

PERSONAL RESPONSE SYSTEMS AND LEARNING PERFORMANCE

**Personal Response Systems and Learning Performance:
The Mediating Role of Learners' Engagement**

Abstract: The use of personal response systems (PRSs) to support the learning process is increasing. This study examines the impact of PRSs from individual learners' and instructors' perspectives on individual learners' engagement with PRSs and their learning performance. Data were collected from a sample of 236 undergraduate BBA students in the School of Business at a Hong Kong university. The results indicated that the learner interface was important to individual learners' engagement with PRSs and their learning performance. Instructor attitude and technical competence had significant impacts on learning performance. Engagement with PRSs partially mediated the effect of both perspectives on learning performance. Implications for the theory and practice of individual learners' learning performance are discussed.

Keywords: Personal response systems; engagement; learning performance; higher education

1 Introduction

Personal response systems (PRSs) have become a popular tool to support students' learning in the academic environment. PRS is an important development in information technology that helps academic institutions change traditional classroom teaching to a more interactive learning platform. PRSs are interactive systems that allow learners to enjoy the learning process in a timely manner (Moss & Crowley, 2011). The format of learning is transformed, and is no longer limited to the one-way delivery of content in classroom settings (Roblyer & Wiencke, 2003). PRSs allow individual learners to respond quickly and anonymously to instructors' questions, which facilitates individual learners' motivation and learning performance (Buli, Catalan, & Martinez, 2016; Hedgcock & Rouwenhorst, 2014).

Despite increasing interest in PRSs, research to date has mostly paid attention to identifying the factors in learners' attitudes in various virtual learning conditions (Han, 2014; Lai, Wang, & Lei, 2012; Simelane & Mji, 2014). The impact of interactivity, collaboration, and engagement with the system on individual learners' learning performance has been examined (Blasco-Arcas, Buil, Hernandez-Ortega, & Sese, 2013). It is important for PRSs to offer a strong potential learning experience to both individual learners and instructors (Choi, Kim, & Kim, 2007). The characteristics of interface, interaction, and instructor attitudes toward individual learners, in addition to instructor technical competence are the critical success factors to enhance learning performance (Latham & Hill, 2013). Thus, the first objective of this study is to determine the characteristics of both individual learners' and instructors' perspectives on PRSs that have an effect on learners' learning performance.

Considerable research has suggested that PRSs have portant implications for the attitudes and learning performance of individual learners (Shapiro et al., 2017; Scott & Walczak, 2009). For

PERSONAL RESPONSE SYSTEMS AND LEARNING PERFORMANCE

instance, Latham and Hill (2013) examined the factors including preference for anonymity between extraversion, performance-prove orientation, performance-avoid orientation and power distance orientation on attitude toward PRSs and perceived usefulness of PRSs. The influence of polling technologies on learners' engagement and attention in class was examined (Sun, 2014). Few quantitative studies have attempted to explain the impact and underlying mechanism of PRSs that affects learning performance, such as learners' engagement with PRSs (Chien, Chang, & Chang, 2016; Eastman, Iyer, & Eastman, 2011; Riggs & Gholar, 2009). The second objective of this study is to examine the mediating effect of learners' engagement with PRSs on the relationship between individual learners and instructors' perspectives and learning performance.

This study contributes to the teaching and learning literature in two main areas. First, it examines the impact of individual learners' interface and interaction on learning performance. It thus extends current research by explicating how individual learners' characteristics influence their attitudes and learning performance. This study further examines the effect of instructors' attitudes and technical competence on engagement with PRSs among individual learners (Sun, 2014), and aims to explain the evaluation of PRSs from the instructors' perspective. Second, this study extends the PRSs literature by exploring whether students' engagement with PRSs mediates the impact of individual learners and instructors' perspectives on learning performance. It helps to explain the mechanism of how PRSs affect the learning performance of individual learners.

The next section of this study contains a review of the literature on PRSs. The following section develops a model for the impact of the perspectives of individual learners and instructors on individual learners' engagement with PRSs and learning performance. The methodology section clarifies the research procedures used to collect data. The key findings are presented in the results section. The findings and implications for further research are then discussed.

2 Literature Review

PRSs have been recognized under a variety of labels, such as audience response systems, electronic voting systems, or “clickers.” PRSs are promising learning tools that allow students to submit anonymous responses or questions in a classroom setting. They thus offer opportunities to develop formative and summative assessments. PRSs offer an interactive platform to support engagement and feedback from individual learners (Latham & Hill, 2014). Students respond to questions and provide instant feedback for sharing through PRSs. Students have used PRSs to respond to questions, which helps them to get teachers’ attention, provide instant feedback for sharing, and increase attendance and class participation. They are highly encouraged to participate in class and increasingly responsible for their own learning (Boyle & Nicol, 2003). The results can then be presented immediately in a histogram or other format after receiving responses from individual learners. PRSs provide instant feedback on the learning process of individual learners and allow instructors to generate results immediately.

PRSs are effective at engaging commitment, encouraging interaction, and providing immediate feedback among individual learners. Lantz and Stawiski (2014) have shown that feedback is important to the effectiveness of PRSs. PRSs allow individual learners to respond to questions with a remote control supplied in class (Lantz, 2010). Keough (2012) reviewed 66 studies related to the effect of PRSs on learners’ attitudes and outcomes; these studies analyzed learners’ attention span, attendance, participation, perceptions of satisfaction and levels of performance. Kay and LeSage (2009) found that the key benefits of using audience response included improvement of the classroom environment, learning, and assessment. However, there are several core challenges, such as the difficulty of creating effective questions, the effort and time spent by the instructors, and variability in the quality of responses from individual learners.

The emerging development of PRSs in the academic and business fields has resulted in a growing volume of teaching and learning innovation research. The majority of research into PRSs has appeared in various academic disciplines (Keough, 2012). PRSs have been broadly adopted in many universities, creating an active learning environment across disciplines. Studies have concluded that the benefits obtained by the usage of clickers are similar in management and other disciplines. Farag, Park, and Kaupins (2015) investigated the adoption and use of PRSs in legal studies in business environments. Teaching experience has a significant effect on the quality of teaching associated with PRSs in the classroom.

More recently, Rana, Dwivedi, and Al-Khowaiter (2016) reviewed the use of PRSs in the business and management disciplines. The study found that clickers had the ability to enhance students' engagement, performance, learning, satisfaction, and motivation. Sprague and Dahl (2010) evaluated the use of PRSs in an introductory course in marketing. Hunsu, Adesope, and Bayly (2016) performed a meta-analysis of the impact of clicker-based technologies on cognition and affect in the classroom. The study identified factors such as class size, the use of questions, and knowledge domain for further analysis. Stowell (2015) compared the use of clickers and mobile devices for classroom polling during lessons. Individual learners using mobile devices for polling had a greater number of missing responses and were less successful.

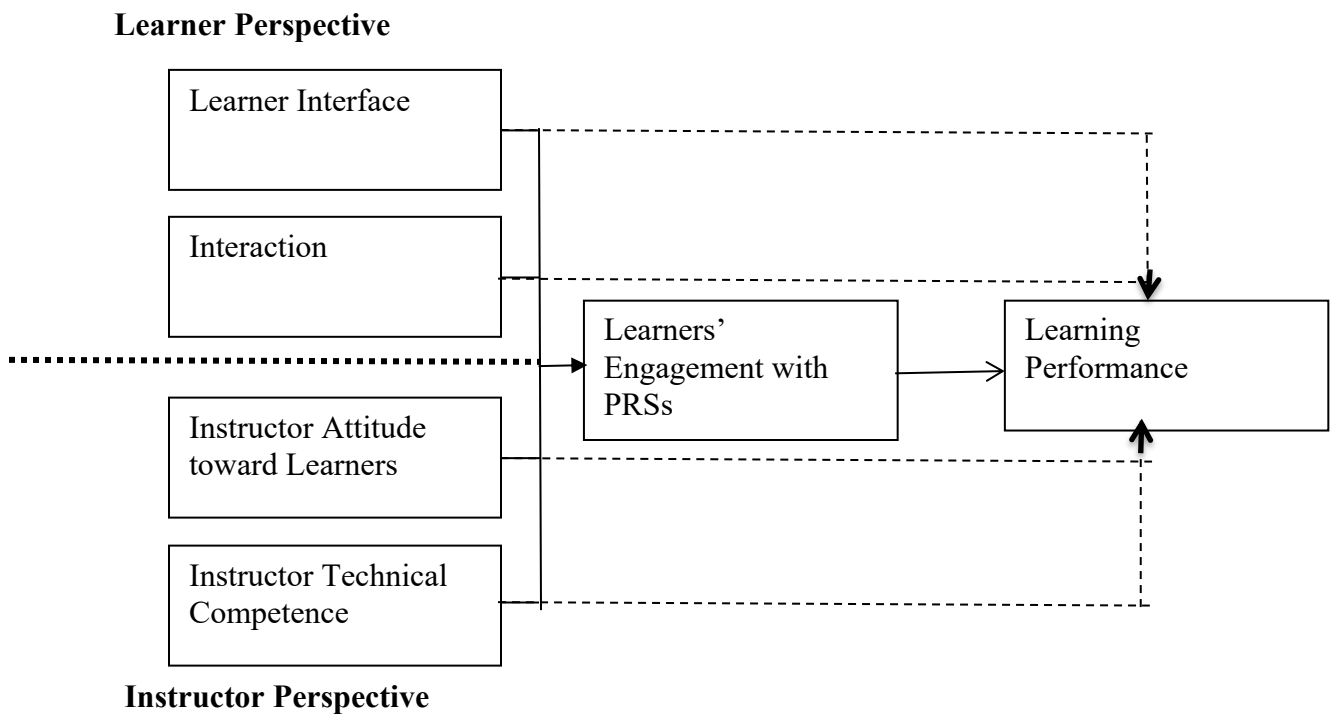
3 Theory and hypotheses

PRS provide instant feedback on the learning process of individual learners and allow instructors to generate results immediately. PRSs are effective at engaging commitment, encouraging interaction, and providing immediate feedback among individual learners in the learning process (Blasco-Arcas et al., 2013). The instructor plays a positive role in learners' experience of PRS. Instructors' attitude and technical competence in PRS affect learners' attitudes and performance

in the learning process (Elicker & McConnell, 2011; Simpson & Oliver, 2007). This study proposes four factors that are important to learners’ engagement with PRSs and learning performance: the learner interface, learner interaction, instructor attitude toward students, and instructor technical competence.

Figure 1 presents the research model.

FIGURE 1
Research Framework



3.1 Learner interface

The learner interface is an important component to determining the use of PRSs in the classroom (Lai, Wang, and Lei, 2012). It helps individual learners to be more comfortable in the use of PRSs and provides real-time response during the lesson. PRSs allow individual learners to meet expectations and share their experience by demonstrating their knowledge in class activities.

PERSONAL RESPONSE SYSTEMS AND LEARNING PERFORMANCE

The ability of individual learners to make use of information technology infrastructure helps to influence their learning performance. With the use of PRSs, individual learners can receive a clear learning goal and multiple tasks to perform, which serves as a new type of teaching method. They can respond to questions, which is useful for mastering lessons. The PRS interface is important to the effectiveness of the delivery of questions. An easy-to-use PRS interface provides a better learning process, which affects individual learners' attitudes toward the adoption of PRSs.

Hypothesis 1. An easy-to-use learner interface is positively related to learners' learning performance.

3.2 *Interaction*

The interactivity of learners is another factor in the use of PRSs in higher education. The experience of directly responding to questions in class can be evaluated as a positive learning experience. This experience for individual learners can produce encouragement and satisfaction. The interaction of individual learners' perceptions and the level of interaction among individual learners and instructors may significantly affect attitudes and learning performance (Choi, Kim, & Kim, 2007). Interactions and collaborations between instructors, peers, and individual learners are important to the learning process and can provide a platform to encourage communication in the learning environment. Individual interactivity is the interaction between individuals, instructors, and PRSs for direct and timely feedback. The ability to use PRSs is positively related to interactivity and learning engagement among individual learners.

Hypothesis 2. A higher degree of interaction is positively related to learners' learning performance.

3.3 *Instructor Attitude toward Learners*

PERSONAL RESPONSE SYSTEMS AND LEARNING PERFORMANCE

Instructor attitude toward students is another key component that determines the success of learners' learning process (Volery & Lord, 2000). The use of PRSs affects the teaching approach of instructors in class. In different learning conditions, instructors must use different teaching styles with the help of technology. For example, in a more open distance-education environment, instructors should use a more interactive teaching style with the help of PRSs to engage the learning of individual learners. When instructors have a positive attitude toward learners using PRSs, there are more opportunities to get immediate feedback, experience different teaching methods, and encourage interaction between instructors and individual learners. An instructor with a positive attitude shares more successful educational experience with PRSs' learners. Individual learners' preference in adopting PRS over traditional teaching methods also depends on the attitudes of instructors. Instructors can foster individual learners' ability to use PRSs.

Hypothesis 3. Instructor attitude toward learners is positively related to learners' learning performance.

3.4 *Instructor Competence*

Instructor competence refers to the ability and teaching style of instructors in effectively using and promoting PRSs. The instructor provides individual learners with their learning objectives and required PRS skills. Instructors must be technically competent with PRS so as to support their smooth operation (Volery & Lord, 2000). There is a risk in using PRS if the instructors have no expertise with them. An instructor with good technical competence has more control and flexibility in handling the operation of PRSs. Instructors can be trained by giving them relevant and up-to-date information on PRSs. If the instructor is highly competent in problem solving, the functions of PRSs can be used and result in better communication with individual

learners. The instructor's control of PRSs is likely to demonstrate a positive relationship with the learning performance of individual learners.

Hypothesis 4. Instructor technical competence is positively related to learners' learning performance.

3.5 *Learners' Engagement with PRSs*

Research has suggested that learners' engagement with PRSs is likely to affect learning performance (Blasco-Arcas et al., 2013; Scott & Walczak, 2009). Choi, Kim, and Kim (2007) explained the effect of flow experience based on learner characteristics, instructor characteristics, and content on the learning outcomes. Brady, Seli, and Rosenthal (2013) also found that PRSs resulted in positive feelings and reduction of the conformity effect on learning performance. Learners' engagement creates a more supportive learning culture through the use of PRSs (Han & Finkelstein, 2013; Preszler, Sawe, & Shuster, 2007; Tloaele, Hofman, Naidoo, & Winnips, 2014). Learners' engagement with PRSs refers to the involvement of individual learners in using PRSs generated from the interactions between instructors and individual learners. Instructors can recognize the use of PRSs in obtaining better engagement from individual learners. Sun (2014) showed that the use of clickers could help to increase learners' engagement and attention. Effective usage of PRSs facilitates a positive attitude toward the learning process, and engenders learner engagement and learning performance (Yourstone, Krave, & Albaum, 2008).

Hypothesis 5. Learners' engagement with PRSs mediates the relationship between antecedents and the learners' learning performance.

4 Methodology

In this study, the sample included 236 undergraduate BBA students studying at the School of Business in a university in Hong Kong, China. The survey was collected voluntarily and

PERSONAL RESPONSE SYSTEMS AND LEARNING PERFORMANCE

anonymously. The researchers administered the questionnaires during regular classes in mass lectures and provided instructions to participants. The participants directly returned the completed questionnaires in class. They were informed that their replies would be kept confidential and used for research purposes only.

4.1 *Measurements*

The instruments were borrowed from the literature, and the scales were revised to fit the context of PRS. Two pretests were conducted. First, two academic teaching staff members with computing education backgrounds were involved in reviewing the questions. A few items in the questionnaire were reworded. The staff members provided comments to clarify the appropriateness of the questions. Second, the modified questionnaire was pre-tested on a group of 36 Master's degree students studying human resources management at a university in Hong Kong. They were free to mark and comment on the measurements.

Learner interface. Volery and Lord (2000) and Wang's (2003) three-item scale was used to measure learner interface ($1 = strongly disagree; 5 = strongly agree$). The items for the learner interface include "PRS was easy to use," "PRS was user-friendly," and "The content provided by PRS was easy to understand." Cronbach's alpha for this scale was .89.

Learner interaction. Volery and Lord (2000) and Wang's (2003) three-item scale was used to measure learner interaction ($1 = strongly disagree; 5 = strongly agree$). The items for learner interaction include "I could interact with other learners through PRSs," "I could easily contact the instructor through PRSs," and "PRSs gave me direct/timely feedback." Cronbach's alpha for this scale was .80.

Instructor attitude toward individual learners. Volery and Lord (2000) and Wang's (2003) three-item scale was used to measure instructor attitude towards individual learners ($1 = strongly disagree; 5$

PERSONAL RESPONSE SYSTEMS AND LEARNING PERFORMANCE

= *strongly agree*). The items for instructor attitude toward individual learners include “The instructor was friendly towards individual learners,” “The instructor had a genuine interest in students,” and “Individual learners felt welcome in seeking advice/help.” Cronbach’s alpha for this scale was .71.

Instructor technical competence. Volery and Lord (2000) and Wang’s (2003) three-item scale was used to measure instructor technical competence ($1 = \textit{strongly disagree}$; $5 = \textit{strongly agree}$). The items for instructor technical competence include “The instructor explained well how to use PRSs,” “The instructor was keen that we were following PRSs,” and “The instructor handled PRSs effectively.” Cronbach’s alpha for this scale was .85.

Learners’ engagement with PRSs. Gallini and Moely (2003) and Medlin and Green’s (2009) three-item scale was used to measure learners’ engagement with PRSs ($1 = \textit{strongly disagree}$; $5 = \textit{strongly agree}$). The items include “Using PRSs, I felt that my opinions have been taken into account in this course.,” “Using PRSs, in this course, my peer and faculty interactions made me feel valuable,” and “Using PRSs, this course has improved my personal relationships with my peers and teachers.” Cronbach’s alpha for this scale was .89.

Learners’ learning performance. The three-item scale adopted by MacGeorge et al. (2008) was used to measure students’ learning performance ($1 = \textit{strongly disagree}$; $5 = \textit{strongly agree}$). The items include “The use of PRSs has improved my comprehension of the concepts studied in class,” “The use of PRSs has led to a better learning experience in this module,” and “The use of PRSs has allowed me to better understand the concepts in this module.” Cronbach’s alpha for this scale was .88.

Control variables. Gender and year of study were used to control for the effects of the model. A dummy variable was used to represent gender (0 = male, 1 = female). Year of study was measured as year 1, year 2, year 3, or year 4.

4.2 Data Analysis

PERSONAL RESPONSE SYSTEMS AND LEARNING PERFORMANCE

Means, standard deviations, and correlations for all of the variables appear in Table 1. The coefficients for all six factors were above 0.7, indicating acceptable reliability.

Insert Table 1 about here

Among the questionnaires distributed to participants, 236 out of 250 questionnaires were returned, resulting in a usable response rate of 94.4%. For the student sample, 44.9% were male and 55.9% were year 2 students. The majority of respondents (85.6%) had experience in using PRSs. Analysis of variance was used to determine if the participants' ratings varied based on gender and years of study. Results indicated that there was no significant difference among the participants.

Baron and Kenny (1986) three-step procedure was used for testing of a mediation model. The three steps are, firstly, the independent variables should be significantly related to the mediating variable (learner interface, interaction, instructor attitude towards learners, and instructor technical competence on learners' engagement with PRSs). Secondly, the independent variables should be significantly related to the dependent variable (learner interface, interaction, instructor attitude towards learners, and instructor technical competence on learning performance). Thirdly, the mediating variables should be related to dependent variables with the independent variables controlled for in the model. If the beta weights of the independent variables are still significant in the last step, partial mediation is presented if the effect is reduced after adding the mediator. If the beta weights of the independent variables are not significant, full mediation is presented.

Table 2 shows the parameter estimates of the regression models predicting that learner interface, interaction, instructor attitude toward learners, and instructor technical competence are significant for learners' engagement of PRSs and learning performance. Model 1 includes only the

PERSONAL RESPONSE SYSTEMS AND LEARNING PERFORMANCE

control variable. Model 2 adds the variables relating to learner interface, interaction, instructor attitude towards learners, and instructor technical competence. Model 3 is the full model, consisting of the control variable, the antecedent variables, and learners' engagement with PRS, the hypothesized mediator.

As shown in Model 2 of Table 2, after all the control variables were included, Hypothesis 1, which predicts that an easy-to-use learner interface is positively related to learners' learning performance, was supported (.28**). Hypothesis 2, which suggests that a higher degree of interaction is positively related to learners' attitude towards PRSs, was not supported (.09). Hypothesis 3, which predicts that instructor attitude toward learners is positively related to learners' learning performance, was supported (.19***). Hypothesis 4, which suggests that instructor technical competence is positively related to learners' learning performance, was supported (.38***).

In addition, following Baron and Kenny (1986) three-step procedure to test the mediation model, Hypothesis 5 predicts that learners' engagement with PRSs mediates the relationship between antecedents and the learners' learning performance. As shown in Table 2, firstly, after all the control variables were included, the results indicated that learner interface (.24***), interaction (.28***), instructor attitude (.22**) and instructor technical competence (.15*) were significantly related to learners' engagement with PRSs respectively, which fulfilled the first requirement for the mediation test. Secondly, based on the results of Hypothesis 1-4, learner interface, instructor attitude towards learners, and instructor technical competence were related, but not interaction, to learners' learning performance, which fulfilled the second requirement for mediation model. Thirdly, as shown in Model 3 of Table 2, learners' engagement with PRSs was significantly related to the relationship between the antecedents and learning performance (.24***), whereas the

PERSONAL RESPONSE SYSTEMS AND LEARNING PERFORMANCE

coefficient of learner interface (from $\beta=.28^{***}$ to $\beta=.21^{**}$), instructor attitude towards learners (from $\beta=.19^{***}$ to $\beta=.13^*$), and instructor technical competence (from $\beta=.38^{***}$ to $\beta=.34^{***}$), remained significant. Therefore, Hypothesis 5 was partially supported.

In sum, results indicated that Model 2 of Table 2, which added the variables of learner interface, interaction, instructor attitude towards learners, and instructor technical competence to learners' learning performance, explained more variance than Model 1 of Table 2 (Change in R^2 from .00 to .48). Model 3 of Table 2 only slightly explained more variance than Model 2 of Table 2 (Change in R^2 from .48 to .51).

Insert Table 2 about here

5 Discussion

PRSS introduce an interactive learning experience in the educational process. This study examines the impact of individual learner perspective and instructor perspective on learners' engagement with PRSS and their learning performance. The findings suggest that the learner interface, instructor attitude toward learners, and instructor technical competence significantly influence learners' learning performance. Surprisingly, interaction was not a significant factor in learners' learning experience. The results revealed that learners' engagement with PRSS mediated these relationships with learning performance.

From the perspective of individual learners, learner interface was found to be a significant factor affecting learning performance. Consistent with the literature, an interface can enhance the extent to which learners engage in the whole learning experience. However, interaction is not an important factor in the use of PRSS to generate involvement of individual learners. The level of interaction was not positively associated with engagement with PRS and learning performance.

PERSONAL RESPONSE SYSTEMS AND LEARNING PERFORMANCE

One possible explanation is that there are many ways for individual learners to communicate with various parties, such as instructors and peers, in the classroom. PRSs are only possible tools and at most another innovative way to deliver content in educational settings.

From the perspective of instructors, instructor attitude and instructor technical competence have a strong influence on engagement with PRSs. Instructors' attitude toward students is significant in the learning performance process. Students are easily influenced by their instructors in responding to questions and activities in class. The immediate and timely feedback provided by PRSs in a large classroom setting provides a potential explanation. Instructor attitudes can help students understand abstract content. Also, instructor technical competence helps to provide better support. It is much better for individual learners' engagement when the instructor can manage the infrastructure and the hardware and software technical support of PRSs.

The results showed that learners' engagement with PRSs partially mediated between the antecedents of individual learners' and instructors' perspectives and learning performance. The efforts to enhance learners' engagement provide a way to improve learning performance (Sun, 2014). However, there are other possible explanations for the linkage between the antecedents of individual learners' and instructors' perspectives and learning performance, such as active collaborative learning (Blasco-Arcas et al. 2013). Universities should be aware of the increasingly widespread use of PRSs in the learning environment. PRS is a promising learning tool to assist instructors in making changes to reflect the learning style of individual learners.

5.1 Implications

This study makes three main contributions. First, it examines the impact of learners' interface and interaction on their attitude toward PRSs. This finding extends current research by explicating how learners' characteristics may influence their attitudes in educational settings. PRS

PERSONAL RESPONSE SYSTEMS AND LEARNING PERFORMANCE

can help to make the learning experience more engaging, which helps instructors to provide adequate feedback and interface for learning purposes. It further examines the effect of instructor interaction on learners' attitudes. The role of instructors is significant, given the nature of PRSs and the tasks involved in the teaching and learning context.

Second, the literature reviews the critical factors that affect learners' learning performance. This study examines whether engagement with PRSs mediates the impact of individual learners' and instructors' perspectives on learning performance. The findings support the evaluation of how engagement with PRS is affected by individual learners and instructors when determining whether to use PRS. It provides an explanation of the "black box" of antecedents for using PRSs and learning performance. Individual learners engage more with PRS when they are supported by learners' and instructors' characteristics related to learning performance.

Third, this study confirms that the characteristics of individual learners and instructors are important for enhancing learners' learning performance in different educational settings (Lai, Hill, & Ma, 2015; Rana & Dwivedi, 2015). The findings may be generalizable to a range of different levels of business students in other universities (Rana & Dwivedi, 2015). This study provides new insight into how business educators can use PRSs to improve engagement and learners' learning performance when designing the curriculum of academic programs. PRSs enable educators to access individual learners' feedback in relation to the course design of any curriculum and the introduction of innovative teaching and learning approaches.

5.2 *Limitations and Future Research*

This study has several limitations. First, it collected data from an instructor and a group of undergraduate students in a business school in one university in Hong Kong. Other respondents from the university may also be an appropriate sample for such a study. Future research can involve

PERSONAL RESPONSE SYSTEMS AND LEARNING PERFORMANCE

the use of PRSs by multiple instructors, and examine the differences between PRSs' users and non-PRSs' users in different contexts. The traits and personalities of individual learners could also be further examined in future studies.

Second, using common method source questionnaires for all measurements produces a bias. Future research can collect data from both instructors and individual learners for analysis. The cross-sectional nature of this research limits the ability to imply causality among constructs. Future research should use a longitudinal design to allow researchers to investigate individual learners' learning performance and its impact over time.

Third, this study mainly focuses on the key determinants from individual learners' and instructors' perspectives (the learner interface, interaction, instructor attitude toward students, and instructor technical competence). Future research should examine other variables that may influence students' learning performance, such as question type and design.

6. Conclusion

This study examines the characteristics of both individual learners' and instructors' perspectives on PRSs that have an effect on learning performance. The results on individual learners' characteristics, i.e. learner interface (Hypothesis 1), had significant impact on learning performance (Latham & Hill, 2014). Unexpectedly, contrary to the literature (e.g. Blasco-Arcas et al., 2013), result indicates that the interaction is not significant (Hypothesis 2) to learning performance. There are other teaching and learning tools to interact and communicate between learners and instructors in the classroom. In addition, this study advances the literature on the impact of instructors' characteristics on learning performance. The results show that instructor attitude (Hypothesis 3) and technical competence (Hypothesis 4) had significant impacts on learning performance. Engagement with PRSs partially mediated the effect of both perspectives

PERSONAL RESPONSE SYSTEMS AND LEARNING PERFORMANCE

on learning performance (Hypothesis 5). This study contributes to help academic institutions to improve the teaching practice, and students to enhance their learning performance. The results clearly indicate that the support from both individual learners' and instructors' are of importance to use of PRSs in business school setting. Instructors have the ability to engage the usage of PRSs and deliver effective teaching and learning experiences to individual learners.

PRSs seem to be an upcoming trend among academic institutions. This study empirically explores the application of individual learners' and instructors' perspectives as antecedents, which affect learners' engagement with PRSs and learning performance. The research findings show that the learner interface, instructor attitude toward students, and instructor technical competence have significant effects on engagement with PRSs and learning performance. PRS can provide an effective and efficient way of helping learners' learning performance in business schools.

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PERSONAL RESPONSE SYSTEMS AND LEARNING PERFORMANCE

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PERSONAL RESPONSE SYSTEMS AND LEARNING PERFORMANCE

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PERSONAL RESPONSE SYSTEMS AND LEARNING PERFORMANCE

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PERSONAL RESPONSE SYSTEMS AND LEARNING PERFORMANCE

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PERSONAL RESPONSE SYSTEMS AND LEARNING PERFORMANCE

Table 1 *Correlations and reliabilities* ^{a, b, c}

Variables	Mean	s.d.	1	2	3	4	5	6	7
1. Gender	.55	.50							
2. Year of Study	2.4	.06	-.02						
3. Learner Interface	4.04	.05	.01	.11					
4. Interaction	3.80	.06	.03	-.05	.62***				
5. Instructor Attitude towards Learners	3.52	.06	-.03	-.20**	.35***	.38***			
6. Instructor Technical Competence	3.94	.05	.03	.09	.65***	.68***	.38***		
7. Engagement with PRS	3.69	.06	.07	.02	.60***	.63***	.47***	.58***	
8. Learning Performance	3.80	.06	.01	-.02	.58***	.55***	.44***	.61***	.60***

Notes:

^a, n = 236

^b The correlation coefficients are significant at *P<.05, **P<.01, *** P<.001.

^c Reliability coefficients appear along the diagonal.

Table 2 *Individual Learner and Instructor Antecedents, Engagement with PRS, Learning Performance*

Step	Variables	Engagement with PRS	Learning Performance		
			Model 1	Model 2	Model 3
1	<u>Control Variables</u>				
	Gender	.02	.02	.00	-.02
	Year of Study	-.02	-.03	-.05	-.06
2	<u>Antecedent Variables</u>				
	<i>Learner Perspective</i>				
	Learner Interface	.24***		.28***	.21**
	Interaction	.28***		.09	.01
	<i>Instructor Perspective</i>				
	Instructor Attitude towards Learners	.22**		.19***	.13*
	Instructor Technical Competence	.15*		.38***	.34***
3	<u>Mediating Variable</u>				
	Engagement with PRS				.24***
	N	236	236	236	236
	Df	6	2	6	7
	R ²	.42	.00	.48	.51
	Change in R ²	.42	.00	.48	.03

* P< .05
 ** P< .01
 *** P<.001