Research on acceptance analysis of application programming learning platform for industrial robots

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Abstract: Objective To investigate the college students' acceptance of solid model teaching and virtual model teaching. Methods Several factors (behavioral intention, effort expectation and performance expectation) in UTAUT (Integrated Technology Acceptance Model) were used for data analysis using T-test. Results The experimental results showed that students had higher behavioral intention to the entity model, higher effort expectation and performance expectation to the entity model, and the difference was significant. Compared with the virtual 3D model, students prefer the physical device that can be held in their hands and operated. Conclusion In the design of robot application programming teaching platform, we should appropriately introduce the teaching link of solid model, and combine the advantages of virtual model and solid model.

Key words: Robot; Application programming; Integrated Technology Acceptance Model (UTAUT); Virtual-real combination

A robot is a highly flexible automatic machine that can perform various actions through programming and automatic control, thereby partially replacing human labor. How to use the virtual and real robot application programming learning platform to carry out the teaching reform of robot application programming course has become one of the important research hotspots in the field of robot education.

Therefore, this paper adopts the integrated technology acceptance model (UTAUT), takes the students majoring in mechanical and electrical engineering in colleges and universities as the research object, conducts a questionnaire survey on the situation of learners learning application programming using two learning platforms: virtual simulation model and entity teaching model, observes several key factors affecting user acceptance in UTAUT, and uses T-test for data analysis. And the valuable conclusions are obtained. This research will help to improve the acceptance of the robot application programming learning platform users, and provide theoretical and practical reference for the teaching reform of intelligent production line, automatic control and other courses.

I. Research and design

1. Model and research hypothesis

In order to investigate students' acceptance of virtual model teaching methods and solid model teaching methods, this study extracted three latent variables, namely behavioral intention, effort expectation and performance expectation, from UTAUT model to analyze students' acceptance of the two teaching methods. Behavioral intention in UTAUT model refers to students' willingness to accept a certain teaching method, which can be used as an indicator of students' acceptance of teaching methods. Effort expectation and performance expectation can be used to analyze the internal reasons for the changes in the acceptance of the two teaching methods. If the students' acceptance of a certain teaching method is higher, and the effort expectation of this teaching method is also higher, it indicates that the effort expectation is the internal reason for improving the acceptance of this teaching method. In the same way, the expectation of performance is also true. If the high acceptance is accompanied by a higher expectation of performance, it indicates that the expectation of performance is also the internal reason for improving the acceptance of this teaching method.

To sum up, this study has the following three hypotheses:

H1: The behavioral intention of solid model teaching method is higher than that of virtual model teaching method.

H2: The effort expectation of solid model teaching methods is higher than that of virtual model teaching methods.

H3: The performance expectation of solid model teaching method is higher than that of virtual model teaching method.

2. Data collection and analysis methods

After the preliminary draft of the questionnaire was completed, 65 students were first predicted, and the data were recovered according to the prediction. Item analysis technology was used to delete the choices with poor reliability, and the wording of some of the choices in the questionnaire was revised to improve the quality of the questionnaire, and then the questionnaire was formally issued. Responses were measured on a 7-point Likert scale, ranging from strongly disagree (1 point) to strongly agree (7 points). In the end, 363 effective questionnaires were collected. Among the effective questionnaires, 54.3% were male and 45.7% were female, all of which were engineering college students. Paired sample t test was used to compare students' acceptance of virtual model teaching method and solid model teaching method and the evaluation difference of influencing factors.

II. Results and Analysis

Table 1 Results of paired sample T-test

	Behavioral intent		Effort expectations		Performance expectations	
	Virtual models	Physical model	Virtual model	Physical model	Virtual model	Physical model

Mean	5.06	5.32	5.15	5.34	5.07	5.40
Variance	1.19	0.95	1.08	0.91	1.13	0.90
Standard deviation	1.09	0.97	1.04	0.96	1.06	0.95
Difference	0.26		0.20		0.34	
Poisson correlation coefficient	0.49		0.56		0.55	
Degrees of Freedom	361		361		361	
Paired sample t values	4.72		3.98		6.66	
Paired sample p values	< 0.001		< 0.001		< 0.001	

1. Contrast of behavioral intention

The behavioral intention dimension consists of three questions:

(1) If possible, I intend to make (virtual simulation/physical model) teaching platform.

(2) I plan to make more use of this (virtual simulation/physical model) platform if possible.

(3) If possible, I will use this (virtual simulation/physical model) teaching platform more often.

The scores of students' answers are from 1 to 7, and 4 is divided into average scores. The average of each student's answers to the three questions is taken as the value of this dimension of student's behavioral intention. Each student has two behavioral intention values, one is the behavioral intention of using the virtual model and the other is the behavioral intention of using the physical model. The average score of students' behavioral intent for the virtual model was 5.06 (SD=1.09), and the average score for the solid model was 5.32 (SD=0.97). The behavioral intent for the solid model was 0.26 points higher than that for the virtual model. There was a significant difference in the paired sample T-test ($t = 4.72$, $p < 0.001$).

The data analysis results show that students' behavioral intention for the physical model is significantly higher than that for the virtual simulation. Behavioral intention represents students' acceptance of this teaching method, indicating that students hope to use this teaching method more frequently in the future. Since the average score of behavioral intention is 4 points, and the average score of students' behavioral intention for virtual simulation and physical model is higher than 5 points, it indicates that students can accept both teaching methods, but students' acceptance of the physical model is higher.

2. Effort expectation analysis

The effort expectation dimension consists of four questions:

(1) (Virtual simulation/physical model) teaching platform should be easy to learn.

(2) (Virtual simulation/physical model) teaching platform should be easy to use.

(3) The interactive interface of the teaching platform (virtual simulation/physical model) should be clear and easy to understand.

(4) I should be able to use this (virtual simulation/physical model) teaching platform very quickly.

The score is from 1 to 7, with 4 being the average score. The higher the score is, the less effort the students think this teaching method is. The value of effort expectation is equal to the average of the responses to these four questions, and the higher the value is, the easier the students think the platform is to master. The average effort expectation of students for the virtual model was 5.15 (SD=1.04), the average effort expectation for the physical model was 5.34 (SD=0.96), and the effort expectation for the physical model was 0.20 points higher than that for the virtual model. The difference in paired sample T-test was significant ($t = 3.98$, $p < 0.001$).

Similar to the results of behavioral intention, students rated the entity model more easily to learn. The impression that solid model is easy to learn may be due to the fact that the three-dimensional rotation and translation operations of virtual model on the computer screen also need to master certain operation methods, which is more expensive to learn than solid model.

In addition, in UTAUT model, effort expectation is an important factor affecting behavioral intention. In this study, students have a higher acceptance of the entity model and a higher evaluation of the usability of the entity model, indicating that the easier use of the entity model is an important factor influencing students' higher acceptance of the entity model. In addition, efforts to improve the ease of use of the robot teaching platform, whether it is the physical model or the virtual model, can well improve the acceptance of the teaching platform.

3. Performance expectation analysis

The performance expectation dimension consists of four questions:

(1) I think (virtual simulation/physical model) teaching platform is very useful for me to learn robot programming skills.

(2) I think the (virtual simulation/physical model) teaching platform enables me to complete the learning task faster.

(3) I think (virtual simulation/physical model) teaching platform can improve my learning efficiency.

(4) I think (virtual simulation/physical model) teaching platform can improve my academic performance in the robot programming technology course.

The dimension of performance expectation examines whether the teaching platform is helpful to students' learning and whether it can improve their academic performance. The scale is from 1 to 7, and 4 is the average score. The higher the score is, the more useful it is for learning. The value of performance expectation is equal to the average of the scores on the four questions. The average performance expectation of students for the virtual model was 5.07 (SD=1.06), and the average performance expectation for the physical model was 5.40 (SD=0.95). The performance expectation for the physical model was 0.34 points higher than that for the virtual model. The difference was significant in the paired sample T-test ($t = 6.66$, $p < 0.001$).

Students have higher performance expectation on the entity model, which indicates that students think the entity model teaching can help the subjects to complete the study better and get better grades. The reason why students' evaluation scores on the usefulness of virtual models are low may be due to the influence of students' daily use of 3D modeling software. Basically, all 3D modeling software is relatively professional. Students' worry about the complexity of 3D modeling software may extend to the 3D simulation teaching platform, resulting in a certain fear of 3D model-related software. If the robot programming teaching platform is built on the 3D simulation system, students may worry that the corresponding 3D operation will hinder their further learning of programming knowledge, while the solid model can avoid this problem, so that students can focus on the learning and training of robot programming knowledge.

III. Conclusion

According to the research data, the teaching link of solid model should be introduced into the teaching platform of inspection robot programming in order to obtain better teaching effect. The virtual simulation platform can execute complex instruction and operation, and has high running precision, which is essential in the in-depth learning of robot programming. Therefore, through the combination of virtual simulation platform and solid model platform, first real and then virtual, real simple and complex, virtual and real combination, it can better help students master the knowledge system of robot application programming and hone solid operation skills.

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