The Eurasia Proceedings of
Educational & Social Sciences (EPESS)
ISSN: 2587-1730

The Eurasia Proceedings of Educational & Social Sciences (EPESS), 2016

Volume 4, Pages 438-443

ICEMST 2016: International Conference on Education in Mathematics, Science & Technology

IDENTIFYING CONSTRUCTS OF WEBQUEST LEARNING AS PERCEIVED BY PROSPECTIVE ELEMENTARY TEACHERS THROUGH DESIGN PROCESS

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ABSTRACT: The aim of this study was to explore prospective elementary mathematics teachers' perspectives on WebQuest learning through the design of topics in elementary mathematics. The data sources included prospective teachers' written responses to the assignments developed for forming their opinions and understanding how they perceived the WebQuest learning process. 48 prospective teachers were participated in this study. Participants' written responses were analyzed according to three underlying constructs of WebQuest learning affecting teachers' perceptions: constructivist problem solving, social interaction, and scaffolded learning. While designing WebQuest, findings revealed that most of the responses addressed making real-life connections in WebQuest learning. Moreover, prospective teachers were aware of the importance of transferring knowledge from different fields (art, science, and architecture etc.), developing better interpersonal and small group skills, and facilitating mathematical content comprehension. Methodological and practical recommendations were provided for further studies to highlight primary factors and constructs of the WebQuest learning.

Key words: WebQuest learning, design process, prospective teachers

INTRODUCTION

With the rapid growth of innovative technologies and the Internet, the use of technology plays an ever-increasing role in the teacher education. Besides other subject areas, the integration of technology in mathematics curriculum and instruction have been an essential component of the learning environment (Niess, 2005). However, there is still some problems reported regarding the use of technology in most teachers' practice (Hofer & Grandgenett, 2012). Therefore, prospective mathematics teachers should be prepared to develop knowledge of subject matter and technology in their teacher preparation programs. As Garofalo, Drier, Harper, Timmerman and Shockey (2000) have suggested that the most effective way to use technology to give rise to student learning is supporting them via incorporating their teaching with activities involving mathematical thinking by technological tools. To provide such an argument, WebQuest design was selected in this study to demand prospective mathematics teachers to link mathematical topics for creating authentic tasks.

The WebQuest, developed by Dodge and March in 1995, provides a constructivist inquiry framework (Dodge, 1997) in which students involve in authentic tasks by using web links. In general, the WebQuest is a web-based learning tool which functioning as a scaffold or form of assistance that supports students' learning. In other words, as Tuan (2011) asserted, the WebQuest is a scaffold learning structure and it is comprised of web links involving vital resources and authentic tasks aiming students to develop their performance through group processes. By using the WebQuest, students have a chance to collect, synthesize, and assess information through defined factors (Manning & Carpater, 2008).

As Dodge (1997) asserted that the WebQuest can be used for improving time on task, using information to problem solve, and utilizing higher order thinking skills. Moreover, Lim and Hernandez (2007) accentuated that critical thinking, knowledge application, social skills and scaffold learning are four constructs supporting the WebQuest. According to their categorization, critical thinking develops through creating a new artifact while

- Selection and peer-review under responsibility of the Organizing Committee of the conference

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knowledge application is highlighted in the design process and support engagement in problem solving and creativity. Similarly, collaboration and accountability might be supported by working in group projects. Finally, they continues by saying in their classification that scaffold learning is the structure in which transformations are promoted. Besides this classification was mentioned in their article, Zheng, Stucky, McAlack, Menchana, and Stoddart (2005) derived new factors critical to WebQuest learning. Based on their empirical evidence, three constructs (constructivist problem solving, social interaction, and scaffolded learning) were explored, and suggested that "these new constructs needs to be taken into account by those who design WebQuest" (Zheng, et al., 2005, p.46). Although researchers have tried to uncover the main constructs of the WebQuest, still limited knowledge exist of how these constructs are interpreted and highlighted in a real WebQuest design process. Therefore, this research study examined here sought to address this gap by exploring prospective elementary mathematics teachers' perspectives on WebQuest learning through the design of topics in elementary mathematics.

METHODS

Participants and Procedure

48 undergraduate teacher candidates were participated in this study. The teacher candidates had enrolled in the Middle School Mathematics Teacher Education program in a Southern university in Turkey. This sample was a fair representation of the population of elementary mathematics education at the university.

The data were collected in the Spring semester of 2015-2016 academic year. A WebQuest design template was developed by the authors and distributed to the participants. The template provided an instructional framework in terms of WebQuest design which a well-designed WebQuest typically contains six steps: 1) introduction, 2) task, 3) information sources, 4) description of process, 5) performance evaluation, and 6) conclusion (Dodge, 1997). Moreover, it included a research report for the design procedure in which the participants were required to write how to gather, synthesize, and evaluate the information obtained from the Internet resources.

Context

WebQuest design was addressed in class as a part of technology integrated mathematics course that requires them to connect mathematics with technology in an authentic context. In the beginning of the course, the principles and objectives in the Turkish elementary school mathematics curriculum were briefly overviewed. While examining the principles and standards, the idea of integrating technology into the mathematics lessons was introduced. The first author was the instructor for the course. Throughout the course, the instructor tried not to impose real-life applications and to make connections with different fields.

To design WebQuest, participants were required to select the objectives from the middle school mathematics curriculum and try to connect their objectives to their WebQuest tasks. They were free to select their topics such as numbers, algebra, and geometry. Those tasks were addressed to a group working and to be investigated by students. After completing design process, participants reflected their opinions and understanding how they perceived the WebQuest learning process to the assignments. They were asked to respond in writing to the open-ended questions: 1) What would learners benefit from the designed WebQuest? and 2) What kinds of opportunities would the designed WebQuest provide learners?

Data Analysis

Participants' written responses were analyzed according to three underlying constructs of WebQuest learning affecting teachers' perceptions defined by Zheng et al. (2005). The analysis of the responses provided descriptive information about the overall picture of the prospective teachers' opinions and perceptions about the WebQuest learning. All responses were analyzed for coding. Initially, the authors independently reviewed the categories and justifications proposed by the participants to identify the major themes and sub-themes. Later, they jointly revised the themes through discussion and comparison. After the themes and codes were identified, the authors independently coded a sample of 48 participants' responses and then discussed until 100% interrater reliability was reached on themes and interpretations. Later, the frequencies of the targeted major themes and sub-themes were identified. In the results section, selected participant responses were used to illustrate the common themes.

FINDINGS

Designing a WebQuest required a substantial amount of problem to find an appropriate examples and websites. The WebQuest environment required prospective teachers to be self-directed in their work. The prospective teachers decided to where to begin their work, how to gather and synthesize the information. This process was neither easy nor familiar for prospective teachers.

48 prospective teachers responded to the open-ended questions and provided a variety of written answers. While the range of responses varied, the most common responses were related to the investigation of the relation between mathematics and art. They used different examples from various art forms (e.g. music, dance, visual arts, sculpture, and architecture) as a context for connecting their tasks. Table 1 showed the constructs (i.e. major themes) and concepts (i.e. sub-themes) used in evaluating the responses in terms of WebQuest learning. The three constructs were identified below based on the current research findings that focused on the essential components in WebQuest design.

Table 1. Themes used in evaluating prospective teachers' responses

Major Themes	Sub-themes	Number of participants (out of 48) who mentioned
Constructivist problem solving	Examining problems from multiple lenses	6
	Proposing a solution with more than one approach	2
	Transferring knowledge from one problem solving situation to another	3
	Pulling knowledge from different fields to solve problems	32
Social interaction	Promoting accountability among learners	4
	Gaining a better understanding of each other's point of view	3
	Promoting interaction between learners	3
	Developing better interpersonal and small group skills	15
Scaffolded learning	Facilitating subject content comprehension	30
	Better understanding how to achieve learning goals	10

Constructivist Problem Solving

As presented in Table 1, analysis of participants' written responses showed that the construct of constructivist problem solving was operationalized on the concepts of examining problems from multiple lenses, proposing solutions with multiple approaches, transferring knowledge from one situation to another, and pulling knowledge from different fields to solving problems. Among these concepts, the last one played a critical role in the WebQuest design.

Pulling Knowledge from Different Fields to Solve Problems (n=32)

The main issue for this concept was combining participants' knowledge from different fields (e.g. music, nature, and architecture) to design WebQuest tasks. The analysis of responses indicated that most of the participants developed, applied, and converted their knowledge from real-life context to their WebQuest tasks. For instance, a participant who used example from architecture as a context for exploring the rules of perspective such as true shapes, vanishing points, and horizon lines and stated,

After this activity, students will be able to understand the concept of perspective which emerges from vanishing points and horizon lines, and see and apply how to draw a cube in two point perspective. They will be able to see the relationship between mathematics and daily life by realizing the mathematics used in art and architecture.

This view addressed how real-life connected cases would enhance students' engagement in mathematics. There were similarities in the responses, like the following example taken from another participant:

It is really important for students to realize that ratio and proportion - like many concepts in mathematics- are used in music. In that manner, students will be knowledgeable with musical note and rhythm in music, realize how to rhythms form patterns; therefore, it will be very easy to learn new concepts.

In both examples, participants provided context in which they presented their understanding of mathematics and connected the topics to the real-life. Briefly, they relied on making connections and used knowledge from different fields to design WebQuest.

Social Interaction

The findings suggested that the construct of social interaction included: (a) promoting accountability among learners, (b) gaining a better understanding of each other's point of view, (c) promoting interaction between learners, and (d) developing better interpersonal and small group skills. Although all concepts of the social interaction seemed to be interrelated, the concept of developing better interpersonal and small group skills became prominent in the analysis.

Developing Better Interpersonal and Small Group Skills (n=15)

The main issue for this concept was developing students' group working and interpersonal group skills. These responses focused on evaluation of individual perspective about group working and pointed out the strengths of group working when learning with WebQuest. For instance, a participant stated,

Students will be able to learn not only the transformation geometry but also the related concepts such as reflection, symmetry, rotation and reflection, and their practice. In group working activities, they will be realize their positive and negative sides, and they will have a chance to learn cooperation. To illustrate, they will help their team mates who could not perform his/her tasks, and they will get to know yourself.

In this reflection, she identified the team roles that allow group working to happen and concentrated on achieving the task and taking responsibility for own learning. This implied that participant realized what students would learn about group working. Similarly, another participant stated,

After a tessellation project which will be a group project, students will change ideas and make cooperation between group members in that environment. On the other hand, their interpersonal and small group skills will be developed.

Here, it could be claimed that group working extends students' interpersonal skills considering that WebQuest teaching provides opportunities for students to discus different point of views and listen to each other. In brief, these statements referenced the importance of social interaction and developing interpersonal skills.

Scaffolded Learning

Analysis of the responses indicated that the construct of scaffolded learning was operationalized on the concepts of facilitating content comprehension and better understanding how to achieve learning goals. As an important concept of facilitating content comprehension, it played a critical role in the construct of scaffolded learning.

Facilitating Subject Content Comprehension (n=30)

In this category, the responses specifically commented on what kinds of activities should be given and how it should be presented to facilitate the content comprehension. All of them voiced their teaching perspective when designing WebQuest. One participant stated,

Since students will find the rules and steps for number and figure patterns by themselves, their subject learning might be easy. Moreover, students will learn rules of patterns with more than one method via visiting pre-determined web links.

Here, she relied on gathering, synthesizing, and evaluating the information gained from the web-based resources that allow students to facilitate the content comprehension. In a similar vein, another participant noted,

Students will be able to recognize right triangular pyramids, learn how to construct them, and find how to draw faces of pyramids. In that sense, students' geometrical thinking levels should be developed within this activity. Moreover, it might be expected their visualization skills will be improved. Indeed, students could learn how to make connections between Egyptian pyramids and the concept of right triangular pyramids. Through this way, students' learning and making generalizations might be facilitated.

Regarding the given information, participants pointed out that WebQuest provided an easily relatable context in which students can strength their mathematical knowledge. It could be claimed that participants recognized how to use technology in their teaching to enhance student learning.

CONCLUSION

Improving mathematics teaching and learning with technology should be highlighted in the use of technology in mathematics teaching rather than teaching only about technology (Garofalo et al., 2000). In this research, the WebQuest design was selected to require prospective teachers to connect mathematics with technology in an authentic context. As Manning and Carpater (2008) suggested that the WebQuest can be used as a model for prospective teachers' education program. We are aware that the WebQuest process was not completed.

Nevertheless, it has been very encouraging for us to discover prospective teachers' designing mathematical tasks in relation to everyday examples. When teaching with technology comes into prominence for mathematics teachers as Richardson (2009) suggested, they should take into consideration simultaneously to teach mathematics concepts in an environment where students have a chance to inquiry with ideas, make conjectures, test hypotheses, and form generalizations. As Garofalo (2000) suggested that in using technological tools, interconnection of mathematical topics and linking with real-world phenomena are two important ways to facilitate mathematical connections. Throughout the study, the prospective teachers investigated the relation between mathematics and art. They discussed and presented everyday life tasks within the certain mathematical topics and gain experience about how they used the everyday tasks in their mathematics instruction. Tuan (2011) asserted that students are encouraged to see valuable thematic relationships between topics, make a connection with real-world of learning, and affect their mental processes through the WebQuest. It could be concluded that they lead to a significant positive change in their perspective about designing tasks in relation to real-life connection.

Social interaction as a second construct emerged through analysis emphasized the developing better interpersonal and small group skills of the participants. The same conclusion has presented in the literature that each team member have to investigate the topic covered in the course, and then make a contribution to the final group tasks (Tuan, 2011). As Agyei and Voogt (2012) points out that involvement in design teams for the mathematics tasks can provide them both to improve interaction and interdependence among other team members and to uncover how to share knowledge and ideas with the help of developing communication and insight.

As for scaffolded learning highlighted by participants in their design process was functionalized as facilitating content comprehension and better understanding how to achieve learning goals. This finding confirms the theoretical argument that the use of WebQuest might be eligible as scaffolding via offering assistance to students by providing information on design topics (Latuperissa, 2012).

RECOMMENDATIONS

Designing WebQuests might support prospective teachers for integrating technology into their future teaching (Kundu and Bain 2006). Wang and Hannafin (2009) had a similar argument about the usage of the WebQuest for prospective teachers to develop technology integration skills before entering the teaching profession. Some empirical studies have examined the underlying constructs of WebQuests. Zheng, Perez, Williamson, and Flygare (2008), for instance, tried to explore factors that significantly predicted teachers' perceptions. Regardless of these efforts, the area remains under-researched. Therefore, further research including qualitative and mixed methods is suggested to better reveal main factors and constructs of the WebQuest learning. Moreover, some suggestions might be offered to research further studies regarding design processes and effects of main WebQuest elements through design.

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