

UTILIZATION OF INFORMATION AND COMMUNICATION TECHNOLOGIES IN MATHEMATICS LEARNING

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Abstract

Attention to integrate technology in teaching and learning has provided a major transformation in the landscape of education. Therefore, many innovations in teaching and learning have been technology-driven. The study attempted to examine what is engineering students' perception regarding the use of Information and Communication Technologies (ICT) in mathematics learning as well as investigate their opinion about how ICT can be integrated to improve teaching and learning processes. The subjects were Iranian engineering students from two universities. The finding showed they are fully aware of importance of ICT in teaching and learning mathematics. Whilst, they were feeling comfortable and confident with technology, they do not have more experience of using technology in mathematics classes before. The findings supported the other studies, which indicated the potentials of ICT to facilitate students' learning, improve teaching, and enhance institutional administration as established in the literature.

Keywords: Technology, Mathematics Learning, Facebook, Attitude Toward ICT

Abstrak

Perhatian untuk mengintegrasikan teknologi dalam proses belajar mengajar telah memberikan transformasi besar dalam dunia pendidikan. Oleh karena itu, banyak inovasi dalam proses belajar mengajar yang telah berbasis teknologi. Penelitian ini berusaha untuk melihat bagaimana persepsi mahasiswa teknik tentang penggunaan Teknologi Informasi dan Komunikasi (TIK) dalam pembelajaran matematika serta menyelidiki pendapat mereka tentang bagaimana TIK dapat diintegrasikan untuk meningkatkan proses belajar mengajar. Subyek dalam penelitian ini adalah mahasiswa teknik asal Iran yang berasal dari dua universitas. Temuan ini menunjukkan bahwa mereka sepenuhnya menyadari pentingnya TIK dalam proses belajar mengajar matematika. Selain itu, mereka juga merasa nyaman dan percaya diri dengan teknologi, mereka tidak memiliki pengalaman yang lebih dalam penggunaan teknologi di kelas matematika sebelumnya. Temuan ini mendukung penelitian lain yang menunjukkan potensi TIK dalam memfasilitasi belajar siswa, meningkatkan pengajaran, dan administrasi kelembagaan sebagaimana yang ditetapkan dalam literatur.

Kata Kunci: Teknologi, Pembelajaran Matematika, Facebook, Sikap Terhadap ICT

In this decade the use of computers and technology have grown tremendously in all aspects of our life specially in education. For the past decades, attention to integrate computer and technology has increased, especially in the education system. Although, finding appropriate pedagogical methods are required to cope with these new challenges in educational institutions (Hakkarainen et al., 2000). Since, the new information and communication technologies (ICT) have being properly skilled and used, they could performance an principal tools for improving students' skills specially by collaborating and working productively with knowledge. In general, these tools have effective role on

restructuring of teaching learning processes. Such skills have impact even outside of technical, subject areas. Skills of using ICT necessary in our emerging, knowledge society involve the ability to solve increasingly complex problems in a variety of knowledge-rich domains, participate in knowledge work as well as engage in various networked activities. Computer as an educational tool can support and supply good opportunity for learners in their learning. Even though many educators have supported the enrichment of learning by computer and technology (Hoffner, 2007; O'Bannon & Puckett, 2006) but others are worried about the influence of technology integration in classrooms (Cummins, 1996; Drier, 2001).

With a focus on the new opportunity for teaching and consequences of technology usage in math classes, the National Council of Teachers of Mathematics (NCTM) has stated, "Technology is essential in teaching and learning mathematics; it influences the mathematics that is taught and enhances students' learning" (NCTM, 2008). Throughout the late 1970s and early 80s, technology training in mathematics education began with the computer science establishment, but due to the lack of hardware in the public school system, there were a little transfer of these training tools into the classroom (Anderson, 1996). It is accepted that technology has been a key aspect of mathematics education for several decades, but its role and use continues to be subjected to the controversy and debate amongst mathematics educators and mathematicians. However, the focus still remained on literacy rather than instructional strategy (Glenn, 2001). Since, some of students usually become discouraged and easily bored in the mathematics classes, Biasi and Domenici (2014), highlighted the advantage of technology as a tool in teaching and learning process. Based on findings from numerous research studies, NCTM emphasizes that students can learn more mathematics deeply through the effective integration of technology into instruction.

What is the importance of investigating into students' insight on the use of technology? Even though, the ICT may promote educational change (Woodrow, 1987), the effective use of technology is truly dependent on the classroom teachers (NCTM, 2008) and how students can access to the new technologies and encourage to use them as learning tools. Several studies indicated that using technology effectively as a learning tool improves students' mathematics achievement and motivates students to learn mathematics and science (Tarmizi, Ayub & Bakar, 2008; Ng & Gunstone, 2002; Nugent, Soh, & Samal, 2006; Shyu, 2000). Further, it is important that students and teachers have sufficient skills in productively using and working with ICT. Montgomery (2013) pointing out that the lack of mathematics laboratory and competent teachers in this field as the most influential factors adversely affect the students' mathematics achievement.

It is clear that among the university students, engineering students need a deep concept of knowing mathematics. By way of using ICT as a pedagogical tool, value of ICT requires a careful examination of the current practices of using ICT in universities. Whilst many studies reported importance of using technology to enhance mathematics achievement, and attitude (Cheung, & Slavin, 2013; Hossain, & Quinn, 2013; Pilli, & Aksu, 2012), providing the basic infrastructure in supporting

of ICT application towards growing the research and academic activities in Iranian universities are the top priorities for the Ministry of Science, Research and Technology (MSRT) (Vajargah, Jahani, & Azadmanesh, 2010). As ICT have originated and established in developed countries, their implementation in developing countries may encounter some difficulties due to teachers' and students' perceptions about the computer usefulness. Computer usefulness refers to the degree of students' perceived usefulness of using computers for their present and future work (Loyd & Gressard, 1984). For example "I will use computers in many ways in my life." This subscale also is known as a cognitive component of attitude (Zimbardo, 1969) which consists of "a person's evaluation of, liking of, or emotional response to some object or person". The purpose of this study was to examine whether students have positive opinion and attitude toward using technology in their mathematics classroom. The following research questions guide this research study:

1. What are the engineering students' attitudes toward usefulness of ICT in learning?
2. Do the engineering students adapt well to the use of computers or Internet resources in learning mathematics?
3. Do the engineering students perceive technology as an important tool in enhancing mathematics learning?

METHOD

The participants were 118 undergraduate engineering students who took Calculus I at two universities in Iran (a private, and a public university). The selected participants were two classes consisting of 84 engineering students at the private university (from approximately 12 classes), and one classe at Public university made up of 34 students as well. In this study, the instrument for data collection was a questionnaire along with a focus group interview. The quantitive part of study was conducted by a questionnaire, attitude toward usefulness of ICT. Attitude toward usefulness of ICT was included the 10 items of a components called "Measures of Computer Usefulness" based on the Loyd and Gressard Computer Attitude Survey (1984) (CAS). For each item, a five point Likert scale allowed respondents to choose five levels of agreement, that is, "strongly disagree", "disagree", "neutral", "agree", and "strongly agree" to describe their attitude toward ICT. Then, for scoring purposes each word was assigned a numerical value as 1= strongly disagree, to 5=strongly agree. The reliability coeffieicents, Cronbach's alpha for the scale used in this research was 0.86. The measured reliability indicates a high reliability (DeVellis, 2011; Nunnally, 2010), hence, It is allowing the researchers to describe the participants attitude toward usefulness of computer in mathematics classroom.

For interview section, the researcher used Facebook as a social media platform. The 21 students (17 male and four female) consented to participate. This section focused on prior exposure and skill of students with ICT included computer and Internet-based resources, and software in mathematics learning, and their opinion on the importance of integrating ICT in the mathematics classroom.

Facebook page designed for this interview to provide friendly and open responses among the students. It also provides superior opportunity for the interviewer to connect with respondents since all respondents were friendly in this virtual space. During the interview, the question was posted on the wall and then respondents situate their answers or comments. During the Facebook communication, any divergent or unclear comments were responded by the interviewer so that the students were able to respond appropriately to each of the posted questions.

RESULTS AND DISCUSSION

In line with the widespread use of ICT, various investigations were carried out regarding attitudes toward ICT. This study has reported on a survey and a follow-up interview for investigating engineering students' attitudes toward ICT at two Iranian universities. The results are organized as follows. In the first section, we described students' attitude toward ICT (measures of computer usefulness). In the following section, the qualitative data of interviewing with some respondents were discussed through the three themes emerged representing the aspects of students' perception through utilization of technology in mathematics learning.

Students' Attitude Toward ICT (Measure of Computer Usefulness)

Table 1, the details of finding for each item are reported, these details are included the frequency and percentage of responses in each point, as well as the item's mean score and standard deviation. In general, the respondents have taken encouraging positive attitudes toward usefulness of computer and ICT integration into learning ($M=3.86$, $SD=0.34$). According to the 5-point scale, the participants' attitude toward ICT was approximately higher than the neutral trend.

Table 1. Student Attitude Toward ICT (Measure of Computer Usefulness)

Statement	Strongly Dis. Agree	Dis. Agree	Neutral	Agree	Strongly Agree	Mean & S.D.
1 I will use computers many ways in my life.	4 (3.39%)	5 (4.24%)	11 (9.32%)	75 (63.56%)	23 (19.49%)	$M=3.92$ $SD=0.87$
2 Learning about computers is a waste of time. (Reversed)	-	-	6 (5.08%)	54 (45.76%)	58 (49.15%)	$M=4.44$ $SD=0.59$
3 Learning about computers is worthwhile.	2 (1.96%)	5 (4.24%)	15 (12.71%)	78 (66.10%)	18 (15.25%)	$M=3.89$ $SD=0.77$
4 I'll need a firm mastery of computers for my future work.	18 (15.25%)	7 (5.93%)	25 (21.19%)	41 (34.75%)	27 (22.88%)	$M=3.44$ $SD=1.32$
5 I expect to have little use for computers in my daily life. (Reversed)	12 (10.17%)	3 (2.54%)	19 (16.10%)	45 (38.14%)	39 (33.05%)	$M=3.81$ $SD=1.21$
6 I can't think of any way that I	9	8	26	61	14	$M=3.53$

	will use computers in my career. (Reversed)	(7.63%)	(6.78%)	(22.03%)	(51.69%)	(11.86%)	SD=1.0 4
7	Knowing how to work with computers will increase my job possibilities.	7 (5.93%)	7 (5.93%)	28 (23.73%)	62 (52.54%)	14 (11.86%)	M=3.58 SD=0.9 8
8	Anything that a computer can be used for, I can do just as well some other way. (Reversed)	11 (9.32%)	4 (3.39%)	21 (17.80%)	71 (60.17%)	11 (9.32%)	M=3.57 SD=1.0 3
9	It is important to me to do well in computer classes.	1 (0.85%)	3 (2.54%)	7 (5.93%)	59 (50%)	48 (40.68%)	M=4.27 SD=0.7 6
10	Working with computers will not be important to me in my life's work. (Reversed)	2 (1.69%)	2 (1.69%)	9 (7.63%)	64 (54.24%)	41 (34.75%)	M=4.19 SD=0.7 8

In general, the obtained mean scores for all items are greater than 3 which means positive attitude toward ICT and computer usefulness. As the most frequent response, 78 persons (66.10%) stated “agree” with the statement which declare “Learning about computers is worthwhile”, while only a few (about 6%) were “disagree” or “strongly disagree” with this statement. The highest reported mean score corresponds to the statement no. 2 that learning about computers is not a waste of time (Mean=4.44, S.D=0.59). Furthermore, 96 out of 118 (81.35%) respondents considered learning computer as saving of time but also they referred that is valuable to learn computer. This outcome explains the students’ positive attitude toward learning computer. The statement responded with the lowest mean score (M=3.44, S.D=1.32) was asking if the students feel the need of a firm mastery of computers for their future work. However, the frequency of responses showed more than half of participants (68 of 118) were found that they need it for their future work.

In addition, all the findings showed that the students have felt confident in usefulness of computers, and the target group reported a positive attitude toward mathematics learning. The participants were aware of the importance of learning computer as well as the advantages of ICT in their future job.

Interviews by Facebook Interaction

While the students in this study were fully aware about advantages of ICT, this section was going to reveal more about their ICT experience in mathematics classroom. Web 2.0 focus group interview was conducted on Facebook as a social network, since majority of them mentioned they have the personal FB page. The interview protocol was focused on students’ view about using ICT in a mathematics classroom. The purpose was to examine whether students prefer to use technology in learning math in university and whether the lecturers must change their tradition teaching strategy. It was conducted in a conversational and informal method. In total the 21 freshman students' views were

captured and analyzed. Initial step taken by the interviewer was to categorize the students' views and thus three themes were gathered.

Students' Computer Skills

The first theme dwelt on students' previous computer skills in using computer and Internet-based resources. This theme was captured based on the following sample questions:

1. How long have you been using the computer?
2. Do you think the current students' generation is confident and well skilled in using technology?
3. What kinds of computer skills do you have?
4. How do you use computers and the Internet? What kind of activity do you do?

The focus group approach was used to probe students' technological know-how and their confidence. The majority of participants were using the computer and Internet to some great extent prior to starting their university course. Their skills and ability to carry out a variety of basic technological tasks was quite sufficient. One of the participants responded as p1 said *...he has been using computer since he was 9 years old*. Whereas the others noted that their use of computers was when they were about 12 or 15 years old. Most of them agreed that nowadays they have to *...deal with the Internet more than the past*. p2 said *... a lot of our university work must be done by internet, citing examples, such as semester registration, getting examination results, searching for the assignment, tasks, etc.* also they mentioned that they surf the Internet on the average of 3 to 4 hours daily. Three of them use the computer for programming purposes. In this case, P3 mentioned *...I can do programming by C++ software, and ... I usually use the computer just for doing my programming tasks or homework*. However, eight students (38.10%) reported that they just use the Internet. While three of them reported playing games and watching movies and listening music are their entertainments' activities by computer. In summary, the students utilize computers and the Internet for several purposes, academic and personal usage. Hence, they have assumed a significant role of these technological tools in their life.

Students' Opinion of Using Technology in Mathematics Classrooms

The second theme was based on students' opinion toward using Internet-based resources and software in mathematics classrooms. The following sample questions addressed this theme:

1. Do you think web-based resources are enjoyable and stimulating?
2. Do you like using technology in mathematics classrooms?
3. Did you have any experiences before?
4. How confident and comfortable do you feel about using technology in mathematics classes?

Pertaining to students' experience in using Internet resources, very few (only two) students reported that they had used mathematics' web-based resources for their classrooms. P4 said *...when I studied Calculus 1 during my first semester... moreover, I was surfing the net for sample questions*

about integral and its application and it was useful for me. In addition, only two of them have had experience about using technology in mathematics classes. P1 said... *I had good experience before; it could help me to enhance the Geometry understanding.*

The majority of the students (16 or 76.19%) indicated that using ICT in the mathematics classrooms would be very enjoyable for them. P5 responded... *I just feel it can help students to visualize the subjects in 3 dimensional spaces like surfaces in the triple integrals.* As the matter of fact, visualizing the area and surfaces in this kind of integrals is one of the major problems for freshman engineering students. P2 mentioned... *I think it's definitely enjoying and it can save time in the classroom and teacher can do more sample questions.* The others said they don't feel totally confident when their math teachers or lecturers use power point or other ICT tools in the class. They prefer to take part in a class with traditional methods. P6 said... *I can't accept to take part a math class that a lecturer use power point or some things like that.* P6 continues ...*I will sleep in this class...It is not an active class that I like.* These responses indicated that the majority seemed to be comfortable and confident with the idea of using technology in their mathematics classes.

Students' Perception about Learning with Technology

The third theme relates to the importance of technology in a mathematics classroom. The main probing questions were regarding their opinion on using technology and ICT in mathematics classrooms, as well as what suggestion they would offer to lecturers who are intense to pursue in using the technology in mathematics classes.

The respondents recognized a great number of educational opportunities by using technology, and explained some well-defined articulated beliefs. Twelve persons (51.14%) stated that computers and technology could be an important part in learning mathematics. They mentioned computers could be used as a main visualization tool in the mathematics classrooms. Some of the students reported that they are visual learners; hence the use of the computer is more useful than pen and paper for them. As an illustration P7 said... *I need to understand the concepts of mathematics, so if they use some tools to provide a visual 3D set and shapes then I can actually see it, and it's easier for me to realize the concepts.* In addition, during the interview all of the participants agree with this statement that the new generation is friendly with technology and especially computers. Most of them stated it is better if teachers use computers and software for teaching geometry and 3D spaces. Three of them mentioned if teachers want to use computers and ICT tools in the class, they should ensure that all tools work well, without any problem. P2 said ... *sometimes the ICT tools are not ready or they don't work property, so it takes time in the class.* In continuing P8 expressed ... *most teachers just use power point and bring their slides and show us, without any changes in their teaching strategy...furthermore, ...They just reduce their activities by using power point. It is not a good idea for teaching mathematics.*

In conclusion, the majority of students view computer as important instructional tools in a mathematics classroom. They indicated computers can provide a visualization of mathematical concepts, for instance the geometrical concepts, which are difficult to understand only by using paper

and pen, or chalk and board. However, a few of the students reported different fearful feeling on using technology in mathematics classes. They mentioned that they don't feel confident with any changes in mathematics traditional teaching methods and they argued that they cannot accept technology in the mathematics classroom. It seems this group of respondents does not have a comprehensive vision on technological tools. Since, as a non complete view of using technology, one of the students argued that technology in learning is using PowerPoint to show the slides, which may lead to reduce the students' activities during lectures in the class, and it is so boring.

CONCLUSION AND SUGGESTION

The finding of this study contributes to an understanding of engineering students' experiences, and opinion of undertaking technology in mathematics classes. The literature indicated the effectiveness of using technology as a learning tool to develop students' motivation and mathematics achievement (Ng & Gunstone, 2002; Nugent, Soh, & Samal, 2006; Shyu, 2000). However, the level of acceptance and competence in using these tools, fall largely upon the students and the instructors. The first session of the study was carried out to acquire preliminary information about the students' attitude toward learning mathematics. The findings identified their shared and reliable opinions, reporting that they do not have any serious problem or negative attitude in the mathematics classes. Hence, this finding to solicit their Internet and technological experiences are encouraging. Earlier studies supported that positive attitudes towards learning through technology were related to a higher level of computer experience (Dyck & Smither, 1996; Teo, 2008).

The importance of Internet and computer usage in mathematics learning was indicative of the students view for the positive role of technology in their life. The finding of interview stressed a large number of opportunities through the learning by technology. For instance, the finding indicated that technology can (a) provide a visual environment to enhance understanding 3D concepts, (b) use Internet resources to let students feel comfortable and confident in learning mathematics, and (c) apply different software as stimulating learning tools. National council of teachers mathematics, NCTM (2008) has indicated and highlighted the use of technology in teaching and learning mathematics, Whilst, the potentials of ICT to facilitate students' learning, and improve teaching have been established in several studies (e.g. Kazu & Yavuzalp, 2008; Kirschner & Davis, 2003). Moreover, Wepner et al. (2000) reported that computers can assist teachers and students find elder information, as well as the new information from thousands of websites on the Internet updated daily.

As a final point, whilst the literature supposed integrating ICT in education system as an avoidable trend, the policy of universities should pay more attention to make more advantages of ICT. For instance, the policy can facilitate teachers training regarding to how to apply ICT effectively in teaching and learning process. In the future research, it can be suggested to do an interview with mathematics lecturers who don't use technology in the mathematics classroom and investigate their opinion regarding this issue.

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