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THE EFFECT OF THE COLLABORATIVE TECHNOLOGY- ENHANCED ACTIVITIES ON STUDENTS' MOTIVATION

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Abstract

The collaborative technology-enhanced activities developed for Algorithm Calculation course in Medical engineering subject-discipline and Computer Workshop courses in two Computer and IT engineering subject-disciplines in two consecutive semesters. Mixed-method research design was used in this study. Content of each course was used in order to develop the activities. Motivational Strategies for Learning Questionnaire (MSLQ) was utilized for collecting quantitative data while qualitative data was collected using interview protocol for further investigation. The analyses showed that the "intrinsic value" was the category with the higher mean score for all students with three different subject-disciplines which is followed by cognitive strategy use. Moreover, the results showed that the students' level of anxiety decreased after using the activities. Analysis of interview data showed that the students emphasized on the role of activities in terms of increasing their "collaboration" with their peers and instructor. Moreover, they perceived that the activities make the course more interesting for them. They also explained that using computerized devices especially mobile ones facilitated their communication and material-sharing.

Keywords

Activities, Collaboration, Communication, Motivation, Technology-enhanced

1. Introduction

Various changes have been occurred in the societies due to the integration of the technologies in daily-life recently. The requirements of the “information-age” encourage and inspire the researchers and educators to modify the educational systems which lead to emergence of the new terms such as “Educational Technology”. Association for Educational Communication and Technology (AECT) (2001) defined “Educational Technology” as “*the theory and practice of design, development, utilization, management and evaluation of processes and resources for learning*” (AECT, 2001).

Technology-enhanced learning was considered from different aspects and various educational methods have been developed accordingly during the years (Duffy & Jonassen, 1991). The role of the technology was considered both in the process and materials of learning (Norman, 1993). Due to the rapid growth of technology, new types of learning such as electronic-learning (e-learning) and mobile-learning (m-learning) have emerged and led researchers to analyze the role of them in students’ learning outcome as well (Keller & Suzuli, 1988; Kramarski & Feldman, 2000; Fox, 2005). The importance of collaborative-learning was mentioned in the studies such as Nelson (1999), Jonassen (1999) and Reigeluth (2009). Nelson (1999) highlighted the effectiveness of collaborative-learning stating “... *cooperative learning is not usually conceived in the context of problem-based learning and problem-based learning does not always requires collaboration.*” (p.245). The effort among learners and instructors was emphasized to define the collaborative-learning in the study by Devilliers (2011). In addition, However, the study by Laurillard (2009) and Stahl, Koschman and Sutter (2006) considered collaborative-learning as a more students-centered learning while solving a problem. While the study by Algwil (2019) considered the role of group-work in providing easier learning in communicative language learning, the result of the study by Amini-Philips (2019) showed that students are not willing to collaboratively working with each other and it was assumed due to the competition among them. Nowadays, collaborative-learning are not limited to the classroom thanks to development of new technologies. The studies by Koschman (1996) Lu, Lajoie and Wiseman (2010) and Sung and Hwang (2013) addressed the computer-supported collaborative learning (CSCL). Moreover, collaboration and subsequently collaborative-learning are easier facilitated using mobile technologies in recent years. Easier connection and communication (Gil & Petterson, 2010), increased participation and material sharing (Hsu & Ching, 2013) and

(Jones, Scanlon & Clough, 2013), increased interaction among peers (Alvarez, Brown & Nussbaum, 2011) are the features that better provided by mobile technologies. Mobile inquiry-learning (Jones et al., 2013) ; collaborative-learning using mobile device (Alvarez et al., 2011; Alioon & Delialioglu, 2017) are also among the concepts that were investigated in terms of the use of mobile technologies in collaborative-learning domains.

Motivation was defined emphasizing its various aspects in different studies. In the study by Bern (2006) (as cited in Pew, 2007, p.14) the effort spent on achieving goal considered for defining the motivation while Pew (2007) focused on intrinsic motivation and Ciampa (2013) related the motivation to the reward and outcomes The motivated strategies for learning (MSLQ) by Pintrich and De Groot (1990) were developed based on the expectancy-value model. In this study, students' motivational level was analyzed using MSLQ.

The role of the diverse technologies in terms of the motivation was analyzed in the studies such as Keller (2008) which considered the principles affecting students' motivation in technology-enhanced education. The study by Giesberg, Reinties, Tempelaar and Gijssels (2013) reveal that the use of the richer communicational tools result in the higher autonomous motivation. The study by Huang et al. (2010) focused on digital game-based learning in which the relationship between motivational processing and outcome processing was revealed and validated. However, in the study by Liu and Chu (2010) learners expressed their willingness to non-gaming instruction using mobile technologies.

1.1 The Purpose of the Study

Various studies showed the effect and importance of the collaborative learning on students' motivations which are mentioned in the previous section. In addition, the role of technologies specially computerized ones was analyzed in terms of collaborative learning. Moreover, the results of different studies showed the effect of collaboration as well as technology-enhanced learning on the level of students' motivation. However, the role of collaborative-learning using technological tools emphasizing computerized tools has not been fully addressed yet. Moreover, the effect of group-work on students' motivation was not considered using technological equipment. In addition, the role of collaborative-learning in decreasing the anxiety level of student as the category of motivation has not been completely investigated yet. Therefore, this study aims to investigate students' motivational level in collaborative-learning environment enhanced with technologies. In the current study, the role of

collaborative-learning and group-work using computerized tool on students' motivation was analyzed. Thus, collaborative technology-enhanced activities were developed for two courses (i.e. Algorithm Calculation and Computer Workshops) and implemented in the two consecutive semesters. The effect of the activities on students' motivation was analyzed. The results of this study may shed light on easier developing and implementing collaborative-learning setting enhanced by computerized technologies. The research questions that the study attempts to answer are as follows:

1. To what extent do the collaborative technology-enhanced activities have an effect on undergraduate students' motivational level?
2. Are there significant differences among undergraduate students' motivational level from different subject-disciplines regarding the use of the collaborative technology-enhanced activities?

2. Methodology

The effect of the collaborative technology-enhanced activities on students' motivational level was investigated using mixed-method research design model. The activities were implemented in Algorithm Calculation courses and Computer Workshop courses in fall semester of 2017 and spring semesters of 2018 respectively. Quantitative data collection as well as qualitative ones was carried out in the study which is shown in detail in the following sections.

2.1 Procedure

The study was conducted in Algorithm Calculation course for Medical engineering students as well as Computer Workshop course for computer and Information Technology (IT) engineering students. In the latter one, students were registered and enrolled in the same class because the Computer Workshop course is the same for both computer and IT subject-disciplines. First, students were requested to be grouped in two or three members for conducting the activities. They needed to find a topic related to the specific part of the course and prepared a document for the topic using a computerized tool. The activities were done in collaboration with each other as well as each member was supposed to present the part of the document with the help of the used devices. The students were expected to complete the activities in collaboration with each other while submitted and presented only one document as the final document. Students were graded on their activities so had a chance to follow their progress. While

conducting the activities students were received feedback from their instructor which enabled them to follow more structured way for completing the activities.

2.2 Participants of the Study

Third grade undergraduate students from three subject disciplines (i.e. Medical, Computer and IT engineering) in fall semester of 2017 and spring semester of 2018 in a public university were participated in the study. 81 students who were distributed in three aforementioned subject-disciplines were participated in the study (i.e. 24 Medical engineering, 30, 27 students from Computer and IT engineering) respectively. The age-range of female and male students was 18-25. 2 or 3 students were in each group.

2.3 Data Collection Instruments

1. Motivated Strategies for Learning Questionnaire (MSLQ)

The questionnaire was adapted from the Motivated Strategies for Learning Questionnaire (MSLQ) by Pintrich and De Groot (1990) and used for collecting data on students' motivational level. The questionnaire included 44 questions in five categories: Self-efficacy, intrinsic-value, test anxiety, cognitive strategy use and self-regulation. 7 point Likert scale was used to score the items (1= not at all true of me to 7=very true of me).

2. Interview Protocol

Interview protocol was used for collecting data on students' opinion on the effect of the activities on students' motivation. The validity of the questions was checked by three subject-field experts and piloted with seven students. The questions in the interview protocol were classified into students' opinion 1) on learning the courses content using the activities 2) the role of the activities on changing the students' attitudes toward course content. In the follow-up interviews, 19 students from three subject-disciplines were chosen in order to have representative from all aforementioned subject-disciplines.

2.4 Data Analysis

Both quantitative and qualitative analyses were carried out in the study. In terms of quantitative analysis, descriptive statistics and inferential statistics using sample t-test was used to find out the effect of the collaborative technology-enhanced activities on motivational level of students and conventional content analysis was conducted on qualitative data.

3. Results

In order to answer the first research question in terms of the effect of the activities on students' motivation, descriptive statistics and paired sample t-test were conducted to compare students' level of motivation in the beginning and the end of the semesters for three different subject-disciplines. A between-group analysis could not be carried out due to differences in the course content in each class. The normality test was conducted prior to analyses which indicated that the distributions were normal at the significance level of $p > 0.001$. The paired sample t-test for the subject-discipline of IT engineering is represented in table 1.

Table 1: Paired Samples t-test for IT Engineering Students

Pairs		M	SD	t	df	P
Pair 1	selfefficiency1	-1.24	.97	-6.664	26	.000
	selfefficiency2					
Pair 2	intrinsicvalue1	-3.87	.57	-35.39	26	.000
	intrinsicvalue2					
Pair 3	testanxiety1	2.77	1.08	13.34	26	.000
	testanxiety2					
Pair 4	cognitivestrategy1	-3.05	.61	-25.84	26	.000
	cognitivestrategy2					
Pair 5	selfregulation1	-1.15	.81	-7.41	26	.000
	selfregulation2					

The 27 students whose majors were IT engineering enrolled in Computer Workshop class. The paired sample t-test on data collected using MSLQ indicated that there is a significant difference in all five categories of motivational level at the beginning and the end of the semesters. The analyses showed that the highest mean score belongs to "intrinsic value" ($M=6.36$, $SD=.29$) which is followed by "cognitive strategy use" ($M=5.86$, $SD=.41$). In addition, there is a decrease in their level of test-anxiety after implementation of the activities ($M=2.58$, $SD=.72$) in comparison with their anxiety level before using the activities ($M=5.34$, $SD=.81$). Sample t-test was conducted on 30 computer engineering students who registered for Computer Workshop class in spring semester 2018. Normality check for distribution revealed that the distribution was

normal at the significance level of $p > .001$. The analyses showed that the activities had an effect on five categories of motivational indicators which are used in MSLQ and shown on table 2.

Table 2: Paired Samples t-test for Computer Engineering Students

<i>Pairs</i>		<i>M</i>	<i>SD</i>	<i>t</i>	<i>df</i>	<i>P</i>
Pair 1	selfefficiency1	-1.37	.82	-9.13	29	.000
	selfefficiency2					
Pair 2	intrinsicvalue1	-3.92	.58	-37.07	29	.000
	intrinsicvalue2					
Pair 3	testanxiety1	2.52	.95	14.49	29	.000
	testanxiety2					
Pair 4	cognitivestrategy1	-2.87	.59	-26.53	29	.000
	cognitivestrategy2					
Pair 5	selfregulation1	-1.25	.56	-12.25	29	.000
	selfregulation2					

Regarding the Medical engineering students whose number were 24 and enrolled in Algorithm Calculation course in fall semester of 2017 data were also collected using MSLQ. Prior to using paired sample t-test, normality check at significance level of $p > .001$ was carried out which indicated that the distribution was normal. The paired sample t-test revealed that the activities had an effect on all five categories of the motivation in MSLQ which is represented in table 3.

Table 3: Paired Samples Test for Medical Engineering Students

Pairs		M	SD	t	df	sig
Pair 1	selfefficiency1	-1.48	.59	-12.24	23	.000
	selfefficiency2					
Pair 2	intrinsicvalue1	-4.19	.47	-43.36	23	.000
	intrinsicvalue2					
Pair 3	testanxiety1	2.35	1.13	10.20	23	.000
	testanxiety2					
Pair 4	cognitivestrategy1	-2.91	.56	-25.31	23	.000
	cognitivestrategy2					
Pair 5	selfregulation1	-1.48	.47	-15.44	23	.000
	selfregulation2					

“intrinsic-value” ($M=6.47$, $SD=.22$) was the category with highest mean score as well as the “cognitive strategy use” is the category with the second highest mean score ($M=5.77$, $SD=.42$). The least mean score belongs to the “test-anxiety” ($M=2.81$, $SD=.66$) at the end of the semester revealing that the use of the activities decreased students level of anxiety.

Students from three subject-disciplines (i.e. IT, Computer and Medical engineering) were interviewed using the interview protocol. The analysis showed that used method helped students to better learning of the course content while encouraging them to find extra and relevant information about different parts of the course. “*The activities helped us to learn the applicability and use of the course content.*” were among expressed sentences by students. The students added that “*since we needed to prepare a presentation and document for the conducted activities, we study the course content carefully.*”

Students explained that “searching and finding” relevant information about the course helped them to understand the course content in an easier way while making the course more interesting for them. Moreover, students believed that preparing and presenting the materials as a group helped them to discuss the content with each other, so increases their collaboration. Three themes which were emerged based on students’ answers to interview questions are (1)

“group-work” (2) “working together” and “helpful”. Furthermore, students believed that preparing the presentation and document as a group decreased their level of stress as they mentioned “*find answers for the question together was easier*” and “*solving the problems were easier*” and “*It was helpful to work together*”. Students also expressed their satisfaction toward using the computerized devices while preparing the document. They believed that the devices facilitated their communication and emphasized on the role of mobile applications in terms of easier material-sharing and collaboration. Content analyses on the students’ interview transcripts showed that “mobile applications”, “video calls”, “easier material-sharing” and “easier communication” are among the most frequently expressed phrases by students in this regard.

The second research question addresses the differences among students’ motivational level from different subject-disciplines regarding the use of the activities. In order to answer this question the acquired results from different subject-disciplines were compared. The comparison of the results revealed that the activities helped to decrease the level of stress and anxiety for students in three subject-disciplines which also explained by students themselves emphasizing on the role of the group-work. The results indicated the effect and importance of the instructional method in terms of motivation. However, due to the similarities in the selected subject-disciplines which were all engineering, the results of the study could be carefully generalized. The similar researches are needed to be conducted in various courses in the future.

4. Conclusion

In this study, the effect of the activities on students’ motivation was investigated. Collaborative technology-enhanced activities were implemented for Algorithm Calculation and Computer Workshop courses in two consecutive semesters. In the activities, students were expected to investigate the topic related to their course content and present their works using relevant computerized educational technologies in a group.

The result of the study indicated that the students’ “intrinsic-value”, “cognitive strategy use” have increased using the activities respectively in three aforementioned subject-disciplines. Furthermore, students’ anxiety level has decreased after implementing the activities in this study. Therefore, it can be considered as one of the advantages of the used activities in the current study. They mentioned that the activities help them to better understanding of the course content as long as they were supposed to search and find relevant information about the course

information. The results of the study shares similar outcomes with the study by Hsu and Ching (2013) in terms of understanding the concepts and used technologies.

The results of the study were in-lined with the findings of the research by Jones et al. (2013) regarding the used instructional method and their effect on students' motivation. Students believed that using the activities increased their collaboration with their peers. They also believed that different communicational tools especially mobile devices and technologies provided easier communication and material-sharing that resulted in better collaboration which are similar to the outcomes of the studies by Gil and Pettesson (2010) , Hsu and Ching (2013), Jones, Scanlon and Cloung (2013), Wang, Rose and Chang (2011) and Alioon and Delialioglu (2017). Nevertheless, the results of the study are needed to be generalized with cautions due to the limitations that the study has.

4.1 Limitation of the Study

Firstly, the limited numbers of students (i.e. 81 students) were participated in this study that was registered in three different subject-disciplines.

Secondly, the activities were only developed for two technical courses. Thus, different results might be achieved in the courses with different course contents rather than technical ones.

4.2 Suggestion for the Future Research

Since it was mention in the previous section as the limitation of this study, the future studies could consider developing the similar activities for various courses with different content without technical approach and background.

Moreover, specific learning software or mobile applications can be used for implementing similar types of activities in the future studies. Using specific application may provide more structured method for students in terms of doing activities while facilitating their collaboration and communications with peers and instructor.

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