TRAINEE TEACHERS' ATTITUDES ABOUT MATERIALS AND TECHNOLOGY USE IN MATHEMATICS EDUCATION

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Abstract: This study is planned to determine mathematics trainee teachers' attitudes about technology and material use in mathematics education. The study is conducted with a self-developed questionnaire as a survey. The second part of the survey is a Likert Type Attitude Scale which contains 31 items. Sample is a total of 125 students from a primary teacher training department. This paper includes findings from the scale. Descriptive statistical techniques (f, %,) were used to analyze collected data for the sample. The results show that the trainee teachers' attitudes are quite positive about materials and technology use in mathematics education. They stated that they are going to use the technology and materials in their professional mathematics teaching as well.

1. Background

Along with new developments, technology effect education in all areas in all levels. Thus, it pushes and forces educationalist to integrate and use technology with sufficient materials in all areas of educational process including teaching and learning of mathematics. The use of materials and technology is definitely connected with pedagogical considerations both in teaching and learning mathematics. The considerations have to focus on cognitive dimensions of mathematics education and effective materials and technology (usually computer and educational software) use in action (Monaghan, 1993, 2004). Also their effects on students' learning, achievements and affective dimensions have to be highlighted.

Relevant literature emphasize that affective qualities (values, beliefs, views and attitudes) are as much as important as cognitive and psychomotor qualities for integration of technology with education (Kadijevich et. al. 2005). In this sense, teachers' (and trainee teachers) attitudes and views are important factors on teaching and learning process. They have a power to effect learning either positive or negative ways. Attitude may be considered as physiological structure that has effects in cognitive, affective and behavioral dimensions. Since the beginning, technology and material course, helping improving cognitive aspects and enhancing the creativity of the individuals, has been taken part of elementary school education in Turkey. The students may gain knowledge, skills for process and attitudes during mathematics learning process.

Teacher training is one of the most critical components for the successful implementation of technology and computer in schools. However, preparing teachers to use technology appropriately is a complex task for teacher educators. Garofalo et al. (2000) underline the fact that adoption of technology by teachers requires professional development that focuses on both conceptual and pedagogical issues, ongoing support in terms of intensive start-up assistance and regular follow-up activities. Teachers' attitude is an important affective dimension which indicates their beliefs, perceptions, views, motivations, anxiety and avoidances about computer, technology and mathematics. If trainee teachers have demonstrated proficiency with the integration of technology into their teaching, but do not believe that technology has a use in the classroom, they will probably

avoid teaching with technology. In this respect, attitudes and beliefs about teaching with and about technology in mathematics could exclude well-planned teaching in teacher training. On the other hand, trainee teachers who believe in the potential and utility of technology in the classroom may persevere through the many challenges that face novice technology users and become models for students to follow. Therefore, trainee teachers' understandings, explorations, views, attitudes, uses and reflections of the subjects on a new technology are important. These consequences may have important implications for mathematics education as well.

Some of earlier literature on technology and pre-service teacher education indicates that teacher training programs were not adequately preparing their graduates to teach with technology (Strudler and Wetzel, 1999; Thurston et al, 1997) and they had not fully integrated technology into their programs for preparing teachers (Wang et al., 2003). It has been found that most teachers do not necessarily see technology as part of their teaching programs (Campell et al., 2000). Several studies usually concluded that many teachers, in particular primary school teachers, need assistance to clarify and reflect on their own perceptions about technology. However, the changing or broadening of teachers' views about the disciplines is proving to be a difficult task all over the world and there is a dearth of research regarding this issue in relation to technology (Wang et al., 2003). All these findings portray a much more different picture than what is expected from colleges of education in terms of equipping tomorrow's teachers with the required technology skills.

On the other hand, many recent literatures show that new developments and considerations are highly appreciated all over the world. The Technology Principle of the NCTM (Principles and Standards for School Mathematics, 2000) identified the "Technology Principle" as one of the six principles of high quality mathematics education and has guidelines and supports about the use of technology. In the 'Principles and Standards of School Mathematics', it is stated that "Technology is essential in the teaching and learning of mathematics; it influences the mathematics that is taught and enhances students' learning (p. 24)" and "Teachers should use technology to enhance their students learning opportunities by selecting or creating mathematical tasks that take advantage of what technology can do efficiently, well-graphing, visualizing, and computing (p. 25)". Furthermore, NCTM suggests that appropriate use of technology can facilitate such applications by providing ready access to real data and information, making the inclusion of mathematics topics useful for applications and to be more practical (e.g., regression and recursion), and making it easier for teachers and students to bring together multiple representations of mathematics topics (NCTM, 2000). It is pointed out that mathematics teachers, not technological tools, are the key change agents in bringing about reform in mathematics teaching with technology (Kaput, 1992; NCTM, 2000).

NCATE (2008) highlights and sets standards very clearly that teacher education programs should "… prepare candidates who can integrate technology into instruction, to enhance student learning (p.4) and "… be able to integrate technology into instruction effectively (p.4)." Thus, the teachers present the content to students in challenging, clear, and compelling ways, using real-world contexts and integrating technology appropriately; and uses technology in their practices in order to plan, instruct and support students' learning. Therefore, the main purpose of using technology in teacher education is to promote an effective teaching and improved student learning. Thus, training of teachers with appropriate and sufficient proficiency is very important. Trainee teachers do not only need to learn how to use computers (or technology), but also how to incorporate computer when teaching. Thereby, pre-service teachers' attitudes and experiences would seem to be important in determining the willingness and preparedness of teachers with professional development opportunities and increasing the effective implementation of computer and IT in classrooms.

Christensen (1998) stresses that the successful use of computers in the classroom depends on the teachers' attitudes towards computers, identifying teachers' attitudes as well as expertise in using computers, are the major factors in the adoption of computers into classrooms. Although teachers' attitudes have not typically been considered in the introduction of computers into the classroom, future successful implementation will need to address teachers' attitudes toward computers. According to a research study which examines the relationship between teacher attitudes and computer skills, it is critical that teachers possess both positive attitudes and adequate computer literacy skills in the successfully incorporate technology into the classroom (Christensen, 1998). Similarly, Mumtaz (2000) reports that teachers who successfully make use of IT, had a positive rather than negative attitude towards IT. Teachers who have positive attitudes towards IT itself will be positively disposed towards using it in the classroom. In this context, there are so-called Educational Technology Standards, which could be taken as relevant indicators as regards how well technology has been involved in educational programmes (Kadijevich,et. al. 2005).

The above conclusions are paralleled in mathematics education as well. It is clear that students' understanding of the nature of mathematics can influence how they think and learn about mathematics and teachers' views of mathematics can influence the way they teach mathematics. It seems to be important for pre-service teachers to develop perceptions of mathematics that are in accordance with technology. This new perception has forced mathematics education authorities to switch the direction of teacher training towards the new changes. For example, the use of technology in mathematics teaching is not for the purpose of teaching about the computer, but for the purpose of enhancing mathematics teaching and learning with computer (Garofalo et al., 2000). They express that teachers who learn to use technology while exploring relevant mathematics topics are more likely to discover its potential benefits and use it in their subsequent teaching. Moreover, there are studies to suggest that integrating progressive technology as a part of students' pedagogical thinking can shift student profiles (Haapasalo & Eronen, 2010). In his study Haapasalo (2007) examined teacher's interest to achieve educational technology standards (Interest) in terms of professional support to achieve these standards offered to him/her by his/her faculty (Support), his/her computer attitude (Attitude) and total computer experience (Experience). It was found that (a) Support was considerably below Interest; (b) Support was not related to any of the remaining three variables; (c) Interest was directly influenced mainly by Attitude that was only shaped by Experience. He also examined implications for teacher education.

These reflections are also echoed in Turkey as well. More recently, Ministry of National Education (MEB, 2007) has changed primary mathematics curriculum. Introduction part of the new curriculum starts with the stress rapid developments in technology and its effects on teaching, learning and communicating mathematics. It highlights the consequence of the technology stressing the importance of estimation and problem solving (MEB, 2007, p.7). The following pages continue to highlight competency on using information technologies for searching, receiving, processing, analyzing, evaluating and presenting knowledge (p. 12). Particularly, it mandates effective use of technology and refers to new opportunities that technology serves for mathematics education nowadays; including materials, calculators and computers. It points out the importance of software, internet and other interactive programs and addresses some of them (ibid, 24 -25). Furthermore, it associates the use of calculator and computer with other abilities such as psychomotor skills (p. 22). All of these concerns address the necessary, formal and compulsory use of technology for the primary mathematics teachers.

Theoretical framework

In this context, Koehler and Mishra (2005) offer a perspective that considers the development of Technological Pedagogical Content Knowledge (TPACK, or formerly TPCK). They claim that their approach toward technology integration values rich knowledge about how technology, pedagogy, and content interact with one another. They stated that "for teachers to become fluent with educational technology, means going beyond mere competence with the latest tools, to developing an understanding of the complex web of relationships between users, technologies, practices, and tools (p.132)." Thus, they view technology as a knowledge system that comes with its own biases, and affordances that make some technologies more applicable in some situations than others. They view teachers' knowledge about technology as important, but not separate and unrelated from contexts of teaching, that is, it is not only about what technology can do, but also, and perhaps more importantly, what technology can do for them as teachers.

Consistent with this situated view of technology, they have proposed a framework describing teachers' understanding of the complex interplay between technology, content, and pedagogy. They have built a framework describing Pedagogical Content Knowledge and to highlight the importance of 'Technological Pedagogical Content Knowledge' (TPACK) for understanding effective teaching with technology. At the core of their framework (Figure 1), there are three areas of knowledge: Content, Pedagogy and Technology. "Content (C) is the subject matter that is to be learned/taught, for example; … high school mathematics…. 'Technology' (T) encompasses modern technologies such as computers, the Internet, digital video, and more commonplace technologies including; overhead projectors, blackboards, and books… 'Pedagogy' (P) describes the collected practices, processes, strategies, procedures, and methods of teaching and learning. It also includes knowledge about the aims of instruction, assessment, and student learning (p. 133)."

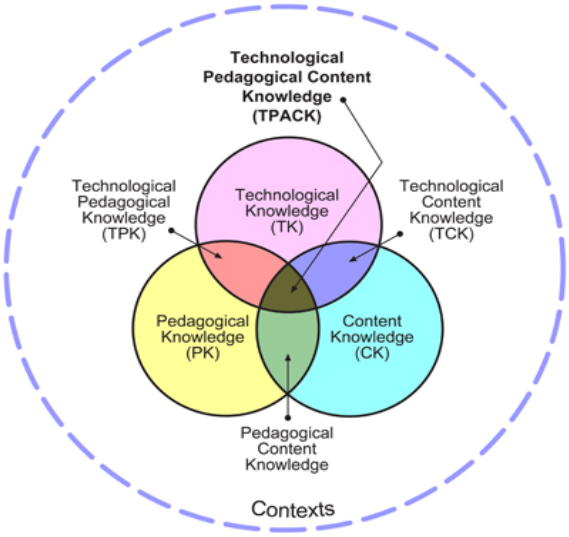

Figure 1. The TPACK framework (Koehler and Mishra, 2008).

However, they demand that their approach goes beyond seeing content, pedagogy, and technology as being useful constructs in and of themselves. They insist that their approach emphasizes the connections and interactions between these three elements. "Good teaching is not simply adding technology to the existing teaching and content domain. Rather, the introduction of

technology causes the representation of new concepts and requires the development of sensitivity to the dynamic and transactional relationship between all three components suggested by the TPACK framework" (p.134).

Aim of the study: The specific aim of this paper is to investigate the mathematics trainee teachers' attitudes towards the use of materials and technology in mathematics education. It also aims to draw implications for pre-service (and in-service) teacher education.

2. Method

The study is conducted with a self-developed questionnaire as a survey. The instrument comprises of three parts. First part is consisted a list of twenty six available groups of materials and technology which can be used in teaching and learning of mathematics nowadays. The second part is a Likert Type Attitude Scale. It was a 1 - 4 scale inventory (in which 1 stands for ''definitely agree'', and 4 for ''definitely disagree''). The final version consisted of thirty one items assessing the students' opinions regarding the extent to which the materials and technology affect several aspects of the educational process, particularly learning and teaching of mathematics. The items measure how well each stated objective is being met based on students' perceptions of their current experience. It is believed that items are most appropriate for the undergraduate level where students have the experience and knowledge needed to accurately assess the importance of particular learning objectives. A total of 18 statements in the scale are positively phrased. The other 13 statements are negatively phrased, so disagreeing with them is considered as a positive attitude. The third part of the questionnaire has a single open-ended question about the trainee teachers' views on the use of materials and technology in mathematics.

The set of 31 items was tested for reliability using an internal consistency method which yielded reliability coefficients of $\alpha = 0.84$. The value is higher than the 0.80 criterion which is regarded as internally reliable (Bryman and Cramer, 1997, p.63).

The analysis is based on an empirical study with students as the main informants. The authors starting point is an interest in understanding student learning from the perspective of students. The empirical material is from a primary mathematics teacher training departments. The questionnaire was administered to the students at the end of academic year. The sample is made up of a total of 125 students (84 female and 41 male). All students were in face-to-face contexts. Therefore, the researcher explained how to complete the questionnaire to reduce any misunderstandings and to ensure high response rate. One important limitation of this study lies in its phenomenological nature; the impacts described here are based primarily on students' responses.

This paper reports quantitative analyses results of the second part (31 Likert Scale type questions) of the survey. The collected data were mainly analyzed using quantitative descriptive statistical techniques. Descriptive analyses included percentages, means, standard deviations and frequency distributions.

3. Results

The results section presents the main findings of the survey which reflects trainee teachers' attitudes about materials and technology use in mathematics. Tables 1- 4 present the primary mathematics trainee teachers' overall responses to the 31 Likert type items about computer. The

tables list the items (translated from the original Turkish) in order of level of agreement, not in the order in which the items were presented in the questionnaire. Some statements are negatively phrased, so disagreeing with them is a positive statement about the use of computers. The results reveal that the Turkish pre-service mathematics teachers' attitudes about materials and technology use in mathematics are varied. Percentages show agreement level of the students with various aspects of materials and technology use in mathematics education. Last columns in the tables give a clear result in the form of mean scores. Mean scores here are considered at intervals as:

$1.00 \leq \bar{x} \leq 1.74$; "definitely adequate", $1.75 \leq \bar{x} \leq 2.49$; "adequate",
$2.50 \leq \bar{x} \leq 3.24$; "inadequate", $3.25 \leq \bar{x} \leq 4.00$; "definitely inadequate

Definitely agreement: The trainee teachers definitely agree with four statements (Table 1). They definitely agree that *"Using materials and technology can make it easier, when students had difficulty in understanding the issues or facts in maths subjects"*. They believe that "*the importance of material and technology use gradually improves in education"*. Majority of them definitely agree that *"Using materials and technology in mathematics are interesting"*. They also "*like using materials and technology in mathematics"*. Nearly all of the trainee teachers are very aware of materials and technology contribution to mathematics education. Furthermore, they like using materials and technology in mathematics. Only a smaller percent of the pre-service teachers disagree with these statements.

Table 1: Definitely agreed statements in the scale (%).

	Definitely Agree	**Agree**	**Disagree**	**Definitely Disagree**	$\bar{x}$	S_x
Using materials and technology can make it easier, when students had difficulty in understanding the issues or facts in maths subjects	51,2	43,0	3,3	2,5	1,57	,681
I believe that the importance of materials and technology use gradually improves in education.	38,0	55,4	5,8	,8	1,69	,617
Using materials and technology in mathematics are interesting.	36,3	58,1	4,8	,8	1,70	,598
I like using materials and technology in mathematics.	38,4	55,2	4,8	1,6	1,70	,638

Agreement: The trainee teachers agreed with half of the statement (total of fifteen) in the scale (Table 2). They *will do their best to use materials and technology in mathematics*. They *will spend more efforts to be better to use material and technology in mathematics*. They think that *teaching practices and experiences during their training avail their professional teaching*. Similarly, they think that *the use of computer and technology will have an important place in their professional teaching*. They see this opportunity as an important indication of being a successful mathematics teacher.

The trainee teachers are enthusiastic and ready to use materials and technology in mathematics education. They *feel comfortable when dealing with an activity related to mathematics* and they are sure that *they will be successful in using materials and technology*. The trainee teachers want *mathematics teachers' cooperation about technology*. Most of the trainee teachers are ambitious about receiving more mathematical experiences with technology during their training; *more activities, materials and technology which can be included in mathematics classes*. They believe that *all mathematics teachers should use technology*. They also believe possible *advantages of using Internet in teaching mathematics*. They declare possible enhancements of individual mathematics learning with the opportunities of technology: *I feel that the activities and experiences in the training improved my mathematical knowledge*. They feel themselves *capable of using*

materials and technology. They are aware of the fact that *teachers must be experienced to be able to use materials and technology in mathematics*. They appreciate that *materials and technology may be used at all stages of mathematics education*. On the other hand, the trainee *teachers will only use materials and technology, if they will get more opportunity and extra time*.

Table 2: Agreed statements in the scale (%).

	Definitely Agree	Agree	Disagree	Definitely Disagree	$\bar{x}$	S_x
I will do my best to use materials and technology in mathematics.	28,2	62,1	7,3	2,4	1,84	,655
I will spend more efforts to be better to use material and technology.	26,8	62,6	9,8	,8	1,85	,614
I think teaching practices and experiences during my training avail my professional teaching.	27,3	58,7	9,9	4,1	1,91	,730
I think that the use of computer and technology will have an important place in my professional teaching.	23,6	63,4	10,6	2,4	1,92	,660
I feel comfortable when dealing with an activity related to mathematics.	17,5	70,8	10,8	,8	1,95	,563
I'm sure I'll be successful in using materials and technology.	17,9	69,1	12,2	,8	1,96	,578
Mathematics teachers need to cooperate about technology.	19,4	66,1	11,3	3,2	1,98	,662
More activities, materials and technology should be included in mathematics classes.	22,3	62,0	11,6	4,1	1,98	,713
All mathematics teachers should use technology.	21,8	59,7	16,1	2,4	1,99	,693
I will only use materials and technology, if I will get more opportunity and extra time.*	17,7	63,7	16,1	2,4	2,03	,662
It is an advantage to use Internet in teaching mathematics.	13,1	71,3	9,8	5,7	2,08	,675
I feel that the activities and experiences in the training improved my mathematical knowledge.	19,0	57,9	16,5	6,6	2,11	,783
I feel myself capable of using materials and technology	16,5	48,8	33,9	,8	2,19	,711
Teachers must be experienced to be able to use materials and technology in mathematics.	9,6	53,6	24,0	12,8	2,40	,833
Materials and technology may be used at all stages of mathematics education.	8,1	45,5	39,0	7,3	2,46	,749

Note: * denotes negatively phrased items.

Disagreement: Trainee teachers largely disagree with the negative statements (disagreement with the negative statements indicates positive attitudes) about use of materials and technology in mathematics education. Trainee teachers disagree that *it should not be dependent on material and technology in mathematics teaching*. They do not believe that *the technology would not be useful in teaching mathematics*. They do not think that *they do not use materials and technology at their professional mathematics teaching*. They disagree that *the technology would reduce the interaction between students in mathematics lessons*. They disagree that *using materials and technology put extra works in teaching mathematics*. The trainee teachers do not see any gender differences about technology use in mathematics education: *Male teachers can use materials and technology better than female teachers in mathematics*. They will use materials and technology by their intentions. They disagree that they *do not use materials and technology in mathematics, unless it is officially requested*. They believe that present technology should be used in mathematics education: *Technology is currently an early issue for mathematics education. It should be considered later*. They do not believe that *the technology will replace teachers*. They also disagree that *the use of materials and technology makes teaching mathematics difficult*. They disagree with the negative statements about use of materials and technology in mathematics both for teaching and learning Thus, the trainee teachers consider using the materials and technology are worthwhile activities in mathematics education. On the other hand, smaller numbers of trainee teachers are in favor of either

agreement or strongly agreement with the above negative statements. Thus, these students are still having negative feelings about materials and technology uses in mathematics education.

Table 3: Disagreed statements in the scale (%).

	Definitely Agree	Agree	Disagree	Definitely Disagree	$\bar{x}$	S_x
It should not be dependent on material and technology in mathematics teaching.*	9,1	30,6	43,0	17,4	2,69	,866
I do not believe that the technology would be useful in teaching mathematics.*	16,1	15,3	30,6	37,9	2,90	1,085
I do not think that I may use materials and technology at my professional mathematics teaching. *	8,1	18,7	46,3	26,8	2,92	,883
I think technology would reduce the interaction between students in mathematics lessons.*	3,2	13,7	61,3	21,8	3,02	,698
Using materials and technology put extra works in teaching mathematics.*	1,6	8,9	66,7	22,8	3,11	,612
Male teachers can use materials and technology better than female teachers in mathematics.*	14,8	8,2	24,6	52,5	3,15	1,088
I do not use materials and technology in mathematics, unless it is officially requested.*	3,2	8,1	58,1	30,6	3,16	,703
Technology is currently an early issue for mathematics education. It should be considered later.*	3,3	8,3	55,0	33,3	3,18	,722
I think the technology will replace teachers.*	1,6	13,7	47,6	37,1	3,20	,732
Use of materials and technology makes teaching mathematics difficult.*	4,0	7,3	52,4	36,3	3,21	,747

Note: * denotes negatively phrased items.

Definitely Disagreement: The trainee teachers definitely disagree that *trying to understand materials and technology based activities in mathematics is a waste of time*. Similarly, they do not think that *using materials and technology in mathematics is useless and it is a waste of time*. Thus most of the trainee teachers consider that using the materials and technology is a worthwhile activity.

Table 4: Definitely disagreed statements in the scale (%).

	Definitely Agree	Agree	Disagree	Definitely Disagree	$\bar{x}$	S_x
Trying to understand materials and technology based activities in mathematics is a waste of time.*	1,6	4,9	54,5	39,0	3,31	,642
Using materials and technology in mathematics is useless and it is a waste of time.*	,8	7,2	51,2	40,8	3,32	,643

Note: * denotes negatively phrased items.

A comparison (t-test) between all of the 31 statements about trainee teachers' attitudes to materials and technology use in mathematics education and the factor of gender are also been calculated. There is not any statistically significant difference ($p \leq 0.05$) between male and female trainee teachers. Thus, it can be said that both male and female students have same level of attitudes, feelings, anxiety and self confidence about computers.

4. Conclusion

The results show different aspects of primary mathematics trainee teachers' attitudes to the use of materials and technology in mathematics education. First of all, they are very aware of the role of using technology in mathematics education. They recognized technology's inspiration to learning,

studying and teaching mathematics both for students and teachers. They appreciate possible enhancements to individual mathematics learning with the opportunities provided by the technology. Trainee teachers accept that materials and technology help to teach and learn mathematics better. For example, they believe that technology make contributions to creative activities in mathematics. Thus, they reassure and clearly declare that teaching and learning mathematics is going to be improved by the help of materials and technology.

Enjoyment, enthusiasm and self-confidence are very important affective factors in learning and teaching mathematics. These results show that Turkish trainee mathematics teachers are enthusiastic and ready to use materials and technology in their professional mathematics teaching. Moreover, they really like to use them. In the same way, the trainee teachers think that both learning and teaching mathematics with technology are enjoyable. Besides, they have some level of self-confidence about doing better tasks with technology.

Trainee teachers largely disagree with statements about the uselessness of materials and technology in mathematics. Most of the samples consider using materials and technology to be a worthwhile activity. Therefore, most of them suggest that they are going to use materials and technology both for teaching and learning activities. It can be said that strategies to enhance teacher experience with materials and technology could contribute to the formation of positive attitudes, thus, influencing teachers' use of materials and technology. These experiences can be in teacher training courses with content specific classes. These classes may be effective for reducing technology anxiety and helping students to gain competency in skills and confidence in using technology in the curriculum.

Despite the possible weaknesses in the study, the findings are consistent with some of the previous findings (Baki, 2000a, 2000b; Vale and Leder, 2004; McAlister, et al., 2005; Kadijevich et. al. 2005; Haapasalo, 2007; Doğan, 2010; Haapasalo & Eronen, 2010). The findings mainly indicate positive trainee teachers' attitudes towards the use of computer and technology in mathematics education. Despite the fact that a smaller percent of the trainee mathematics teachers still seems to be resistant to the use of technology for their future professional teaching, most of them have significantly stated that they are going to use it. Although many teachers believe that technology are important components of mathematics education, their lack of knowledge and experience lead to a lack of confidence their attempt to introduce technology into teaching. This lack of confidence then leads to anxiety and reluctance to the use of technology.

All these findings support the conclusions of Baki (2000a, 2000b) by indicating the need to change the syllabi of teacher training courses in Turkey in a way that it is better matched with the expectations and professional needs of the students and trainee teachers. Teachers need assistance in becoming more aware of how computers can be used to help their students meet a range of instructional objectives. These considerations can be supported by taking into account of Koehler and Mishra's (2008) TPACK theoretical framework to strengthen possible links and interactions between all main factors of pedagogy, technology and content knowledge. Vale and Leder (2004) suggest that the voices of students bring poignancy to the need of considering pedagogical approaches when using computers that will enhance the attitudes and learning of mathematics for these students. As Neiderhauser and Stoddart (2001) concluded, effective ways in using computers to meet a variety of instructional goals will need to become a carefully integrated part of teacher training and professional development efforts designed to change teachers' perspectives about teaching and learning.

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