PRESERVICE MATHEMATICS TEACHERS' VIEWS ABOUT USING GEOMETER'S SKETCH PAD

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Abstract

In this study it was aimed to find out preservice elementary mathematics teachers' views about computer assisted geometry instruction through Geometer's Sketch Pad (GSP). Participants attended to computer assisted geometry course for 14 weeks as a part of their undergraduate course program. Before the course, questionnaires named as Self-Efficacy towards Mathematics Scale by Umay (2001), Self-Efficacy towards Computer Scale by Askar and Umay (2002), and Computer Literacy Scale by Kilinc and Salman (2006) were applied to 75 preservice elementary mathematics teachers and nine voluntary participants were selected among them according to those questionnaires. At the end of the course semi structured interviews were conducted with those nine participants who were selected through applied questionnaires. In general it was revealed that participants agreed on the effectiveness of GSP on teaching geometry. They mentioned their views of usage and features of GSP. They made useful suggestions for further development of this program.

Key words: Geometer's Sketch Pad (GSP), preservice elementary mathematics teachers, geometry.

INTRODUCTION

Computer-based learning environments have been an important issue in mathematics education. With the development of technology, Dynamic Geometry Softwares (DGS) have become beneficial tools to teach geometry effectively since they support visualization to students about the features of geometric shapes. Besides, with the help of DGS users can interact to geometrical objects and relations by manipulating those (Healy and Hoyles, 2001).

The National Council of Teachers of Mathematics (NCTM) has given a great deal of importance on technology utilization in mathematics classrooms. It was claimed that if technology especially computers are used in true conditions in order to teach geometry in schools, it will provide a rich learning environment to develop students' geometrical thinking (NCTM, 2000).

The Geometer's Sketch Pad (GSP) which is one of the DGS a computer software system for creating, exploring, and analyzing a wide range of mathematics concepts in the field of algebra, geometry, trigonometry, calculus, and other areas (Key Curriculum Press, 2001). GSP is an excellent interactive tool which encourages a process of discovery in which students first visualize and analyze a problem and then make conjectures (Furner and Marinas, 2007). It also allows learners to work through numerous examples and enables them to discover patterns by constructing their own sketches (Stols, 2007).

From related research studies, it was revealed that students are willing to learn when geometry activities are presented in dynamic geometry software learning environments (Furner and Marinas, 2007; Shafer, 2008). Furthermore, by using DGS, students enhance their geometrical creativity and problem solving abilities (Battista, 2001; Hoffer, 1983). As De Villiers (2004) noted that to provide DGS environment for students, firstly preservice and inservice mathematics teachers should be engaged using dynamic geometry activities to develop a better understanding of concepts and definitions on their own. Hence, the purpose of this study is to introduce GSP to preservice elementary mathematics teachers and explore their views about computer assisted geometry instruction through GSP.

Computer Assisted Geometry Instruction Course

Two of the researchers were instructors of Computer Assisted Geometry Instruction Course which lasted 14 weeks with three hours a week in a laboratory environment. The content of this course includes dynamic geometry softwares (GSP, Geogebra, Wingeo, LogoTurk) related to geometry and mathematics teaching. The participants who were seniors studied in pairs during the course. Firstly, programs were introduced to them and then they engaged in some geometry activity worksheets distributed by the instructors, and lastly they were asked to create new geometry activity worksheets.

METHOD

Selection of Participants

The interview process composed of the purposeful sampling of nine seniors from Computer Assisted Geometry Instruction Course. This sampling method selects information rich cases for in-depth studies (Maxwell, 1996; Patton, 1990). In 2007-2008 academic year spring term, this study started with the needs to identify preservice elementary mathematics teachers' self efficacy towards computer and mathematics and to find out their views about geometry instruction through GSP. The participants composed of 75 seniors involved the Computer Assisted Geometry Instruction Course in their fourth year of undergraduate study program. At the beginning of this course two of the researchers administered three different instruments namely Self-Efficacy towards Mathematics Scale developed by Umay (2001), Self-Efficacy towards Computer Scale developed by Askar and Umay (2002), and lastly Computer Literacy Scale by Kilinc and Salman (2006). The participants were selected on the base of getting high scores from each scale. Nine of them were volunteered for semi-structured interviews.

Procedure

This is a qualitative research study using interviewing as a method of data collection. The standardized open-ended semi-structured interviews (Maxwell, 1996) were conducted to obtain data on preservice elementary mathematics teachers' views about Computer Assisted Geometry Instruction through GSP. After selecting the interview participants, each participant was interviewed individually, going through the interview questions in order, asking further questions when it was essential and appropriate to clarify in more detail some of the responses of the interviewees. These interviews took place in researchers' room at times that suited to seniors' schedules and all the interviews were audio taped with the permission of them. The researchers informed the interview participants about the purpose of the study and the content of the interview. After the questions, probes and follow-up questions were directed in order to deepen the interview responses. Each interview lasted approximately 60 minutes. After collecting data, each interview was transcribed by researchers. Each transcript was coded by at least three researchers. Afterwards the common codes were identified and codes conflicts were resolved in a group discussion. The analysis of data was based on this structure.

After approximately six months interviewees were called and asked for follow-up opinions about using GSP. Since they are working as elementary mathematics teachers now, it was wondered whether their opinions were changed or not, and are they using any computer programs for teaching geometry in their classes.

FINDINGS OF STUDY

Six themes emerging from data were identified as follows; *how to teach geometry, utilization of GSP, effectiveness of GSP, efficacy in using GSP, suggestions for software development,* **and** *GSP usage in mathematics classrooms.* **The findings will be presented with respect to the themes.**

How to teach geometry

Participants mentioned that geometry is more concrete and visual comparing to other mathematical concepts. Besides geometry has a rigid connection with daily life. Due to this view it should be taught with the tools that make geometry more concrete and visual. Most of them emphasized using only GSP as a tool of teaching geometry is insufficient. In addition to GSP, geometry classes should be supported with concrete manipulatives.

Utilization of GSP

Prerequisite knowledge and skills for using GSP, laboratory environment, and difficulties regarding using GSP were emerged from participants' scripts related to utilization of GSP. They all mentioned that since GSP functions in English, it requires intermediate English level to use the program effectively. Basic computer knowledge and skills as well as mathematical understanding are also necessary for GSP. Regarding to laboratory environment, participants all agreed on enough computers and at least one projector to reflect the selected works are needed. They also added that there should be enough opportunities for students to practice GSP on their own in schools. They faced two main difficulties such as; the language and complexity of some commands. Although the basic toolbox is easy to use, some commands such as iterate command need to be assisted. Therefore they accepted that first they need a guidance to understand the function of commands, and then they are ready to explore GSP effectively on their own. For instance one of the participants explained this difficulty as follows;

'I would not understand the iterate command in creating fractals without your instruction since I would not be able to understand the importance of mark center command because when you change the center the whole fractal develops in diverse ways.'

Effectiveness of GSP

Two main dimensions were evolved from this theme; cognitive and affective. In the cognitive dimension, GSP was perceived as an effective tool for teaching geometry since it makes geometry topics and geometrical proofs more understandable. Because of the program teachers can draw geometrical figures flawlessly and quickly. This saves teachers' time for depth in teaching and conceptual classroom discussions around geometrical topics. Moreover saving time by GSP enables teachers and students deal with more geometry problems.

According to participants, another effective feature of GSP is within its power of visualization. One of the participants expressed that;

'…in a triangle when you increase one of the degree of angles, the opposite side of this angle gets longer. This can be shown through GSP easily and quickly. If I wanted to show this on the blackboard, I would have to draw couple of triangles with different measure of angles so it is time consuming and hard to be followed by students. My drawings might also involve some errors and this may confuse student's understanding.'

Related to the affective dimension, they all denoted that GSP is such a kind of attractive tool that it can enable users to enjoy geometry, to motivate to study geometry and to participate actively in geometry classes, as well as it can increase the students' basic computer skills. One of the drawbacks of using GSP was signified by participants. Using GSP as an only tool to teach geometry for all time might lead to reduce the attractiveness of the program. Students can perceive GSP just as a game for fun, so they can be distracted from the geometrical concepts and comprehending geometry lessons.

Efficacy in Using GSP

Related to feeling efficacious towards using GSP, all of the participants perceived themselves as efficacious but they need to improve their own methods and techniques to utilize GSP in their geometry classes as an elementary mathematics teacher.

Suggestions for Software Development

The participants made following suggestions; there should be a variety of language selection so users can choose the most appropriate language for themselves. This option can eliminate the possibilities of misusage of GSP menu and it can save time for beginners to learn GSP. Another suggestion was about the possibility of adding appropriate feedback like voice feedback while solving problems. Lastly, the participants specified that the GSP menu can be improved by adding icons which make automatic drawing of basic geometric shapes like in Geogebra software. To illustrate this view, the following excerpt can be followed; "…there should be ready commands such as; hexagon and pentagon icons to draw in one step".

GSP usage in mathematics classrooms

The participants described how they will use GSP in their future geometry classes. They will guide their students rather than give instruction directly. They will prefer their students to work in pairs not individually. They will choose to use concrete manipulatives as a complementary tool for GSP when it is necessary. One of the students uttered that

"...according to the mathematical topic I will use GSP at the beginning of the class, in the middle or at the end. GSP gives me this flexibility". This view is supported by another participant as; "when students get bored I choose something enjoyable from GSP or if I introduce a concept I prefer to use it as a conceptual tool."

According to all participants, experienced mathematics teachers do not choose to use GSP in any condition since they had no experience with dynamic geometry softwares during their undergraduate program. Besides the participants pointed out these teachers are unwilling to use GSP in their School Experience Courses.

CONCLUSION AND SUGGESTIONS

The present study shed light on the themes of how to teach geometry, utilization of GSP, effectiveness of GSP, efficacy in using GSP, suggestions for software development, and GSP usage in mathematics classrooms.

Findings of the study confirmed that participants agreed to the effectiveness of GSP usage in geometry since it provides a dynamic learning environment and enjoyable geometry tasks. They specified that GSP should be used in the classes to ensure effective teaching in geometry although they declared some constraint regarding to the laboratory environment, GSP usage menu, and language selection. This is in conjunction with the result of the study in which students' appreciation of student-centred classroom environment with GSP took place (Powers and Blubaugh, 2005).

Furthermore preservice elementary mathematics teachers implied the importance of usage GSP in their future mathematics classrooms. This is consistent with Stols' (2007) study in which it was implied that teachers perceived GSP extremely useful in geometry classes. They asserted that they will use GSP as an additional tool in geometry classes along with concrete manipulatives. This view is parallel to Reys *et al* (2006) who signified learners need to experience with concrete manipulatives for geometry, use semi-concrete manipulatives, like sketching software, and lastly develop abstract understanding of geometrical concepts.
Follow-up telephone interviews revealed that the participants who are currently working as elementary mathematics teachers in different regions indicated that the working conditions in schools are not suitable for DGS to use. Although they are willing to introduce GSP to their students, they complained some issues, for instance; insufficient number of computers for students to work individually or in pairs, intense of mathematics curriculum, and crowded classrooms. Therefore the necessary steps related to mathematics curriculum, teacher training, and laboratory conditions should be taken immediately in schools.
From this study it can be suggested that dynamic geometry software usage is related with teacher education in general. Although the participants of this research declared that they are willing to use GSP in their geometry classes, the issue is to make inservice mathematics teachers to get used to this program and to utilize it in their current classes. Inservice teacher training is essential since it is in general lack of a sense of vision and financial support which is needed for teachers to use GSP in schools. Even if the technical and financial supports are given to the teachers, it should be continuous since DGS is advancing. Teachers need to review current software and search further materials with respect to their curriculum needs.
As a last word, it can be said that technology, especially computers, has become a major part of our daily lives. The uses of technology seem to enhance at an almost too fast pace. We

cannot avoid its progress. Clearly there is a need for all learners to develop basic skills to use all kind of technology.

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