for the students to use.

4.2 Comparison of the attitudes of visualisers and verbalisers in the two groups

Taking the different learner styles into consideration, in this study we further compared the variable which categorises the students into visualisers and verbalisers in each group. After the SOP evaluation, the results showed that only four students were verbalisers while 21 were visualisers in the experimental group. Also, only four students were verbalisers while 22 were visualisers in the control group. The means of perceived usefulness, ease-of-use, and enjoyment were all higher than 3 points regardless of whether the students were in the experimental or the control group. The results displayed that the students had positive opinions and attitudes toward using the two instant interactive systems during the peer-to-peer feedback. In particular, the visualisers outperformed the verbalisers, as shown by the means listed in Table 2.

<table>
<thead>
<tr>
<th>Scale</th>
<th>Styles</th>
<th>Experimental group</th>
<th>Control group</th>
</tr>
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<tbody>
<tr>
<td></td>
<td>N</td>
<td>Mean</td>
<td>SD</td>
</tr>
<tr>
<td>Perceived</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>usefulness</td>
<td>Verbalisers</td>
<td>4</td>
<td>3.25</td>
</tr>
<tr>
<td></td>
<td>Visualisers</td>
<td>21</td>
<td>3.43</td>
</tr>
<tr>
<td>Perceived</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>ease-of-use</td>
<td>Verbalisers</td>
<td>4</td>
<td>3.50</td>
</tr>
<tr>
<td></td>
<td>Visualisers</td>
<td>21</td>
<td>3.52</td>
</tr>
<tr>
<td>Perceived</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>enjoyment</td>
<td>Verbalisers</td>
<td>4</td>
<td>3.00</td>
</tr>
<tr>
<td></td>
<td>Visualisers</td>
<td>21</td>
<td>3.62</td>
</tr>
</tbody>
</table>

Note: $^*p<.05$.

Table 2 shows that the visualisers perceived higher enjoyment than the verbalisers in the experimental group. Therefore, the instant interactive system showing responses in
like-ranking sequence by means of like icons to rank the popularity or like degrees of the messages made the visualisers more interested in the interactions. It was also found that one of the most important functions of the interactive application installed on the handheld devices such as smartphones and tablet PCs for visualisers to give instant responses in the classroom was the function of showing the ranking of the audience’s likes. As a result, the instant interactive system showing responses in like-ranking sequence which is used for educational purposes in this study satisfies most of the requirements of the students, especially the visualisers, in the experimental group.

The study results also showed that the students had similar external motivation, which refers to perceived usefulness, no matter whether they were visualisers or verbalisers in the two groups. However, the visualisers had higher intrinsic motivation (mean = 3.62; SD = 0.00), which refers to the evaluation of Perceived Enjoyment, than the verbalisers (mean = 3.00; SD = 0.80) in the experimental group ($t = -3.53^*; p < .05$). The visualisers perceived enjoyment when using the new technology for classroom feedback and responses. The two systems both have multimedia functionality, but the multimedia in the control group emphasised the affective facial expressions more, while the multimedia in the experimental group focused on the like and dislike illustrations. The simple multimedia in the experimental groups not only had positive impacts on the visualisers, but also prevented the students from being distracted from the learning topics in the classroom. Too much affective multimedia in the control group had negative impacts on the students, as is further analysed in the next section.

4.3 Analysis of the number of interactions in the two groups

The students in the control group were attracted by the affective multimedia which promoted their interactions at the beginning. However, they did not really perceive higher usefulness, ease-of-use, or enjoyment when they used the system for educational purposes (instant classroom response), as has been shown in the above section. From the interaction content analysis, the study found that 48% of the interactions were irrelevant to the course in the classroom, although the students in the control group interacted more frequently at the beginning. Every student in the control group had more than seven instant classroom interactions and feedback comments on average, as shown in Figure 5. However, the students appeared to be too excited about the interactive software to concentrate on the discussion due to the software providing many interesting affective pictures which are attractive and amusing to students, especially in the beginning. When this tool was used in the classroom instant feedback, the number of interactions declined very fast week by week, which shows that the students were just interested in the software in the beginning, and did not believe that the use of the application with a wide selection of interactive multimedia facial expressions for classroom interactions was more useful, usable or pleasant to use than other tools.

On the contrary, there was no vivid facial expression multimedia in the experimental group, but there was popularity ranking, that is like and dislike rankings, of students’ immediate interactions. Each student sent instant feedback about three times on average in the class during the first week, and there was almost no distraction. As a result, it reached a relatively more stable state each week. The exception was the third week because the system server did not work smoothly that week, thus affecting the number of interactions. In the fourth week, the average number of interactions per student in the experimental group was no less than the average number of interactions per student in the
control group, indicating that the popularity ranking of messages when there is peer feedback can stimulate students to speak at least once and to concentrate on the course interaction in the classroom. The system in the experimental group did not let learners lose the feeling of freshness or pleasure when using the tool in the classroom for immediate feedback.

**Figure 5** The average number of interactions per student in the two groups each week (see online version for colours)

![](image)

## 5 Conclusions

In conventional instruction, teachers can only grasp students’ learning situation through examinations or reports, and cannot grasp it immediately in class. Besides, teachers cannot easily engage in instant interaction with several students simultaneously. To improve teaching methods, instant interactive response systems were developed. However, they are expensive for schools to purchase, and teachers and students may not be familiar with their operation. Therefore, the aim of this study was to use college students’ smartphones as instant interactive tools in the classroom as a replacement for the interactive response system, and then to compare two instant interactive mobile applications with different design orientations, that is, ranking of number of likes and a multimedia-oriented system, in a university basic computer science concepts class. The results showed no significant difference between the two systems in terms of perceived usefulness, ease-of-use or enjoyment. The average frequency of the messages in the multimedia-oriented system was higher than that in the other system on average at the beginning. However, the average frequency of messages decreased considerably week by week, and became lower than the messages produced by the like-ranking system users in the fourth week. The results also showed that the visualisers perceived higher enjoyment in comparison with the verbalisers in the interactive system showing responses in like-ranking sequence. Nevertheless, due to the research limitation of the sample size in this study, it is suggested that future studies extend the sample size to more courses integrated with the flipped classroom. In addition, future studies can perform sequence analysis of interactive message content to compare the students’ learning process and behaviors in
the two systems, and to explore the behavior of students with different learning styles in various interactive systems, so as to identify the impacts of the two variables, that is, the different systems and diverse learning styles.

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References


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