Technology-enhanced 5th grade mathematics curriculum

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Abstract

The purpose of this study is to design a 5th grade mathematics curriculum. The main feature of the designed curriculum is supposed to incorporate the integration of technology into teaching and learning of mathematics. In the technology-enhanced 5th grade curriculum, graphing calculators, spreadsheets, interactive geometry software and some other useful technological tools are encouraged for use in the classroom. The proposed technology-enhanced mathematics curriculum design is formed by combination of the various instructional models such as Wulf and Schave (1984), Dick and Carey (1996), and Posner and Rudnitsky (1997). © 2009 Elsevier Ltd. Open access under CC BY-NC-ND license.

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1. Introduction

Advancements in technology are inevitable reflected in educational systems. In most of the developed countries education has been penetrated by information technologies (IT); schools have computers, a large numbers of teachers use computers and new technologies while teaching, and more over textbooks have some parts devoted to new technologies. New technologies are integrated into disciplines and more disciplines are being influenced by the new technologies in an integrated way. Most of the educators and researchers try to use the new technologies in various subject matters, and this integration changes the nature, concepts and methods of work in each subject. The integration of the new technologies to the education should be considered on the different bases; disciplines, teaching, learning, education environments and teacher training.

Mathematics is widely regarded as one of the most important subjects in the school curriculum. In order to develop a curriculum, one needs to segment and sequence the mathematical ideas for instruction. Mathematical knowledge means leading to do mathematics rather than knowing about mathematics. In mathematics, one can learn the concepts about numbers, how to solve equations, and so on, but that is not "doing" mathematics. Doing mathematics involves solving problems, building mathematical models, abstracting, inventing, proving, and so forth. The objective, then, is to develop sequences of activities that should both interest students and give them an

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opportunity to develop mathematical power (Romberg, 1991). Mathematics curricula should not have a purpose to transfer knowledge but to create environments and experiences that bring students to discover and construct knowledge for themselves. The mathematics curriculum must be restructured to include activities that allow students to experiment and build models to help explain mathematical ideas and concepts. Technology can be used most effectively to help students gather data, and test, modify, and reject or accept assumptions as they think about these mathematical concepts and experience mathematical research. In recent years much attention has been focused on the reform of mathematics education with the aid of technology. Before discussing how to integrate technology, it is necessary to talk about why integrate technology with mathematics. Two major reasons are the Curriculum and Evaluation Standards for School mathematics (NCTM, 2000) and the research. There are numerous research findings about the effectiveness of appropriate use of technology (Hsiung, 2003).

Before education incorporates this new electronic media, educators need to discern what is different about the new technology and what those differences mean in terms of cognition, learning, teaching, and education in general (Kaput, 1992). This process may lead to a better consensus among educators as to the role technology should play in mathematics education. Computers are used more often in mathematics than in any other subject (Kober, 1992). The distinct potential of visually representing abstract mathematical ideas appears to offer promise to educators who realize the computer's capabilities (Fey, 1989). This study aimed at assessing both the students’ and teachers’ perceptions and needs in the frame of technology integration into mathematics curriculum. Furthermore, this study aimed at developing a 5th grade technology-enhanced mathematics curriculum.

2. Method

For the purpose of this study, several data sources and instruments acknowledged to be consulted about the technology-enhanced mathematics curriculum. The research design of this study is consisted of two phases; needs assessment and filed testing. Document analysis, interview, questionnaire, and observation are used to identify the needs of the students and teachers. The needs assessment phase is carried out for the following purposes; to figure out what students have already mastered about technology, to identify teacher’s and students’ perceptions, beliefs and attitudes toward technology and also to identify the students’ and teacher’ needs, preferences and interests regarding technology and mathematics education. At the end of the study, based on the needs assessment results the proposed technology-enhanced mathematics curriculum is field tested.

2.1. Participants

The research was conducted in one randomly selected primary school located in North Cyprus. The target population of the study is comprised from the 5th grade private primary school students. The 5th grade mathematics teacher and computer teacher were also included in the participants of this study. Although there were three 5th grade classrooms, 5A, 5B and 5C having a total of 66 students, the study is carried out with a random selection of 21 students. The needs assessment is conducted with all of the students from 5th graders. Besides this, classroom observation and group interview were also conducted with the class 5B. The age of these students ranges around 11-12. The mathematics teacher of the classroom was interviewed through the needs assessment phase of the study; however computer teacher were interviewed after the field-testing of the curriculum.

2.2. Data collection process

Both the qualitative and quantitative data collection methods were administrated to collect the needed information from the field in the fall semester of the academic year 2007-2008. These were classroom observation session, teacher interviews, and group interview with students, teacher questionnaire, student questionnaire, and document analysis. The study was begun with the required consent obtained from the institution. Whenever the preparations for the instruments are completed, data collection was started with interviewing 5th grade mathematics teacher. Thus, both student and teacher questionnaires are submitted to the mathematics teacher, in order to be performed at a more appropriate time. Randomly selected 21 fifth grade students from the sections 5A, 5B, and 5C were administered the questionnaire. At the same time period, the teacher responded teacher questionnaire. After one week, the researcher was observed in one of the 5th grade mathematics lessons. The students from the class 5B
were not informed of being observed, thus the researcher was settled in such a way that the students as well as the lesson were not distracted. At the end of the observation session, a group interview was conducted with the students. Meanwhile, the documents and the current mathematics curriculum that is offered by the Ministry of Education were analyzed.

2.3. Data analysis

Both qualitative and quantitative data analysis methods were used to analyze the collected data from the field during the needs assessment phase of the study. The quantitative components of the Students Questionnaire and Teacher Questionnaire were analyzed by means of the utilization of the Statistical Package for the Social Sciences (SPSS) computer program. All the items related to students’ opinions about the computers and the other items in the computer attitude scale in Student Questionnaire and also the items in the Teacher Questionnaire were analyzed by using frequency distributions. Because some of the items in the Student Questionnaire were open-ended type, the analysis was qualitative in nature. A content analysis was used to identify themes in students’ responses, to develop categories of responses based on those themes, and to tabulate the number of percentage of responses for each category. On the other hand, classroom observation session were transcribed and reviewed for several times in order to identify the general picture of the classroom activities, teaching strategies and materials, teacher’s role, students’ role, and instructions. Both the teacher and students’ interview sessions transcribed and later initial development of the codes based on the interview notes carried out by the researcher. First, transcribed interview notes were reviewed in order to form the theoretical framework of the study to reveal the codes. Then the descriptive codes were grouped into categories, based on the codes emerged from the field notes.

The overall results, which came up from the needs assessment procedure are found to be promoter enough to continue with the next stage of the curriculum design study. The data that were collected from the literature review, students, teacher, and institution were supplied as a background for the curriculum design process. The needs assessment phase showed that the students’ readiness level for the implementation of the technology-enhanced mathematics curriculum was quite positive. Beside this, the attitudes and beliefs of the teachers about the integration of technology to the mathematics education were on the positive side. These results provide sufficient information for the continuation of the design procedure for the new curriculum. Moreover, the results can also lead one to make a prediction that the implementation of the proposed technology-enhanced curriculum will increase students’ perceptions and achievements in the long run. The proposed curriculum would be helpful for students to transfer the abstract concepts to concrete ones and also to visualize the mathematical concepts with the implementation of technological tools in the classroom activities.

2.4. Proposed curriculum design model of the technology–enhanced 5th grade mathematics curriculum

5th grade technology-enhanced mathematics curriculum designed by integrating the computers into the 5th grade mathematics lessons. The proposed technology-enhanced mathematics curriculum design formed by combination of the instructional design models. Although a typical instructional system development include five major phases – i.e. Analysis, Design, Although Development, Implementation and Evaluation, instructional design models on how to develop the curriculum range and it displays variety regarding interpretation from student-centered approach to an objective-centered approach. Beside this some of them would be more systematic approach some could be based on the more flexible approach. In general sense these diversity mainly orientated with learning theories such as humanism, behaviorism, and constructivism. From this point of view, the researcher believed that, an approach to the curriculum design should have a purpose that is related with the context of the curriculum.

In this study, the technology-enhanced mathematics curriculum is based on combinations of the various theories. Therefore, utilization of one instructional design model would not be related with the approach that the current curriculum design lays on. This model was synthesized from components found in three existing instructional design models. These models bring; Dick and Carey (1992), Wulf and Schave (1998) and Posner and Rudnitsky (1996). This curriculum design model is based on three phases namely; diagnose, design and evaluation. For example, in the design phase, the model has involved the some elements from Posner and Rudnitsky’s “Course Design” such as developing rationale, describing intended learning outcomes and teaching strategies. In “Course Design” they emphasize the rationale statement of the course since a course rationale involves the values, educational goals,
teaching procedures and related purpose of guiding the planning. Therefore, having such a rationale in the curriculum design process is necessity and beneficial both for curriculum designer and teachers. Since the technology-enhanced mathematics curriculum will be designed for the first time, rationale should be provided clearly. The “Course Design” intended to bridge the theory with practice, since it is thought to be flexible and systematic. On the other hand, this design also contains some elements from Dick and Carey (1996). The researcher thought that it would be effective if some part of the curriculum were focused on the learner outcomes. As Dick and Carey stated their instructional model contains a strong linkage between the learner outcomes and the instructional strategy. Beside this, the proposed technology-enhanced mathematics curriculum contains some steps from Wulf and Schave (1984) such as “Designing a learning environment”. To get most effective and the successful outcomes from the developed unit plans and lesson plans, there is a need for the optimal learning environment. Although the other instructional design models indicated the necessity of the designing a learning environment, none of them, except Wulf and Schave (1984), state the explicitly the importance of the learning environment. The researcher herself also attaches of importance to the organization of the learning environment. Since utilization of computers into mathematics lessons are directly related to the learning environment. The following Table1 represents the basic components of the proposed curriculum model, which is based on the various instructional models such as Wulf and Schave (1984), Dick and Carey (1996), and Posner and Rudnitsky (1997).

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<tr>
<th>Phase 1: Diagnose</th>
<th>Step 1. Figure out what students need to know</th>
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<td>Step 2. Assess what audiences already know</td>
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<td>Phase 2: Design</td>
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<td>Phase 3: Refine</td>
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2.5. Field testing

Field-testing provides an opportunity for the curriculum designer to put into practice the already developed curriculum. Filed testing helps to find out the how the curriculum works or actualizes. Beside to this, it helps to make decisions regarding changes or modification needed to improve the curriculum. The technology-enhanced curriculum was piloted in the same private primary school. Although it was prepared one unit with five lesson plans, only one lesson plan could be able to piloted because of time constrains. The lesson plan was piloted in the class 5B which was observed. There were 22 students, 15 of them were girls. The prepared spread sheet namely “shopping sheet” installed into eleven computers. Although the number of computers is adjusted to the number of students in the computer laboratory, students used only eleven of them since they worked in groups of two. The overall piloted lesson was well designed and performed as planned. Beside this, at the end of the piloted lesson, group interview with students and informal interview with the computer teacher were conducted.
3. Results

The need assessment phase of the study revealed that the students were willing to study with computers while learning mathematics. It was also observed that students were participating eagerly throughout the lesson. However, as the computer teacher stated, students always willingly participate in the computer laboratory. One of the specific topics was the graphics that 14% of them stated that they would like to study with computers. In this respect, the piloted lesson was also responsive to the students’ needs and preferences. Beside this, utilization of spreadsheet was revealed from the needs assessment phase of the study, most of the students stated that they used spreadsheet at least once. Against this, the piloted lesson was organized in a way that students can have an opportunity to learn the graphics with the help of computers without any background knowledge about computers or spreadsheets. On the other hand, students’ already gained knowledge and skills about the spreadsheet provided a significant advantage of field-testing process. Since in the designed curriculum students actively participate the learning activities and also they were responsible to interact both their partner in the group and the computers, individual differences play a significant role in terms of timing. For this reason, it might be given extra time additional to the planned time for each lesson. Thus, in this way any unplanned events can be handled within extra given time. During the piloting of the lesson plan of the design curriculum students were easily motivated into the lesson, since the theme of the lesson was the “picnic shopping” their interest was aroused right after some warm-up questions.

Students’ interview, and attitude scale revealed that their attitudes and perceptions towards computers were very positive. Thus, they were mostly concentrate on machine and they hardly let to interference other things to affect them. Thus, teacher could not be able to reach all of the students at the same time. This also supported with the computer teacher during the interview session. She also added that teacher should have to provide all the instructions related with activities before the students begun to interact with computers. Moreover, as she stated, prepared handouts which contain the instructions about the activities would be more helpful during the lesson. Inevitably, the role of the teacher in this proposed curriculum is completely different compared the traditional ones. In the observation session, it is observed that the teacher provides the information and students follow the teacher’s presentation. Students were only participating when they are asked questions. However in the designing curriculum, students are responsible of their learning. All the students were all actively participate during the field-testing. Beside to this, field-testing revealed that in order to implement the technology-enhanced curriculum properly mathematics teachers should have enough knowledge about computers. Beside this, when the students face with technical problem, teacher should be able to solve the problem practically.

Another main issue is emerged from the study is the content of the curriculum. The content of the designed curriculum was based current curriculum which is offered by Ministry of Education, however the thematically organization of the topics in the 5th grade mathematics curriculum that is integrated to other subject matters would be an effective way. Besides, real life situation could be integrated into mathematical concepts easily if the thematic approach is used to define the content of the 5th grade mathematics curriculum.

To sum up, both the students and observer teacher stated their enjoyment and satisfactions at the end of the field-testing process. All the students indicated that they got pleasure from the lesson; these attitudes and perceptions were also stated in the need assessment phase of the study. One of them indicated that since they were able to visualize, and actualized the most of the mathematical activities in a short time with the help of computers. Except from some minor problematic issues, the field-testing of the proposed technology-enhanced curriculum was accomplished successfully.

4. Conclusion

The proposed technology-enhanced 5th grade mathematics curriculum was developed regarding basic needs and problems in the fields of education. In the literature review part of this project provide requirement of revision of the current curriculum. There are lot of studies that support the integration of computers into mathematics teaching, however there is no such integration in North Cyprus education system. In this respect, there is a definite need to provide such learning environments to primary mathematics classes in North Cyprus, which enable students to explore, explain, construct, and create the mathematics concepts by their own. Likewise, utilization of the computers in mathematics lessons would be an effective technique for learning some abstract mathematical concepts. Since the computers are capable to provide real-life situations to students, in this way, they have an opportunity to engage
with problem-solving activities. As a consequence, integration of computers in mathematics curriculum by using the content that is familiar with their life may be an effective way to help students comprehend and retentive the basic mathematics concepts.

References


