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Developing and Validating a High School Version of the Robotics Motivated Strategies for Learning Questionnaire

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ABSTRACT

Robotics has become a crucial domain in technology education, helping students to improve their abilities in assembly and programming. Despite the considerable research that has gone into the learning performance associated with robotics, little work has been done on the cognitive processes involved in learning this subject. The purpose of this study was to develop an instrument (based on the theoretical framework of MSLQ), with which to evaluate the motivation of high school students to learn robotics and the strategies they employ. Fifty participants in the open category competition of the World Robot Olympiad 2010 completed the self-reported questionnaire (RMSLQ-HS). Thirteen factors and fifty one items were extracted using exploratory factor analysis. Implications for the educational application of robotics and research suggestions related to RMSLQ are also discussed.

KEYWORDS

Educational Technologies, Exploratory Factor Analysis, Robotics Motivated Strategies Learning Questionnaire (RMSLQ), Scale Validation, World Robot Olympiad

INTRODUCTION

Educational technologies are becoming increasingly critical. Among these, edutainment artifacts provide students with a pleasurable and meaningful learning experience through hands-on training using programming bricks (Resnick, Martin, Sargent et al., 1996). Educational robots are a highly popular form of edutainment artifact used in a wide range of subjects and classroom contexts. Previous studies have found that learners are highly motivated and satisfied with courses based on Lego design (Liu, Lin, & Chang, 2010) and other Lego-accompanied learning environments (Wei, Hung, Lee et al., 2011). In terms of learning performance, observational evidence has shown that learners can acquire basic programming skills through competition-based Lego games (Atmatzidou, Markelis, & Demetriadis, 2008), requiring the identification of factors influencing system performance in a project-based robotics environment (Barak & Zadok, 2009). In addition, when integrating robotics into schooling, elementary students exhibit active learning behavior with instructional humanoid robots, such as raising their hands to answer questions and greeting robots loudly in English class (Chang, Lee, Chao et al., 2010). Besides, the university students in South Africa also have well responses to

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problem solving, critical thinking, and collaborative learning in an introductory programming course via Lego Mindstorm-NXT (Chetty, 2015). Different from the perspective of the pedagogical tool, students also can improve their English Verbs using via teaching the robot about the care-receiving (Tanaka & Matsuzoe, 2012). These studies have indicated that robots could be effective elements in enhancing learning motivation and learning performance.

Though instructors can integrate different kinds of technologies to academic learning, researchers still explore some relevant factors of students' effective learning. In traditional classroom context, seventh-grade students' scores in MSLQ survey indicated that self-regulation, self-efficacy and test anxiety were the best predictors of English and science performance (Pintrich & DeGroot, 1990). Today, many children regard educational robots as toys and as a way to access high-level technology (Liu, 2010), but few researchers have studied the actual psychological status of those learning robotics. Researchers in robotics learning domain also have to consider which motivational or cognitive components would influence students' engagement in their learning processes. Thus, such an understanding would enable instructors to optimize their instructional design and approaches according to the motivation of students and the various aspects of self-regulated learning.

The aim of this study was to design an instrument for measuring personal learning motivation and strategies use associated with robotic activities in order to verify the reliability and validity of the robotic learning scales. Currently, two inventories are used as the most common measures of self-regulated learning: the Learning and Study Strategies Inventory (LASSI) and the Motivated Strategies for Learning Questionnaire (MSLQ), in the fields of education and psychology, respectively (Magno, 2011).

LASSI is commonly used to measure general aspects of self-regulated learning; however, MSLQ is used to address specific characteristics based on Social Cognitive Theory (Dunken & McKeachie, 2005). According to advocates of reciprocal determinism, learning is actively influenced by ones' own cognition, behavior, and existing social context (Bandura, 1986), making MSLQ more flexible in the assessment of the dynamic cognitive processes associated with a wide variety of subjects. Establishing a framework to describe the relationships among various factors in self-regulated learning system is crucial. MSLQ has helped to establish the existence of a relationship between self-regulated abilities and academic performance in class and at the course level (Pintrich & DeGroot, 1990; Pintrich, et al., 1993). For this reason, we applied MSLQ to the learning content of robotics courses to investigate the structural factors associated with robotics in the learning domain.

DIFFERENT VERSIONS OF MSLQ FOR EDUCATIONAL SURVEY

Two versions of MSLQ are generally used in the field of education: one version is used to investigate college students (Pintrich, et al., 1993) and the other junior high school students (Pintrich & DeGroot, 1990).

One study applied an earlier version of MSLQ called MSLQ-JHS (Junior High School version) (Pintrich & DeGroot, 1990) to junior high school students in East Asia with a classroom context (Rao & Sachs, 1999). The MSLQ-CV (Chinese version) was adaptive for high school students in Hong Kong after revising some items and altering some descriptions according to the classroom environment as well as colloquial language found in Hong Kong. On the other hand, the later version of MSLQ (Pintrich, et al., 1993) has seldom been modified through the factor analysis despite of the wide application across the tested languages.

Thus, this study adopted the framework of MSLQ for college students (Pintrich, et al., 1991; 1993), rather than MSLQ-JHS or MSLQ-CV for use with high school students in Taiwan. Considering

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