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Haptic's suitability to constructivist learning environment: aspects of teachers and teacher candidates

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Abstract

Until today many technologies are used in constructivist learning environments. As for this study, it is tried to reveal haptic's suitability to constructivist education environments together with aspects of 6 teachers and 21 teacher candidates. Semi-structured interview and qualitative methods are used for this study. In this study, it is revealed that haptic is suitable to constructivist learning environments by providing active, cognizing, exploring and meaningful learning. Showing the scene on the computer to the class with projector and using work sheets in the application were presented as solution to the problems.
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1. Introduction

1.1. Constructivism and technology

Temporizing developing and changing world is provided with scientific and technologic advances. Scientific and technologic advances are becoming real with growing up individuals who are innovated, aware of the responsibilities of him, and who is producing something. Therefore, developed and developing countries are giving importance to growing up individuals who are responsible, who can think critically, who can exhibit products by analysing and synthesizing. They are leaving behind traditional approaches in education and starting to use constructivist approach which has a very important place in contemporary approaches.

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Constructivism is an epistemology based on many thinkers', psychologists' and educators' studies (Çınar, Teyfur and Teyfur, 2006). According to constructivism, individual does not accept the knowledge without any qualification, but constructs discussing, defending opinions, hypothesizing and questioningly (Crotty 1998, 42; Fosnot 1996; Hendry, Frommer & Walker 1999). Meanwhile, he experiences a process in which he learns thinking, learning, how and with what purpose the knowledge is being constructed (Shunk, 1996; Akar and Yıldırım, 2004; Titiz, 2005; Yapıcı, 2005). While the individual is experiencing this process, the mistakes he did is seen as a result of constructing the knowledge, and the dilemmas he experiences are illuminated, discussed and searched (Fosnot, 1996). The aim is not helping learners to reach specific targets but it is creating learning opportunities for them to give meaning to knowledge mentally (Wilson, 1997).

In constructivism, instead of an learning environment where individuals are equipped with all the knowledge on a specific topic, learning environments which learners can construct personal knowledge are prepared (Ersoy, 2005). Since main assumption of constructivism is learning becoming fact with tools and signs, learning environments are equipped with the tools and materials which direct the learning of individuals (Duffy & Cunningham, 1996; Ezell & O'Keeffe, 1994). Therefore, technological tools and materials are seen as strong catalysers of learning process (Jonassen, 2002).

There is a complementary relationship between technology and constructivism and positive effects of them to each other in applications are observed (Burns, Heath & Dimock, 1998). Constructivism is interested that learning takes place in contexts, while technology refers to the designs and environments that engage learners. Thus, technology creates learning environments adapted to constructivist approach by providing students'

1. Making multi-directional comments,
2. Active learning in virtual environment,
3. Experiencing learning process which is important as much as product,
4. Producing solutions to problems from real life,
5. Collaborating during learning process,
6. Sharing their opinions openly

with acceptable tools and circumstances. Therefore, in recent times technology is integrated into classes suitable to constructivist framework (Richards, 1998).

The programme named as Archaeotype, is one of the examples to the conducted studies. By means of this programme, an interactive graphic simulation of an archaeological region is presented to students. In interactive learning environments, students are trying to obey general rules with the applications by studying as groups. In this way, advances in discussing and commenting skill of students are provided (Black & McClintock, 1999).

Virtual environment is designed for students to learn "crossbreeding" and to developing hypothesis in a web based conducted study (Limsun, Witzlih & Desharnais, 2007). In the developed virtual laboratory environment, a chance to combine and analyse fruit fly called as "Drosophila" according to different mutations, is provided to students. Additionally, opportunity for students to examine fruit flies under microscope, to take notes online, to prepare reports is given. As for teachers, they have the authority to check and help the applications made by students through network. Thanks to the system, students can develop hypothesises, make tests and learn scientific studying.

Another study is about developing algorithm and converting algorithm into programme which have importance in computer programming. In the study, in order to create student based learning environment, interactive traffic lights simulator is used. It is wanted from the students to regulate the traffic in according to while, for and if logics. Programme can provide learning environment for students to motivate and make research, and gives feedbacks. According to the feedbacks given by programme, students can continue their studies correcting their mistakes. In this way, students learn topics not by memorizing but cognizing, in addition their algorithmic thinking is developed (Yuen, 2006).

As can be seen from the examples, potential of technology in development of learning products, and its effect in constructivist class applications are searched in many studies. Apart from the given examples, in many classes, electronic portfolios, presentations, video conference programmes, databases and other technologies are utilized for students' organizing, presenting and interpreting knowledge. Therefore in the last ten years, sudden increase in interest, where technology is utilized in classes, is observed specifically (Reiser, 2002).

1.2. Haptic

With development or researches in technology and robotics, the need to move objects by feeling occurred and haptics are developed. Haptic means "tactile" in Greek enables human-machine communication (Hayward, Astley, Cruz-Hernandez, Grant & Robles-De-La-Torre, 2004). As for human-machine communication, it becomes fact with tactile sensation to user, and power feedback becomes fact with vibration and motion application. Haptic outputs are delivered to users simultaneously with input data (Williams & Michelitsch, 2003). User inputs are transferred to the computer with a communication like the one mouse and keyboard has. Users both perceives objects which he moves in virtual environment and interprets features belong to objects (Barbaglı, Salisbury, Ho, Spence & Tan, 2006). In this way, it is aimed to present more factual environments to users and to make them live experiences look like alive.

Haptic consist of two parts which are software and hardware. Software has simulation features and presents sound, visuality, interaction facilities. As for hardware, it is in interaction with software which has simulation feature, arranges perceptions according to encoding principle. Haptic's hardware part can be in shape of glove, joystick and pencil. The interface which provides interaction with user can change according to target group and studying topic. Specific features can be changed by software and hardware parts, changes in software can be perceived and sensed.

Haptic is used in many disciplines from medicine to military in present day. As for the applications in education, they are very new and not widespread yet. The concepts which are perceived by students in conducted studies are about relating science course to life sensing. Thus an increase in learning and remembering skills of students is expected and it is hoped that they will become superior in science and mathematics (Williams, Chen & Seaton, 2000).

In the studies made about education, it is generally mentioned that haptic will contribute to individual's constructing his or her knowledge, making comments, to learn cognizing and experiencing and so on. All these features actually constitute the core of constructivist approach. However, in the studies, haptic's feasibility in constructivist classes, the advantages and disadvantages of its application are not clearly mentioned. Therefore, in this study it is tried to reveal whether haptic is suitable to constructivist learning environments with teachers' and teacher candidates' viewpoints.

2. Method

2.1. Haptic

The haptic used in this study has the interface related to gravitation, mass and weight concepts. In the used haptic environment there is three dimensional (x, y, z) haptic stick which enables the user to move objects in the real environment. The stick is pencil shaped and it can be easily moved according to the power direction given by user in the three dimensional environment Figure 1.

Figure 1. Haptic and haptic stick

All the movements done with haptic in the space are simulated with a yellow coloured ball in the software Figure 2. Thus, the ball simultaneously can do all the movements which are done by stick in the computer screen the same in three dimensional environments. The location of the ball model in the simulation also changes according to the direction given by user to the stick.
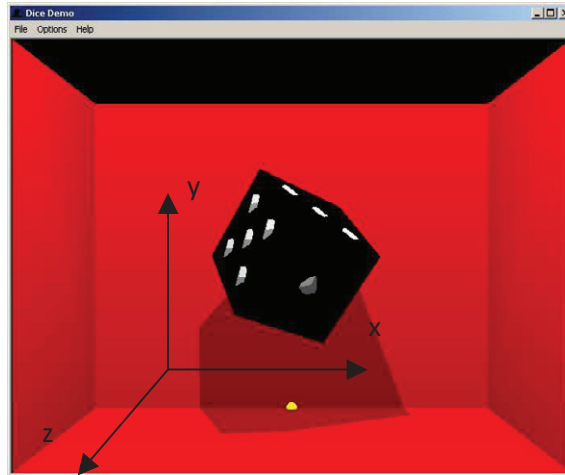

Figure 2. Haptic simulation interface.

Haptic software tool provides interaction with user. With the aid of ball which imitates haptic stick, user can implement effects like hitting and pushing the diaphragm in virtual environment. These effects are experienced to the user with haptic stick. Besides, by means of "options" menu in the software interface Figure 3, mass, weight, rigidity of diaphragm and acceleration of gravity in the environment can be altered.
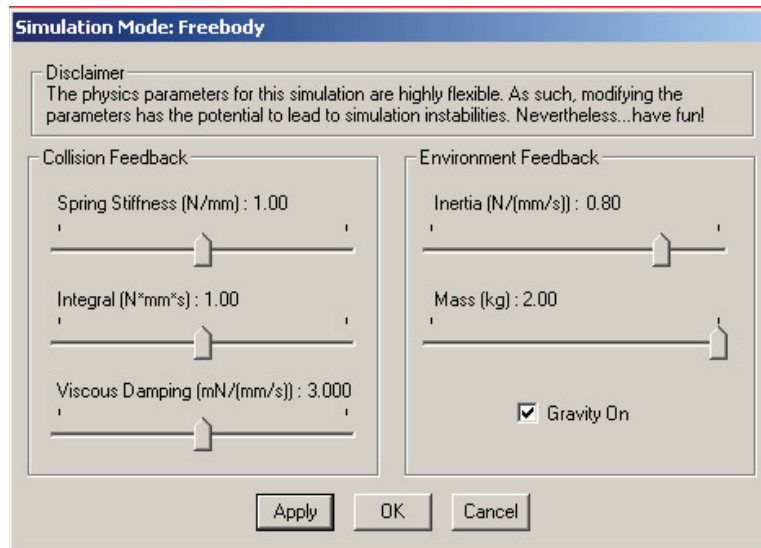

Figure 3. The interaction windows which enables to alter features of virtual environment.

2.2. Research Design

In the study no theory or hypothesis was developed beforehand. Facts or cases are examined in their own environment in a flexible research process. Researcher himself spent time in the environment, interviewed with the

participants in the research directly and tried to investigate the problems in depth. Considering the mentioned situations, the research design was determined as case study.

2.3. Sample selection and sample of research

The study was conducted with teachers and teacher candidates in order to determine haptic's suitability to constructivist approach. Purposeful sample method is used, so as to obtain suitable data. 6 computer education teacher who is having master in Karadeniz Technical University, Fatih Faculty of Education, Department of Computer Education and Instructional Technologies and 11 senior year students from the same university's Department of Computer Education and Instructional Technologies, 10 senior year students who are teacher candidates from Department of Primary Science Course participated in the study.

2.4. The role of the researcher

During semi structured interviews which were conducted, participants answered the questions of researcher earnestly, faithfully and fairly. In the interviews, researcher avoided from the questions which would direct the participants and tried to keep separated his prejudices from the obtained data during the research process.

2.5. Validity and credibility of research

In order to provide credibility of the study, data were evaluated by different researchers. Purposeful sampling method is used so as to provide transmissibility of the research and research process was tried to explain to reader in a detailed way as much as possible. During the analysis of the data, in order to provide credibility criterion, crude data, findings, comments and recommendations were recorded and checked over and over again.

2.6. Data gathering tools and data analysis

In the study semi structured interviews were benefited from. Interview data were transcribed by researcher electronically. Researcher tried to keep separated from his prejudices in the process of creating themes by writing his opinions about transcribed data in reflective remarks. Besides, researcher's opinions about each participant, interview and analysis process were noted down. After all these studies, gathered crude data were encoded by reading over and over again. As a result of the interpretations made from codes, themes were created.

3. Findings

The opinions of computer education teacher candidates concerning haptic's suitability to constructivist classs environment were taken by means of semi-structured interviews. In the conducted interviews to teachers;

- Is haptic enough for drawing attentions of students to topic in your view?
- Is there any difference between haptic and the other education materials you have seen until today? If there is can you please tell them?
- Does haptic provide required learning environment for students' active learning? Why?
- Does haptic provide required learning environment for students' cognizing learning? Why?
- Does haptic provide required learning environment for students' exploring learning? Why?
- How can you define haptic with a sentence?
- Can haptic contribute to meaningful learning? Why?

questions were directed (same questions were asked to other participants also). The common opinions of computer education teachers gathered from the data analyse were converted into themes and were reflected in the Table 1 together with direct quotations.

Table 1. Post Graduate Computer Teachers' Opinions

Themes/Sub-Themes	Opinions	Teacher Participants					
		X	Y	Z	M	N	O
Sensation	It is a kind of material which teaches students the topics and concepts which they do not understand, and have complexity with ,by living and sensing one-to-one.	+	+	+	+	-	+
Attention	Haptic can increase the interest of students to the topic.	+	-	+	+	+	-
Active Learning	Haptic can provide active learning of students.	+	+	+	+	+	+
Learning Through Exploring	Haptic can help learning through exploring.	+	+	+	+	-	+
Learning Through Cognizing	Haptic can be helpful in students' cognizing the topics.	+	+	+	+	+	+
Haptic/Difference	The difference here is the one-to-one interaction and user feels all the experience.	+	-	-	-	-	+
Research Will	Thanks to this device, if student does not know the topic, haptic encourages the student to make research.	+	-	-	-	-	-
Knowledge Construction	For the students reach the knowledge all by themselves, it contributes to constructivist approach.	-	-	+	-	+	-
Quick Learning	Besides, since it addresses to more than one sense, it accelerates learning.	-	-	+	+	-	-

When Table 1 is examined, it is seen that participants have a common opinion that haptic will provide learning through cognizing, exploring and active. Since mentioned concepts constitute the basis of the constructivist approach, it can be said that participants think that haptic is suitable to constructivist approach.

The themes obtained from the data gathered from the interviews made with science teacher candidates are showed in Table 2.

Table 2. The Opinions of Science Teacher Candidates

Themes /Sub-Themes	Opinions	Teacher Participants									
		L	P	R	S	T	U	V	Q	W	A1
Active Learning	It can provide learning actively.	+	+	-	+	+	+	-	-	+	-
Recommendation	It can be a more efficient material if it isdeveloped.	-	-	+	-	-	+	-	-	-	-
Learning Through Exploring	It presents exploring learning environment to students.	+	+	-	+	+	+	+	-	+	+
Education-Technology	It is a device which shows technology's contribution to education.	-	+	-	-	-	-	-	-	-	-
Misconceptions	It is an effective device in clearing the error among mass, weight and comprehending the gravitation.	-	-	-	+	-	-	-	-	-	-
Attention	In my point of view it draws attention to the topic since it provides one-to-one sensation.	-	-	-	-	+	-	-	-	+	+
Construction of Knowledge	In constructivism, it is aimed that student's reaching to knowledge by himself. Student can reach knowledge by his experiences.	+	-	-	+	+	+	-	-	+	-
Concretization	Physics is an abstract course. It is an effective tool for concretization.	-	-	-	+	-	-	-	-	+	+

When the data in the Table 2 are examined, it is seen that science teacher candidates like computer education teachers, also think that haptic is suitable to constructivist approach. However, some of the teacher candidates think that haptic would be more efficient if it is gained different features. Besides, it can be said that science teacher candidates better comprehend technology's contribution to education by means of haptic.

The themes obtained from according to the opinions of computer education teacher candidates are given in Table3.

Table 3. The Opinions of Computer Education Teacher Candidates

Themes/Sub-Themes	Opinions	Teacher Participants										
		A	B	C	D	E	F	G	H	I	K	L
Concretization	It can be used in teaching of many abstract concepts.	-	-	-	-	+	+	-	-	-	-	-
Concept Teaching	By means of haptic technology, one-to-one animation of the events will provide better concept teaching.	-	-	+	-	-	-	-	-	-	-	-
Meaningful Learning	Provides more stable learning.	-	+	-	+	-	-	-	+	+	-	+
Cost	It costs much.	-	-	+	-	-	+	+	+	-	+	+
Motivation	Increases the motivation.	-	-	-	+	-	-	-	-	-	-	-
Wandering Off The Subject	When a child who does not know computer sees haptic he or she focuses on haptic not on the topic.	-	-	-	-	+	-	-	-	-	-	-
Physical Environment	Its utilization possibility is low in crowded classes.	-	-	-	-	-	-	-	-	-	+	-

As can be seen from the table, in accordance with computer education teacher candidates' opinions, haptic is suitable to constructivist approach. However, it is thought that haptic's utilization in crowded classes will cause financial and temporal loss.

4. Conclusions and Recommendation

According to constructivist approach, individuals form the distinctive knowledge by relating the knowledge which they obtained from making research to prior knowledge of them. Therefore, the cores of constructivist approach are active learning, learning through cognizing, meaningful learning, learning through exploring. In the conducted study, teacher and teacher candidates stated that haptic can provide active, cognizing, exploring and meaningful learning. In this direction, it can be said that haptic is a suitable education tool to constructivist approach.

In the constructivist approach, when individual encounters with new knowledge, he uses the prior knowledge to define and explain the existing situation. If his prior knowledge is deficient in explaining the existing situation, individuals become in search of the encounter which will explain the situation. In the conducted study, computer education teacher explained that *"Thanks to this device student forms new knowledge with the ones he has beforehand, if he does not know haptic will encourage the student to search."* When participant's viewpoint is analysed, it is seen that haptic encourages the individual to search to construct the new knowledge. Research and encouraging research are important in constructivism for constructing the knowledge. Therefore, it can be said that haptic is a suitable tool to encourage student for making research in class environments.

In constructivist approach, class environment is prepared such a way that it will draw interests of learners to subject. Because, interest increases the individual's interest and motivation for subject. Considering the conducted analyses, it is revealed that haptic can increase the interest in learning environments. Since interest will increase both the attention and environmental perception, it will contribute to the construction of new knowledge.

Students construct or associate the knowledge actively with the aid of audition, smell, visual and tactile sensations. In other words, the more addressing to sensations and the more efficient would be the learning environment. Haptic has the features to help perception of individual of new situation actively, in addition to its concretization the abstract concepts with its features like visuality, auditory, tactile and interaction.

In the study, participants mentioned possible problems which can occur in the class environment in addition to haptic's positive features. These problems can be arranged as cost, difficulty of application in crowded classes, and wandering off the subject. The cost of materials' being economic is one of the important issues. Since haptic's price is higher than other education tools and technologies, it is evaluated as a disadvantage. Besides, it is thought that it will cause problems in crowded classes when only one haptic can be afforded in the schools of our country.

Additionally, under the circumstances of our country, since students are newly adapting to computer technology, it is one of the important points that students' attention will wander to haptic instead of the subject.

Mentioned negative features were discussed by experts and tried to be explained. With respect to experts, haptic is more economical when more complex and dangerous applications are taken into consideration than real applications. Therefore, it can be beneficial for educators to think that haptic can be used in teaching more complex topics. Additionally, it is thought that haptic's usability adapted to other kinds of software would be beneficial in changing educators' views.

Students'interests', who cannot adapt to technology, wandering off the other different things, can be prevented by teacher's preparing activities or course plan beforehand. With the concern of students' interest' wandering off, staying away from the technology which can make students live more realistic experiences can prevent integration of technology with education.

As for the haptic's application in crowded classes, one scene of the computer which is linked with device can be reflected on the monitor while the other can be reflected on the curtain by projector. While a student is making application with the computer others can observe the interactions take place in simulation from the curtain. Preparing work sheets suitable to topic can help students to make discussions and not to wandering off the subject. Thus, all students' being active can be provided and cost can be reduced to its lowest level.

In science course, many abstract concepts are not comprehended by the students. Haptic presents knowledge to students concretizing it, giving a chance to sense concepts like gravitation, weight in virtual environment. Maybe in this way, students' misconceptions would be eliminated and the abstract concepts' learning would be easier.

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