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# Understanding students' preferences toward the smart classroom learning environment: Development and validation of an instrument

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ABSTRACT

This article presents the rationale for developing an instrument and initial evidence of validity and reliability in a higher education context. The 40-item instrument measures students' preferences toward the smart classroom learning environment from eight constructs that are characteristic for this environment, including: Student Negotiation, Inquiry Learning, Reflective Thinking, Ease of Use, Perceived Usefulness, Multiple Sources, Connectedness, and Functional Design. Data was purposely collected from a group of 462 college students enrolled in at least one smart classroom course during the time of this study. The results showed no difference in preferences between genders and concluded that the instrument was a valid and reliable tool for measuring college students' preferences toward a smart classroom learning environment.

## 1. Introduction

The rapid development of technology has enabled more social, interactive, flexible, and student-centered learning environments. The smart classroom is one of these learning environments, which has recently gained attention. In general, the term 'smart classroom' refers to a physical classroom that integrates advanced forms of educational technology to increase the instructors' ability to facilitate students' learning and the students' ability to participate in formal educational learning experiences beyond the possibilities of traditional classrooms (cf. Baepler, Walker, & Driessen, 2014; Dascălu, Dessus, Nistor, & Trăușan-Matu, 2014; Niemeyer, 2003; Shen, Wu, & Lee, 2014; Shi et al., 2003; de Oca, Nistor, Dascălu, & Trăușan-Matu, 2014). The utilized specific technology may vary; however, a typical smart classroom would incorporate technologies such as digital cameras and recording or casting equipment, multiple student-controlled interactive whiteboards or touch screen televisions, mobile devices (e.g., tablets and/or smart phones) that are compatible to connect with student-controlled displays, wireless Internet, and educational management software. With these types of technologies, instructors are more capable to facilitate, monitor, guide, and assess students, as well as to provide immediate feedback when necessary. Similarly, students are more uniformly equipped with technology, and required to actively integrate this technology as a support process for their face-to-face communications and group work activities. As a result, the smart classroom describes a learning environment that differs both conceptually and theoretically from traditional classrooms or computer labs. Furthermore, the reliance on students' face-to-face interaction describes a context that differs from other internet-based, ubiquitous, mobile-based, or multimedia-based learning environments.

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The smart classroom is founded in constructivist epistemology, which has become a well-recognized basis of a high quality pedagogical approach (Thomas & Anderson, 2014). Constructivist pedagogy focuses on students developing their own understanding of knowledge via social interactions in a learning environment (Maor, 1999; Schunk, 2012; Vygotsky, 1978). Such an approach has been shown to result in more diverse student learning (Tynjälä, 1999) and to improve critical thinking abilities when compared to traditional settings (Kwan & Wong, 2015). Constructivist pedagogy in smart classrooms encourages new roles and responsibilities for learners. For example, student-controlled interactive whiteboards provide learners with new visually-supported capabilities for socialization. In this sense, technology integration actively supports the cultivation of social relationships, whereas, learners must make sense of the presented information themselves (Krause, Bochner, & Duchesne, 2007; Schunk, 2012) by engaging in collaborative activities that require justification of opinions and listening to other students' personal views (Chu & Tsai, 2009; Taylor, Fraser, & Fisher, 1997; Yau et al., 2003). Thus, student negotiation is a critical learning process of the smart classroom, as it requires the analysis of individuals' input to develop an overall group conclusion.

The versatility of students' tablets and smart phones shifts pedagogy away from didactic teacher-centered educational practices, stimulating participatory student-centered learning (Looi et al., 2010). Students engage in active scientific investigations and personally reflect on the acquired knowledge. Due to these practices, students share the responsibility of technology integration and content acquisition more equally with their instructor. In many cases, students are even required to lead the interaction with technology acting as a cognitive tool that "can facilitate critical thinking and higher-order learning" (Jonassen & Reeves, 1996, p. 694). Therefore, inquiry learning and reflective thinking (Chu & Tsai, 2009; Maor & Fraser, 1996, 2005) are critical learning processes of a smart classroom.

Based on these constructivist learning processes, the smart classroom requires a conceptually unique physical design. Classroom space must be flexible to support a variety of classroom purposes, including lectures and simultaneous small-group learning activities (Johnson et al., 2016; Niemeyer, 2003). Constructivist learning environments almost always focus on problem solving, and problem solving requires the exploration and evaluation of multiple sources of information (Jonassen, 2002). Therefore, furniture is typically ergonomic with a design that supports comfortable usage of both digital and non-digital resources (Johnson et al., 2016; Niemeyer, 2003). Additionally, furniture design configurations encourage the students' communication and interaction during class. In contrast, traditional classroom furniture was typically designed to ensure teacher control of the learning process and to reduce potentially disruptive student interactions.

Given the many advantages offered by a smart classroom, an awareness of the positive impacts of the smart classroom on student learning has led to an increase in the popularity and demand (e.g., Johnson et al., 2016; Li, Kwok, Wu, & Ni, 2016). Some large countries, of which China is one, are even providing significant government sponsorship to facilitate the implementation of smart classrooms at all levels of education (Huang, Yang, & Hu, 2012; MOE, 2017). Therefore, the students' perception of this learning environment has become an issue of great importance, particularly with regard to the aspects of constructivist learning processes, student socialization, the physical design of the learning space, and student-centered technology integration. Furthermore, previous studies on other constructivist technology-supported learning environments have recognized the importance of understanding potential gender influences toward students' preferences. For example, for the constructivist internet-based learning environment, Tsai (2008) reported higher levels of male preferences toward the measures of challenge, cognitive apprenticeship, and epistemological awareness among college students. Additionally, Yeo, Taylor, and Kulski (2006) identified that female college students reported lower level preferences on all measures (relevance, critical thinking, student interaction, facilitator support, peer support, communication online) of the constructivist online learning environment. These studies both suggest that males may more strongly prefer such environments. A growing body of research is also suggesting that gender may not be an influential factor toward other constructivist technology-supported environments (e.g., Shieh, Chang, & Liu, 2011; Tsai, Tsai, & Hwang, 2012; Whiteside, Brooks, & Walker, 2010). However, gender differences have not been explored in the smart classroom and a more general understanding of students' preferences toward the smart classroom is missing, since the instrumentation for assessment does not exist. Therefore, research on this topic can provide several important implications for both educational researchers and practitioners.

Fraser (1998) suggested that understanding a learning environment through the participants' perception is a significant issue. In consequence, many technology-supported learning environments have utilized surveys to assess the relationships between students' preferences and learning environment features (Chang et al., 2015). This strategy of analyzing students' perception implies that researchers and practitioners can develop more appropriate learning environments by obtaining information regarding students' preferences in specific settings. Such considerations highlight the general significance of technology-supported learning environments in assisting learners to develop knowledge and skills more efficiently (Mayer, 2005) and in ways that could not be otherwise achieved in traditional learning environments (Noroozi, Weinberger, Biemans, Mulder, & Chizari, 2012; Wu, Lee, Chang, & Liang, 2013).

Without having the required assessment tools for a smart classroom, the data necessary to initiate learning environment improvements is not available. This research gap indicates that the smart classroom is not currently being used most effectively to support students' learning. To address this significant issue and research gap, our study:

(1) Developed a new instrument to survey students' preferences toward the smart classroom;
(2) Provided initial validity and reliability analysis to support instrument use in higher education;
(3) Examined gender influences to understand potential differences in this environment.