

# Handbook of Research on New Media, Training, and Skill Development for the Modern Workforce

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*Teachers College, Columbia University, USA*

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# Chapter 13

## A Review of Personal Response Systems in Higher Education: Theoretical Model and Future Research Directions

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### **ABSTRACT**

*Personal response systems (PRSs) are still prevalent in a wide range of educational settings, and this increasing importance has prompted many researchers to examine their various aspects. PRS effects on student learning performance are generally divided into three main categories of factors: (1) learner characteristics (learner interface and learner interactions), (2) instructor characteristics (instructors' technical skills and attitudes toward students), and (3) other contextual factors (content and types of questions). This chapter discusses the characteristics of PRSs, reviews their advantages and disadvantages, and proposes a theoretical model of the factors affecting student engagement and performance in learning. The chapter concludes by exploring the research implications of the findings and directions for future PRS research.*

### **INTRODUCTION**

Academic institutions have used advanced technologies and information systems as strategic resources to create better educational environments. Teaching and learning are evolving at a steady pace, and the learning formats used by instructors to prepare their work using information technology are being reorganized to enable changes in teaching. The way students learn to meet challenges is also changing, as is the way their learning needs are met (Eastman et al., 2011). A more interactive way to learn new

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knowledge in an academic environment with a variety of teaching and learning tools can enhance students' involvement in the whole learning process.

The value of personal response systems (PRSs) is increasingly recognized in the literature review. PRSs are defined as integrated information systems that can support the learning process in a timely manner (Moss & Crowley, 2011; Stuart et al., 2004). These systems are instructional technology tools that consist of a proprietary software application in computers, mobile phones, and other response tools used by instructors and students (Pearson, 2020). As a result, their use to provide information and receive responses has revolutionized learning for both instructors and students.

PRSs are discussed using a wide variety of labels, including audience response systems, classroom communication systems, electronic voting systems, group response systems, wireless keypad response systems, student response systems, mobile phone polling, and “clicker-based technology,” although there is no universally accepted term. This chapter uses PRSs to refer to these systems.

To support effective teaching and learning, it is beneficial to know the formats and types of PRSs being used. This chapter can help academics and practitioners better understand these issues. This chapter has four main objectives: (1) describe the characteristics of PRSs, (2) evaluate their advantages and disadvantages, (3) develop a theoretical model of their key factors as a strategic tool to support student engagement and performance in learning, and (4) generate research implications and directions for future research.

## **BACKGROUND**

The growing popularity of PRSs has substantially improved the quality of teaching and student learning performance (e.g., Blasco-Arcas et al., 2013; Li & Wong, 2020; Mishra et al., 2020; Rana & Dwivedi, 2018). Specifically, PRSs have generated new teaching and learning practices in education. Research has raised awareness among researchers of the importance of PRSs in teaching and learning (Mishra et al., 2020; Rana & Dwivedi, 2018; Voith et al., 2018). Li and Wong (2020) examined the use of PRSs with learning analytics during the 2008–2017 period to evaluate student engagement, their learning experience, and the effectiveness of teaching and learning. The design of questions in PRSs that higher education students are asked to answer in class has also improved clarity (Stowell, 2015).

Most studies have examined the impact of PRSs on student learning and performance (e.g., Buil et al., 2019; Chan et al., 2019; Shapiro et al., 2017). Putwain et al. (2018) examined the relationship between students' academic enjoyment, boredom, and achievement. Their results indicated that the relationship between academic enjoyment and boredom was mediated by achievement. Chan and Ko (2019) examined PRS user interfaces as an important antecedent of student engagement and performance in learning. They found that the impact of PRSs on learning performance was mediated by student engagement in learning across a wide range of educational settings.

PRSs are widely used across disciplines and educational settings, including accounting, business, management, information systems, psychology, mathematics, biology, chemistry, engineering, and computer science (Addison et al., 2009; Carnaghan et al., 2011; Keough, 2012). For example, Rana et al. (2016) reviewed the use of PRSs in business and management. In business schools, an instructor may use a theoretical model and cases and ask students how they would act in a given business environment. PRSs have also been used in large introductory courses (Bonaiuti et al., 2015; Grund & Tulis, 2020; Trees & Jackson, 2007), small tutorial classes, online learning environments (Almusharraf & Almush-

## ***A Review of Personal Response Systems in Higher Education***

arraf, 2021), and laboratory classes (Rana et al., 2016). Barnett (2006) discussed the implementation of personal response units in large lecture classes. More recently, Joshi et al. (2021) examined student engagement with course content, their lecturer, and peers using PRSs in the classroom.

Empirical studies have also found that feedback increases the effectiveness of PRSs (Lantz & Stawiski, 2014; Rana et al., 2016). PRSs can increase students' attention, improve attendance, increase participation, and enhance their learning performance (Buil et al., 2016; Hedgcock & Rouwenhorst, 2014; Roblyer & Wiencke, 2003). Specifically, when using PRSs, students are required to answer questions, which helps keep their attention, provide instant feedback for sharing with their peers, and encourage classroom participation (Boyle & Nicol, 2003). In addition, PRSs allow students to answer review questions anonymously and can help them become increasingly responsible for their own learning. Therefore, PRSs are among the most useful tools in lifelong learning and can increase its effectiveness.

### **Characteristics of Personal Response Systems (PRSs)**

As the use of PRSs has become widespread in educational institutions, instructors have started to use information technology and response systems using the Internet (i.e., Wi-Fi) to deliver content in their classes. Studies have shown that PRSs can increase student engagement, performance, learning, satisfaction, and motivation (Sprague & Dahl, 2010), offer an interactive platform to support engagement and provide immediate feedback to individual learners (Keough, 2012), and ensure the anonymity of responses to questions (Latham & Hill, 2014; Shapiro et al., 2017). Instructors can either prepare the review questions in advance or create questions spontaneously during class. Meanwhile, during lessons, students can simply input their responses into the software system, and the PRS provides real-time polls in PowerPoint format.

For implementation, PRSs can operate via two approaches: anonymous mode and known mode. In anonymous mode, the answers to the questions do not identify the students. In known mode, the instructor can see which students give which answers. The poll results or student feedback can be recorded, summarized, and immediately displayed on screen in class. The polling data can be transformed into a histogram or other formats to show the statistical results for each review question, which can serve as a basis for class discussions. Questions asking students to give numeric, short text, or multiple choice answers can be used. After class, the results can be saved in spreadsheets and the response logs can be kept for records.

PRSs can also be integrated into PowerPoint presentations. Instructors can collect the identification codes for further analysis. Students can receive instant feedback on the course or multiple choice tests. Questions can be displayed directly via PowerPoint presentations during lectures as yes–no, right–wrong, true–false, multiple choice, rating scale, fill in the blank, and answer-specific questions. In short, PRSs are a simple technology that provides students with interactive experiences (Blood & Neel, 2008; Trees & Jackson, 2007) and facilitates attendance, summative assessment, formative assessment, homework collection, and peer instruction (Rana et al., 2016).

### **ADVANTAGES AND DISADVANTAGES of PRSs**

PRSs are personal response devices that allow interactions between instructors and students through answers to review questions (Kay & LeSage, 2009). Students thus experience rapid and interactive



feedback in the learning process (Stowell & Nelson, 2007). Figure 1 summarizes the advantages and disadvantages of PRSs.

## **Advantages**

The use of PRSs can increase the learning performance of students. Their effectiveness in this regard is indicated by their benefits (Kay & LeSage, 2009). Specifically, PRSs are inexpensive and effective teaching and learning tools for promoting student involvement in class (Trew & Nelsen, 2012). Their four main advantages are that they enable positive engagement, active collaborative learning, assessment, and instant feedback.

### **Positive Engagement**

PRS functionality can promote positive student engagement during lessons. If instructors ask their students well-chosen questions during lectures, the students can better reflect on and absorb the content of the course. The integration of formal questions in class can facilitate student engagement (Sun, 2014). In the classroom, PRSs provide innovative ways for students to answer review questions. As mentioned, students can answer questions during a lecture anonymously, which can increase their level of engagement (Voelkel & Bennett, 2014).

In general, students are interested and engaged in the concepts presented and discussed using PRSs (Barnett, 2006; Preszler et al., 2007; Simpson & Oliver, 2007). Blasco-Arcas et al. (2013) found that high levels of student interactivity with their instructors resulting from the use of PRSs were more likely to enhance student engagement. Studies have also shown that students' interactions with their environment can influence their perceptions of, and engagement with learning (Tloaele et al., 2014). PRSs also enable instructors to check individual learners' attendance based on their responses. As a result, PRSs can be used to ensure student attendance because they have a reason to attend classes regularly.

### **Active Collaborative Learning**

PRSs can enable students to engage in active collaborative learning because, as individual response devices, they allow students to answer questions anonymously during a lesson. Students can read, respond to, and reflect more actively on their learning with their instructors. PRSs greatly increase students' ability to respond critically and encourage them to give and share their opinions (Kay & LeSage, 2009). With the use of PRSs, students play an active role in creating new knowledge that contributes to the learning process. As a result, PRSs can be seen as a new teaching and learning strategy to sustain motivation for learning and engagement in constructive activities.

The increasing use of PRSs has created a platform for the promotion of active collaborative learning. By increasing the scope of discussions during lessons, PRSs can lead to more interactive discussions between instructors and students in the learning process. This creates a positive channel of communication between instructors and individual learners, which is a critical component of teaching and learning (Siau et al., 2006). By facilitating active collaborative learning, PRSs allow students to better assess their level of learning relative to their peers during lessons. Therefore, PRSs are an effective tool to encourage student thinking and provide an opportunity for active collaborative learning.

## Assessment

PRSs enable the assessment of students' knowledge when collecting their responses. Studies have shown that students generally appreciate the anonymity and ease of use offered by PRSs and participate more when PRSs are used during lessons (Kay & LeSage, 2009). These assessments can be used to evaluate student learning and determine whether they are performing well in class. PRSs can also be used to score student responses and enable students to complete tests at their own pace.

Assessment via PRSs can be done by asking students to answer questions, which provides a real-time flow of information. Instructors can then use these responses to make changes to the learning process. PRSs can capture students' attention and identify their learning needs. Students can also devote as much time as they need to the content of a lesson, allow instructors to determine whether they fully understand the important points of a lesson.

## Instant Feedback

PRSs can effectively engage students in the classroom, promote interactions between students, provide immediate feedback on their understanding of lessons, and facilitate their active participation in the learning process by prompting discussions of their responses. This instant feedback function is also beneficial to teaching and learning (Lantz & Stawiski, 2014; Simpson & Oliver, 2007). Chen et al. (2010) identified the benefits of timely and specific feedback on a task or concept provided by PRSs. They revealed that feedback occurs when students answer the instructors' questions. Instructors receive immediate feedback on student learning, and students can check whether their answers are right or wrong.

PRSs allow instructors to teach and discuss course materials differently. In particular, instructors can use the immediate feedback provided by PRSs to dynamically modify their lesson based on the nature and distribution of student responses (Yourstone et al., 2008). They can use these tools to get feedback on the whole class, as they can obtain a complete picture of the students who grasp the material and those who do not. Thus, PRSs allow instructors to explore in more depth what their students think about their teaching and their overall knowledge.

## DISADVANTAGES

The disadvantages of PRSs should also be acknowledged (Kay & LeSage, 2009). Although problems related to technology have decreased in recent years, other important problems related to the use of technology remain, including technical difficulties, access and resource issues, learner resistance, and learner boredom.

### Technical Difficulties

Although PRSs are generally easy to use, Internet service and unreliable devices pose technical challenges. PRSs often have connection problems or require long loading times when students complete polls (Stowell, 2015). PRSs must be connected to and recognized by a computer before starting the software. Students without appropriate device support cannot participate in the polling system (Caldwell, 2007). To support the use of PRSs, students are responsible for bringing the appropriate devices to class. PRSs

can also lead to unsatisfactory or bad situations due to technical difficulties, such as slow loading times and poor Wi-Fi connections. Such problems can be avoided by ensuring good system maintenance, stable content delivery, and reliable loading of software.

### **Access and Resource Issues**

Despite their benefits, instructors may be reluctant to use PRSs because of access and resource issues. Accessibility can be an issue with information system solutions. Internet support (i.e., Wi-Fi), Internet service, mobile or computer speed, and availability must be compatible with the PRS package. Another issue is the availability of adequate hardware for the students. Instructors who use a PRS must configure the system before their lessons and consider that students may have difficulty accessing and connecting to the Internet using their mobile phone or computer to answer the questions.

The resources required to set up PRSs and pre-class preparation are important barriers (Barnett, 2006). Most PRSs are password-protected and require students to log into the system. Instructors may feel that there are certain elements that students need to master before discussing a particular topic further. Class-wide discussion takes too long; therefore, institutions must support instructors by providing them with relevant support.

### **Learner Resistance**

As the format of teaching and learning has changed with PRSs, students may be reluctant to use this new tool. Students may experience stress, frustration, and resistance to answering questions in class. These negative emotions should be monitored to ensure learner participation (Caldwell, 2007). Forcing students to learn to use PRSs creates challenges and can lead to complaints about these new polling systems.

For example, in a large classroom, lectures tend to involve the instructor providing information and sharing experiences with their students in a one-way approach (Trees & Jackson, 2007). Instructors should be aware of individual learners who are reluctant to adopt PRSs and find ways to ensure that they use them.

### **Learner Boredom**

Boredom is a negative emotion and indicates an individual's state of being bored due to repeated use of PRSs. Boredom is defined as unpleasant feelings, low physiological arousal, perceived lack of cognitive stimulation, task-irrelevant thinking, and impulses to escape through disengagement (Pekrun et al., 2010). In the context of PRSs, students may feel bored if they have to use this tool repeatedly in class. As a result, students are likely to stop using PRSs to enhance their learning expectations. Chan and Ko (2020) found that boredom with PRSs decreased students' perceived learning and satisfaction, but the negative relationship between these variables was weaker when instructors provided higher levels of feedback. If students receive useful feedback from instructors, they are more likely to experience high levels of perceived learning and increased learning satisfaction.

## **THEORETICAL MODEL OF PERSONAL RESPONSE SYSTEMS**

The literature review presented above shows that most PRS studies have focused on organizational characteristics, with little empirical research on other factors (e.g., Blasco-Arcas et al., 2013; Han, 2014). Research must identify the antecedents of the learning attitudes of students in a virtual learning and academic environment. Few studies have examined the impact of PRSs on student learning performance (Rana & Dwivedi, 2015), although some empirical studies have identified the effects of student interactivity, collaboration, and engagement with PRSs on their learning performance (Chan & Ko, 2019). However, it is also important to provide students with good learning experiences (Choi et al., 2007). Keough (2012) reviewed studies of PRSs in a management setting which indicated significance of student attention span, attendance, participation, perceptions of satisfaction, and levels of performance among students. Chan and Ko (2019) examined the learner interface when using PRSs as an important antecedent of student engagement and learning performance. Their results indicated that engagement with PRSs mediated the impact of PRSs on learning performance.

Based on the literature review, three main characteristics (i.e., learner characteristics, instructor characteristics, and contextual factors) influence student learning (Choi et al., 2007). PRSs can effectively increase student engagement, encourage interactions between students, and provide immediate feedback to individual learners in the learning process. The interactive capabilities of the system provide timely feedback for teaching and learning. These factors are the key determinants of student learning performance. Instructors play a positive role in learners' experience with PRSs. Specifically, their attitudes and technical skills affect the attitudes of learners and the effectiveness of the learning process (Hunsu et al., 2016; Simpson & Oliver, 2007). The remainder of this chapter examines learner characteristics, instructor characteristics, and other contextual factors to explain the effect of PRSs on student learning outcomes. It also shows that individual learners and instructors can benefit from the use of PRSs (Kay & LeSage, 2009; Simpson & Oliver, 2007).

Based on the literature review, a theoretical framework for PRSs is developed and shown in Figure 2. The framework links six factors representing the three main categories: (1) learner characteristics (learner interface and learner interactions), (2) instructor characteristics (instructors' attitudes toward students and their technical skills), and (3) contextual factors (content and types of questions).

### **Learner Characteristics**

PRSs have become increasingly important to the potential of individual learners. As mentioned, studies have shown the effects of student interactivity, collaboration, and engagement on their learning performance (Blasco-Arcas et al., 2013). In addition, the learner interface and learner interactions are two important factors that influence the learning performance of students (Choi et al., 2007).

#### **Learner Interface**

A learner's preference for PRSs can be encouraged by their involvement with the system (Lai et al., 2012). The learner interface, an important element in promoting the use of PRSs, is defined as the extent to which learners can use them to connect to other learners. Individual learners are expected to have enough experience with PRSs to navigate the interface (Simpson & Oliver, 2007). Easy to use learner

interfaces can help save time in learning. Such PRSs are therefore user-friendly for individual learners, which makes them more comfortable using the tool.

PRSs enable individual learners to meet expectations and share their experiences by demonstrating their knowledge in classroom activities. The content they provide is easy for students to understand. Their perceived ease of use enhances students' attitudes toward their use. In the learning environment, PRSs facilitate communication between learners and instructors and can help disseminate new knowledge, keep users up to date with the latest information, help users engage in new learning experiences, and facilitate monitoring of the learning experience. The perceived ease of use of PRSs will thus positively affect students' attitudes and learning performance.

## **Interactions**

Interaction refers to the ability of the instructor and students to interact via the PRS. PRSs can engage students by providing them with quick and compelling interactions and feedback. It is important to determine whether students can interact with their instructor through the PRS. If so, they can easily contact their instructor and receive timely feedback (Latham & Hill, 2014).

PRSs give students the opportunity to be actively involved and engaged in lectures. Students can share their views and comment on the questions, topics, and materials provided in class (Yourstone et al., 2008). The results can help correct student misconceptions and facilitate discussions with instructors. Collaboration between instructors and individual learners enables better communication in the learning environment.

## **Instructor Characteristics**

The literature has shown that the student-instructor interaction improves learning outcomes and they actively interact with each other (Kang et al., 2012; Lantz, 2010). Instructor characteristics play an important role in the application of PRSs in the classroom (Choi et al., 2007), because instructors can modify their teaching and learning practices according to the attitudes and technical skills of their students.

## **Instructors' Attitudes Toward Students**

Instructors' attitudes toward students refer to how instructors respond to the use of PRSs. The teaching and learning practices of an instructor can help their students learn using a PRS. Instructors can increase the interest of students who seek advice on PRSs. When instructors have a positive attitude toward PRSs, the classroom environment will be more open, and by providing more direct answers to student questions, the students will be better able to recognize clear goals and receive instant feedback (Kay & LeSage, 2009). In different learning environments, instructors can use different teaching styles with the help of technology. In a more open and remote environment, instructors can use more interactive teaching styles with the help of PRSs to engage individual learners (Choi et al., 2007). When instructors have a positive attitude toward PRSs, using such systems allows them to provide more immediate feedback, use different teaching methods, and interact more with learners. Instructors should continue to use new technologies to meet the learning needs of their students.

## **Instructors' Technical Skills**

Instructors' technical skills refer to their knowledge of information technology or their skills in using PRSs in the classroom. Many instructors interested in using PRSs may not do so because they do not know how to implement them effectively. As a result, students may view instructors who use PRSs effectively as more competent with information technology and information systems than those who do not use them (Choi et al., 2007).

Skilled instructors can provide learners with clear goals and the necessary technical skills in advanced technologies and systems (Volery & Lord, 2000), and they can effectively explain how to use PRSs. As a result, instructors' technical skills in PRSs are positively related to the learning performance of students. Thus, the use of PRSs improves the learning experience of students in educational settings. To this end, instructors should have the ability to use PRSs effectively and attentively and to strategically develop relevant questions.

## **Contextual Factors**

Contextual factors, such as content and types of questions, play a key role in learners' attitudes and learning performance (Choi et al., 2007).

### **Content**

The use of PRSs can transform the content and format of learning in large introductory lectures and in medium-sized and small group discussions.

For students to have a clear idea of what they are supposed to learn, course content should be useful and tailored to individual needs of the students. When students answer questions, a better understanding of the content will help them develop a more positive attitude toward the use of PRSs. The content of the questions asked through PRSs can increase the students' interest in the material and their academic performance. For example, if an instructor wants to discuss thought-provoking questions in a large class, students will need to reflect on the course content for their answers.

### **Types of Questions**

The types of questions asked through PRSs can affect student learning. The most effective questions should be specific to avoid confusion, provide direction in a new context of PRS, and generate a wide range of answers. PRSs use questions of different formats, from yes–no and true–false to multiple choice and open-ended questions.

Gier and Kreiner (2009) argued that the type of question can significantly affect the outcomes. Their results indicated that students with experience using PRSs scored higher on exams than those without that experience, and that this increase in grades was related to the students' increased interactivity or active learning by asking relevant questions. PRSs are particularly effective in eliciting answers to low-level questions related to remembering and understanding facts. Hubbard and Couch (2018) also highlighted the importance of considering the effect of active learning strategies on students' initial level of performance.

## **Student Engagement and Learning Performance**

Engagement refers to the involvement of individual learners resulting from their interactions with instructors. Instructors can thus use PRSs to increase student engagement. Sun (2014) examined how the use of clickers can increase student engagement and attention. Yourstone et al. (2008) showed that instructors' effective use of PRSs facilitates positive learning attitudes and enhances learner engagement and learning performance (Blasco-Arcas et al., 2013; Keough, 2012; Scott & Walczak, 2009). Hedgcock and Rouwenhorst (2014) examined how to use PRSs to provide feedback to enhance student learning performance, as student learning performance is a crucial part of the evaluation and impact of PRSs (Nelson & Hauck, 2008; Zhu, 2012). Choi et al. (2007) explained the effect of learner's experience between learner characteristics, instructor characteristics, and content on learning outcomes. Cheng and Wang (2019) explored the effect of PRSs on learning performance using social presence and knowledge type. They showed that students with a higher level of social presence were more motivated to learn and performed better in school.

The use of PRSs integrated with peer instruction can significantly influence student performance in class settings. They are also useful for instructors to identify the proportion of students who are not participating in the discussion. Students who participate in class with PRSs generally have better academic results.

## **SOLUTIONS AND RECOMMENDATIONS**

This chapter makes several contributions to the literature. First, this chapter discusses the antecedents of PRSs using a theoretical model and empirically examines their effect on student learning performance. It also illustrates how developing a model of the impact of PRSs on student learning performance is a promising theoretical basis. PRSs can be useful in understanding the learning styles of individual learners. This chapter theoretically discusses relevant factors that can improve both learner characteristics and instructor characteristics to increase student learning performance. PRSs can increase student engagement in the learning experience and help instructors provide adequate feedback and a good learning interface.

Second, this chapter examines the effects of the contextual factors of PRSs on learning performance as an innovative way to deliver content in educational settings. One of the main functions of PRSs is to deliver content directly to students using different types of questions. It is important to identify what content is offered to learners. PRSs offer students an innovative way to participate in lessons, and their real-time feedback benefits both instructors and students. Future research could seek expert advice to address challenges at different levels of study on when and how to set content and types of questions to complement the learning process.

Third, PRSs can improve the awareness and attention of individual learners in the classroom. Instructors and students benefit from the innovative educational experience offered by the effective use of PRSs. PRSs are also useful for designing curricula to capture the attention of students. This can provide learning opportunities for students with different learning styles. PRSs can help instructors design balanced teaching approaches that meet student needs and guide new teaching and learning practices by increasing student attention. Students are thus encouraged to develop problem-solving skills with flexible classroom applications. Their answers to questions can also serve as a roadmap for teaching and learning.

Finally, in terms of practical implications, this chapter encourages academics and practitioners to adopt PRSs to meet the needs of instructors and students. Their use can lead to greater achievement and understanding for students and can complement traditional teaching and learning tools as an innovative means of communication between instructors and students. This chapter also has implications for educators based on the theoretical model developed in the current competitive environment. Given the close link between teaching and learning, educators should consider how the benefits of PRSs can be achieved.

## **FUTURE RESEARCH DIRECTIONS**

This chapter investigates the effect of three categories of factors related to PRSs on student learning performance (i.e., learner characteristics, instructor characteristics, and other contextual factors). The results show that the learner interface and instructor characteristics are two important factors affecting the attitudes and learning performance of students. Instructors should focus on when students use technological devices to interact with them. Instructors can then develop appropriate strategies to clearly explain the concepts and create student groups to discuss the questions that arise. Other factors, such as disciplinary differences and course levels, may also affect student learning performance (Han, 2014). Future research could identify the key success factors of PRSs. What other potential variables can influence student learning performance? What are the conditions that make PRSs more effective? These questions are left for future research.

This chapter can serve as a roadmap for future PRS research by identifying different categories of variables that can improve student engagement and learning performance. The unique characteristics of PRSs are more restrictive for knowledge delivery. The characteristics of individual learners may be more important in an interactive learning environment, and their experience may be improved by changing course content, adopting an inclusive teaching method that involves everyone in the class, and enhancing classroom interactivity to bring everyone to the same level. Future research could examine individual differences in PRS use, such as gender (Kang et al., 2012), learning style, and experience with PRSs (Lantz, 2010). More research is needed to understand whether gender differences affect the overall learning experience of students.

Moreover, the characteristics of individual learners and instructors are important in enhancing student learning performance in different educational settings (Lai et al., 2015). The findings of this chapter may be generalized to various levels of business students at other universities (Rana & Dwivedi, 2015). The literature review in this chapter compares the findings with reviews of other multidisciplinary research on PRSs, such as legal studies (Farag et al., 2015). Future research could examine how instructors create review questions in PRSs, how they share information or results in the classroom, and how PRSs lead to the creation of new learning practices.

This chapter offers important insights into the development of effective PRSs, which can be aligned with different learning philosophies to maintain competitive advantages. The use of PRSs is a new trend in higher education. Their characteristics, advantages, and disadvantages are discussed. The effects of specific types of questions can create student-centered learning. PRSs can thus provide effective learning to the students who use them. Future research should evaluate their effectiveness in the classroom (Masikunis et al., 2008; Shaffer & Collura, 2009). For instance, students could rate different types of lectures as interesting, entertaining, educational, and interactive (Masikunis et al., 2009).



Finally, students' emotions are important variables that influence their motivation to learn using PRSs. Limited research has investigated students' emotions in academic settings (e.g., Pekrun et al., 2011). Academic emotions refer to "emotions that are directly linked to academic learning, classroom instruction and achievement" (Pekrun et al., 2002, p. 92). Future research should examine both positive and negative emotions (e.g., enjoyment, pride, anxiety, anger, and boredom) using PRSs in relation to students' perceived learning effectiveness.

## CONCLUSION

As educational technologies and information systems continue to evolve, the role of PRSs as an innovative way to implement interactive polling experiences between instructors and students in the classroom has grown. PRSs are increasingly accepted by academics as a supplement to support student learning. Academic institutions have benefited from their use for years as they show great promise for student learning. PRSs are effective learning platforms based on sound pedagogical practices. Students are expected to be highly satisfied with their use and to appreciate the instant feedback provided by the instructors.

This chapter explores the effect of PRSs on student learning performance and develops a theoretical model. The results show that (1) learner characteristics, (2) instructor characteristics, and (3) contextual factors have important effects on the attitudes and learning performance of students. This chapter fills a gap in the literature on the effect of PRSs in academic institutions. It shows that PRSs are effective tools for enhancing student learning performance across disciplines and class sizes in various academic contexts.

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## **KEY TERMS AND DEFINITIONS**

**Active Collaborative Learning:** A method of encouragement that gives students the chance to speak up, listen to others, and reflect on their own thoughts.

**Boredom:** A negative emotion and indicates an individual's state of being bored.

**Interactive Learning:** An effective two-way learning format that encourages active participation between instructors and students.

**Learner Interface:** The extent to which individual learners can use PRSs to connect to instructors and other learners.

**Learning Performance:** The relatively permanent changes in knowledge or behavior that support retention and transfer of learning.

**Personal Response Systems:** An integrated information systems that are instructional technology tools that consist of a proprietary software application in computers, mobile phones, and other response tools used by instructors and students.

**Student Engagement:** An involvement of students who result from the interactions with instructors.