The Impact of a Question-Embedded Video-based Learning Tool on E-learning[*]

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Abstract

In this study, it is mainly focused on investigating the effect of question-embedded online interactive video environment on student achievement. A quasi-experimental design was development to compare the effectiveness of a question-embedded interactive video environment (QVE) and an interactive video environment without the question component (IVE). The data were collected from 318 teacher education students enrolled in an introduction level computer literacy course. Two different course materials were designed, developed and implemented to teach the same content and the same data collections instruments were used to assess student achievement. A computer knowledge evaluation form was utilized at the beginning and at the end of the study to examine about the students' computer literacy and knowledge. A quantitative design method was used to inquire the effect of question-embedded online video-based environment tool on student achievement. Two quizzes and two surveys were performed. The research results show that the question-embedded video-based environment tool promote the student learning, improve the amount of interaction of the student as well as time spent with the learning materials. Simply incorporating interactive video into e-learning environment may not always result with improving learning. However, QVE tool may lead to better learning outcomes and higher learner achievement.

Key Words

Video-based Learning, E-learning, Online Education, Distance Education, Design Learning Tool.

Film and video as powerful complements to instruction have been promoted to classroom instruction since 1950 (Marchionini, 2003). Video, combination of images and sound, creates a powerful medium for explanation of concepts while instructing learners with content that provides multiple senses. Advanced developments in a computer and software technology made it possible the use of dynamic visualizations to illustrate abstract cognitive processes or concepts (Casey, 1996; Chee, 1995).

The results of some research studies show that a face-to-face instruction is not necessary for learning (Chang, 2004). Other forms of instruction can be used for learning such as distance education. According to some reports, distance learners prefer instructional videos to other instructional media (Chang). More than half of distance education programs in the US have used some form of video materials (National Center for Education Statistics, 1999). The internet technologies provide new possibilities for delivering educational video more easily than ever before. These new possibilities provide opportunities for learners to watch the instructional video and also interact with each other from where they have internet connection. Therefore, instructors at all levels have an opportunity to incorporate video and interactive materials in their classrooms.

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Information technologies such as Internet and digital libraries have evolved with time and allowed creating and designing new educational environments for teaching and learning. Nowadays, some of the educational institutions have distance education programs where learners can participate, complete their higher education, and get a certification through online (Bian, 2009).

Advanced internet technology makes it possible to transfer information faster from one place to another, download educational data sooner, and browse educational websites easier than ever before. Moreover, advanced mobile technology makes it possible to connect internet from anywhere and anytime allowing students to continue their education from a distance (Hepp, Hinostroza, Laval, & Rehbein, 2004).

Digital libraries can be defined as a collection of documents in organized electronic form which are audio and video materials converted and coded such as mp3, mp4, wav, mpeg, avi, mov, etc., available on the internet or stored in CD, DVD, or hard disk. Advanced information technologies allow to store, recall and deploy digital materials in electronic database through internet that makes possible to deliver digital libraries to the remote students who do not have physical access to the campus (Zhang, Zhou, Briggs, & Nunamaker, 2006).

Prior studies investigated the learning outcomes of video-based instruction delivered as distance education (Zhang et al., 2006). In such studies, video-based instruction either broadcasted through TV programs or recorded on CD-ROMs was mainly used as the educational material. These non-interactive video instructions produced unsatisfactory results (Kozma, 1986). Recent studies on advanced multimedia and communication technologies have showed that the non-linear, interactive digital video technology allows students to interact with instructional video that may increase students' engagement with learning material, and improve students' learning (Zhang et al.). Attribution of interactive video is usually defined as random access to video content (Salomon, Perkins, & Globerson, 2003) and users can select, stop or play a video segment with minimal effort and time (Zhang et al.). There is enough research on the effectiveness of interactive video-based instruction on student learning; however, we need more search on the effectiveness of various interactive activities embedded on instructional videos. Furthermore, there is not enough research on how interactivity embedded on video-based instruction affects student achievement.

In a previous study, Vural and Zellner (2010) investigated how concept mapping in video-based learning impacted on student achievement. The previous study results showed that the amount of time spent on interactive video-based environment tool did not explain student achievement (Vural & Zellner). Creating concept mapping is a time consuming process and required student to spend a lot of time. Therefore, in the previous study the amount of time spent on interactive video may not explain the relationship between student achievement and the amount of time spent on the learning tool. In this study, instead of concept map, multiple-choice questions are embedded in instructional video clips and it is believed that this tool helps to find out the relationship between student achievement and the amount of time spent on the learning tool.

In the present research, the purpose is to investigate the effect of a question embedded online interactive video environment on student achievement. To accomplish the research purpose, a quasi-experimental design was development to compare the effectiveness of a question-embedded interactive video environment (QVE) and an interactive video environment without the question component (IVE).

Theoretical Ground of the Research

This research was conducted based on two theories which are cognitive information processing theory and constructivist learning theory.

Constructivism

Constructivism refers to the idea that learners construct knowledge for themselves. Constructivists assume that learners do not just comprehend information as they encounter but also they do a great deal with the information they get, trying to organize and make sense them in light of prior knowledge, experience, mental structures, and beliefs (Ormrod, 2004). Constructivists claim that learning occurs when a learner constructs knowledge for themselves (each learner individually and socially construct meaning) based on past experience. Constructivism is student-centered that means learners play active roles in learning activities. When learners, active in learning activities, can engage and motivate learning more effectively than activities where learners are passive. Learners are expected to learn better when instruction is constructed based on constructivism; learners use prior knowledge to solve complex problems, discover things by them-

selves, and control the pace of learning (Leidner & Jarvenpaa, 1995). Therefore, we can expect that self-motivated and interactive learning would improve learning outcome.

The constructivist learning theory argues that learners should engage in the process of learning instead of finding a correct answer. On the other hand, teachers' role, in this theory, is to help learners when it comes to their own understanding instead of giving a lecture. Therefore, richer learning environment such as graphics, video, and other media and educational materials is required to aid learners discover things by themselves. This environment also enhances learners' interest and participation to learning materials. Brandt (1997) asserted that constructivism is a basis for e-learning, especially for web-based learning. E-learning constructed by the constructivists learning theory should enable learners to engage in interactive, self-motivated, creative, and collaborative learning activities during constructing their own knowledge (Zhang et al., 2006).

Cognitive Information Processing Theory

The cognitive information processing theory is the extension of the constructivist learning theory and focuses on cognitive processes used in learning (Leidner & Jarvenpaa, 1995).

Cognitive information processing theory looks at the role of the memory. According to the theory, individuals receive information, then organize group of information, then connect it with previous knowledge, then transfer and encode it in memory to store, and then recall from memory to apply knowledge across learning environment. Reiser and Dempsey (2007) mentioned that the cognitive information processing theory emphasizes using different instructional strategies that focus the learners' attention, support encoding and retrieval, and provide for meaningful, effective practice across learning environment.

A major assumption of the theory is that learners have different learning style. If instructional method is prepared in terms of learners learning style it will be the most effective (Bovy, 1981). This implies that individualized instruction is needed for learning. The cognitive learning theory also supposes that the individual's prior knowledge is an important factor to determine how effectively the learner will process new information. This suggests that the instructional support is required to complete individual's missed knowledge based on the depth of existing knowledge (Bovy). A third assumption

is that a learner has limited capacity of mental system. Therefore, learners' attention is the key factor when someone learns new information by coding in limited capacity of human memory. Selective attention is an interrelated with the prior experience and the cognitive structure of the learner. If a learning tool helps to enhance learners' attention it might improve learning because it attracts attention (Bruning, 1983). People cannot learn when they are not paying attention to the information. Interactive, self-motivated, creative, and collaborative learning activities enhance learners' attention and aid learning. Therefore, we can assume that interactive, self-motivated, and richer media should be more effective than the media is lack of these features. Interactive question-embedded video-based online learning environment is required learners play an active role. The learners can control the video and can watch it as many time as they want. Graphics, pictures and voices enrich the learning environment. Furthermore, it helps students with different learning styles by presenting visual and auditory learning materials. Based on constructivism and cognitive information processing theory, interactive video-based tool can be used on online learning because video catches the eye, enriches the environment with graphic, text, and audio. Instructional video expresses more information, demonstrates complicated process and explains abstract concepts which are usually difficult to explain. It is the reason why online learning institutions prefer video-based learning into instruction.

According to constructivist learning theory and cognitive information processing theory, when we design video-based learning instruction that is required the learners' engagement in learning process and the learners' interaction with the instructional video that may cause learning better for a difficult content.

Video-based E-learning Tool

Many research studies related to e-learning have provided that students get benefits from e-learning (Zhang et al., 2006). These benefits can be summarized as providing time and location flexibility; helping educational institution to save time and money; providing self-directed and self-paced learning activities; building an environment to study collaboratively in distance; make available learning materials anytime (Baloian, Pino, & Hoppe, 2000; Kumar, Kumar, & Basu, 2001; Piccoli, Ahmad, & Ives, 2001).

Wetzel, Radtke, and Stern (1994) mentioned that instructional video increases learners' interest in a

learning topic and motivation to learn a new subject. Some researchers reported that students find instructional video attractive and taking them to higher degrees of satisfaction (Kearney & Treagust, 2001). Donkor (2010) compared the instructional effectiveness of the video-based instructional materials and traditional print-based instructional materials. The investigation results showed that video-based instructional materials are pedagogically superior to the traditional instructional materials when used as distance education materials. In the recent research result of Donkor (2011) showed that when the quality of the instructional video materials such as content, text, images, and sound appear good and visible, online learners responded positively to the video-based instructional materials. According to Donkor the use of video-based instructional materials is likely to increase learners' motivation, interest, and practical skills acquisition. Under the view of these previous research findings, the purpose of this study is to examine the impact of the learning tools presented online on student achievement.

The following the research questions guided the study to accomplish the purpose as present above

1. Is there a difference between QVE tool and IVE tool with respect to the amount of interaction and time spent?

2. Is there a relationship between student achievement and the amount of interaction with the QVE tool?

3. Is there a difference between the effect of the QVE and the IVE tool on student achievement?

Method

The research was conducted in the spring of 2012. Two different video-based learning tools embedded in the online component of an introduction level computer literacy course offered at a large public university in southeastern Turkey. Three hundreds and eighteen teacher education students (205 females and 113 males) participated in the study. The convenience sampling method was used to assign the students into the treatment groups. In this quasi-experimental design study, a quantitative research paradigm was utilized to explore the effect of a question embedded video-based learning tool on student achievement. Student achievement is a dependent variable. The amount of times spent while interacting with the learning materials, the number of actions on the course site, the pre and post test results gathered from the instructional materials

are independent variables. The independent variables help us predict how these two different instructional tools should be used to improve online video-based learning.

The 318 participants were divided into two treatment groups; QVE and IVE groups. The IVE group contained 143 participants from the Elementary Mathematics Teacher Education and Primary School Teacher Education programs established in the School of Education. There were 175 participants who followed the QVE instruction. The QVE group contained teacher education students from Turkish Language Art and Psychological Counseling and Guidance Education programs located under the same School of Education. Table 1 presents the number of students in each group and the distribution of the participants by gender.

Table 1.
Distribution of the Participants by Treatments Groups and Gender

Treatment groups	The Program of the Students	Female	Male	Total
IVE	Elementary Mathematics Teacher Education	46	17	63
	Secondary Elementary Mathematics Teacher Education	33	13	46
	Primary School Teacher	27	7	34
QVE	Turkish Teacher Education	47	34	81
	Secondary Turkish Teacher Education	37	29	66
	Psychological Counseling and Guidance Education	15	13	28
	Total	205	113	318

Two different course materials were designed, developed and implemented to teach the same content and the same exams were performed to evaluate to the students achievement. The interactive video-based learning materials for the first group and the question embedded video-based learning materials for the second group were delivered through online. The only difference between groups was the student interactions with the developed materials. The course was conducted through online and the students had to log in the course site once three weeks. The both groups were the responsible for learning the content to pass the course.

QVE tool was created based on the constructivist learning and information processing theory and it was supposed that using QVE tool in education enhances the learners' achievement. QVE tool, consisted of 83 short instructional clips, is required the learners to watch instructional video clip more

carefully to complete instruction since the learners should respond correctly the multiple-choice question at the end of each clip to pass the next clip. This interaction requires for the learners' attention and self-motivation.

The first group was not required to interact with the course materials while they were watching the instructional videos through online from the course website. The video could be watched randomly anywhere and anytime. However, the second group was required to interact with the course materials while they were watching them through online from the course website. They had to watch the video in a sequential order. The second group students should have watched very carefully the instructional video and answered correctly the multiple-choice question to continue the next video clips. The instructional video created for the both groups consisted of several short video – video clips. In addition, the instructional material created for the second group included the multiple choice question related to prior video clip was embedded between two sequential video clips. The students have to answer correctly of the question to watch the next video clip.

Data Sources

In the study, the data were collected using a computer knowledge evaluation form. The amount of interaction with Moodle site and the amount of time spent with the learning materials were recorded by Moodle for each user. The data was used to determine the number of times each user interacted with the learning tool and the amount of time each user spent on the learning tool. At the end of the instruction, both groups took the same post test on the content delivered by the instructional clips. The test results were used to compare the scores of treatment group.

Data Collection Instruments

Three tools were utilized to collect data from the participants in order to answer the research questions.

The Computer Knowledge Evaluation Form: Students filled out the *Computer Knowledge Evaluation Form* twice, at the beginning and at end of the study. The purpose of the form was to collect data on the participants' technology knowledge, their level of access to technology, and how frequent and for what purposes they use technology.

The form examined about the students' computer literacy and their experience and knowledge with Content Management Systems (CMS). Moodle (CMS)

was used to deliver the course materials. The results showed that the students in each group did not significantly differ in relation to previous computer knowledge as well as experience with CMS. The table 2 and 3 below show that the students were not familiar with CMS; log in and log out the course website, discussing on the forum site with classmate, chatting in the chat room, downloading and uploading the course materials on the course website. The most of them took online course first time in their education lifetime.

The Course Management System, Moodle: Moodle is an open source Course Management System, also known as a Learning Management System (LMS) or a Virtual Learning Environment (VLE). It has been used as a tool for creating online dynamic web sites for their students to enrich a learning environment (Dougiamas & Taylor, 2003). Many educational institutions use it to conduct fully online course or some uses it to enhance face-to-face course known as blended learning. Moodle includes the many activity modules that enrich learning environments such as forums, databases, wikis, email, discussions. Also it is very convenient to follow users' interaction while they log in and use Moodle activities.

Moodle records every movement and time of the action in the course site until users log out the Moodle site. These data are recorded in the server and can be reached by an admin user or a user set by an admin user. The data recorded during the experimental study were backed up and used in the study analysis.

Quizzes: Two quiz results were used in the study. The first quiz results were collected from a content that was taught using the same interactive online video instruction for the both groups. The first quiz results were used as a covariance to reduce bias between groups on one or more variables (Glass & Hopkins, 1996). The latter quiz was conducted after the treatment. The second quiz results were used to analyze the relative effectiveness of two instructional activities.

Data Analysis

Three different data analysis methods were utilized to find out the answer of the research question. Descriptive analysis was conducted to show the amount of interaction and time spent with the learning tools. As it is seen on the table 6, the difference between the amount of interaction and time spent with the learning tools are clear. Furthermore, descriptive statistic was utilized to show the frequencies of participants' responds for the computer knowledge evaluation form. The level of knowledge of the participants about CMS is shown on the table 2 and 3 below.

Regression analysis was utilized to find out a relationship between student achievement and the amount of interaction with the QVE tool. Table 4 below shows the regression analysis result.

ANCOVA analysis was utilized to find out a difference between the effect of the QVE and the IVE tool on student achievement. The pretest scores of the two groups were significantly different (t = 2.518, p = .012, $p < .05$, alpha level at .05) so the pretest scores was used as covariance to remove the bias of the group differences. ANCOVA analysis result is shown on the table 7 below.

Question Embedded Video-Based Environment Tool (QVE): The question embedded video-based learning tool, used mainly in the study, was developed to teach MS PowerPoint 2010. The course material comprised the two parts: (a) video section and (b) multiple-choice question section. The video section consisted of basic (56 short video clips) and advance (27 short video clips) instructional videos. The basic instructional video mainly included the information about MS PowerPoint 2010 platform, the properties of the button on the platform, and creating simple presentation. The advance instructional video gave more specific information used mostly to design more complex presentation. After watching each short video clip, students should answer a multiple-choice question to watch a next topic. The multiple choice questions were created from the content of the short video played recently. If the answer was wrong, the student would watch the same video again.

QVE tool is a multimedia-integrated into the e-learning (Moodle) system for the research. In order to increase learners engagement, the QVE tool was designed and implemented to the course website that provide self-paced, limitless learning environment. The second group students could log in the course website and use QVE tool from anyplace having internet connection whenever they wanted. The course topic designed and developed from the same course materials taught previous years was professionally converted into video and delivered through online. The course topics were divided into short clips, each of which plays among two to five minutes. The students should follow the sequential orders of the instructional video. Moodle environment records any actions of students; such as, click play button, stop button or pause button of video, log in and log out the site, interaction which parts of the course site. These data were used to find out the relationships between students interaction with the learning tool and students achievement.

Interactive Video-Based Environment Tool (IVE): IVE is a multimedia-integrated into the e-learning (Moodle) system for the research. The same as QVE tool, the first group students could log in the course website and use IVE tool from anyplace having Internet connection whenever they wanted. Although the same instructional videos were embedded in QVE and IVE tool, the students could start from any part of the video clips and could jump one video clip to another video clip without any restriction in IVE tool. The students were not required to answer any question before or after watching the instructional video. The IVE tool did not expect from the students interacting with the instructional video directly

Results

Computer Knowledge Evaluation Form was used to find out the students background knowledge and experience about e-learning system. Table 2 below shows that the students' experience and knowledge about CMS at the beginning of the study.

Table 2.
Participants' Level of Knowledge about CMS at the Beginning of the Study

Knowledge to do	Excellent	Good	Moderate	Poor	Don't know
Log in and out CMS	75	49	49	58	155
Join forum discussion in CMS	101	50	51	57	127
Join synchronous discussion in CMS	61	55	48	37	185
Participate in CMS activities	170	60	57	53	46
Download and upload course materials from CMS	141	70	70	49	56

Table 3 below shows that the students experience and knowledge about CMS at the end of the study.

Table 3.
Participants' Level of Knowledge about CMS at the End of the Study

Knowledge to do	Excellent	Good	Moderate	Poor	Don't know
Log in and out CMS	261	49	35	14	15
Join forum discussion in CMS	139	79	68	33	55
Join synchronous discussion in CMS	92	63	66	44	109
Participate in CMS activities	218	67	40	33	16
Download and upload course materials from CMS	188	78	52	35	21

The data sources from students were collected in several ways: (a) Computer knowledge survey, (b) pretest used as covariance, (c) posttest used to evaluate the learning tools, (d) recorded data during the interaction of the students with the short video. These data were used to find out how the QVE tool enhances student achievement, improve learning effectiveness, and affects the interaction of the students with e-learning material in e-learning environment.

A regression analysis was conducted using student achievement as the dependent variable and the amount of interaction with QVE tool as the independent variable in order to determine the effect of interaction with QVE tool on student achievement. The regression analysis ((β = .303, $p < .001$) showed that student achievement was related the interaction with QVE tool. The regression analysis result is shown on the table 4.

Table 4.
Regression Analysis for Student Achievement and the Number of Interaction with QVE Tool

Variable	Standardized Coefficients β	Std. Error	t-Statistics	Prob.
Constant	72,913	1,050	69,448	<0,001
The number of interaction with QVE tool	,303	,005	5,661	<0,001

The table 5 below shows the amount of interaction and time spent of the two groups with the two learning tools. According to the table 5, the students in the group using QVE tool spent more time and interacted more with the learning material than the students in the group using IVE tool.

Table 5.
The Amount of Interaction and Time Spent with the Learning Tool

Groups	Interaction with learning tool			Time spent with learning tool		
	X	sd	n	X	sd	n
E-learning group with IVE tool	4,19	4,27	139	6,35	10,64	139
E-learning group with QVE tool	198,45	214,29	179	189,99	209,96	179

Note: X – mean; sd – standard deviation; n – sample population

In the study, ANCOVA analysis was conducted to increase statistical power and reduce bias to statistically equate groups (Glass & Hopkins, 1996). In addition, ANCOVA statistical model was used to eliminate group differences and reduce the magnitude of the error. As you see the pretest scores of the students in the Table 6, the pretest scores of the groups are significantly different (t = 2.518, p = .012, $p < .05$; alpha level at .05) so ANCOVA statistical model is used to eliminate the effect of internal validity and to control for the differences on the independent variable. Pretest score as a covariance was used to control how much two group students' scores change together. Posttest score (student achievement), shown in the Table 6, as the dependent variable and student groups as the independent variable were used to analyze the relative effectiveness of two instructional activities.

Table 6.
Descriptive Statistics for Pretest and Posttest Scores of the Treatment Groups

Groups	Pretest			Posttest		
	X	sd	n	X	sd	n
E-learning group with IVE tool	70,28	13,012	139	72,59	17,353	139
E-learning group with QVE tool	73,71	11,229	178	78,59	15,882	178
Total	72,21	12,144	317	75,96	16,783	317

Note: X – mean; sd – standard deviation; n – sample population

The result of ANCOVA analysis shown in the Table 7, F(1, 314) = 4,615, p = .032, $p < .05$, indicated that the students who took the QVE tool significantly got better results than the students who took the IVE tool. The effect size of the study is found as ( ) (partial eta squared) = 0,014.

Table 7.
ANCOVA Results of the Achievement Scores of the Treatment Groups

Source	Type III Sum of Square	df	Mean Square	F	p
Intercept	3716,12	1	3716,12	19,524	<0,001
Pretest	26435,84	1	26435,84	138,887	<0,001
Group	878,51	1	878,51	4,615	0,032
Error	59766,84	314	190,34		
Total	1918029	317			

Dependent variable: Student achievement; Adjusted R Squared = 0,324; Computed using alpha = 0,05

Based on the findings, it can be concluded that using the QVE tool as e-learning materials aids the students' learning. The students who used the QVE tool spent more time and more interacting with the learning materials than the students who used the IVE tool. There is a relationship between the amount of the interaction with the learning tool and the student achievement. Therefore, the stu-

dents who used the QVE tool interacted more with the learning materials and got higher achievement.

Discussion and Conclusion

In the study, the researcher investigated whether the QVE tool enhances students' achievement and improves learning effectiveness in e-learning environment. The findings indicated that the QVE tool promote students' learning, improve students' interaction as well as time spent with the learning materials. These findings imply some helpful information about how to design and present an instructional video in an e-learning environment to enhance the amount of interaction and higher achievement. The results of this study and the previous studies show that video-based learning tool should be designed to incorporate learners in the learning process by doing interactive activities. The cognitive information processing theory and constructivism theory also support this finding. A video-based learning tool should encourage and motivate learners to attend learning environment by doing activities such as creating concept map related to video contents (Vural & Zellner, 2010) or keep learners' interests up by requiring them to complete learning activities such as a gap-filling, answering a multiple-choice or a tag question, matching etc., to continue the next part of the instructional video. The QVE tool users stayed more in the learning environment because they might think that the similar questions would be asked in the final exam. That might motivate the students to stay more and watch all the clips.

In the previous studies, the researchers have reported mixed results with delivering video-based learning on e-learning systems (Zhang et al., 2006). The study results showed that simply incorporating video into e-learning environment may not always result with improving learning since it does not motivate individual to interact with instructional video materials. However, the QVE tool, that provides individual to control video, requires individual to spend more time and interacts with the instructional materials to finish learning content, may lead to better learning outcomes and higher learners' satisfaction. The results indicated that the students using the QVE tool spent more time in the course site (it is usually more difficult to motivate students to spend more time on site in e-learning), interacted more with the learning materials and got higher achievement from the course. The study supports the previous finding and constructivism and cognitive information processing theory that interactivity with learning materials can be a more valuable criteria in the video-based learning in e-learning en-

vironments to improve the student achievement. The implication of the study is that the QVE tools or the similar video-based tools can be utilized in online education to enhance student achievement and improve the interaction with the instructional materials

Another important result is that students learn an environment of a learning tool presented. The participants learned to use the environment of Moodle (CMS) without giving a special training. Even they learned how to use some features of CMS not required to use during the video-based instruction. It means that if we want to teach a new e-learning environment to a student, one way might be to create a log in account for each user and ask them to complete an obligation for a course. If the obligation requires many things to do, it might yield better results.

Limitation and Future Study

There are some limitations that need to be addressed and acknowledged regarding the present study:

1. Some participants might download the instructional videos and watch them without visiting the Moodle course site. Furthermore, they might share these videos with their classmates. This may affect the validity of the study.

2. Some participants filled out the Computer Knowledge Evaluation Form more than one. The first form was accepted as data source that may affect the reliability of the study.

3. The study was conducted as a part of the course so that some participants may have bias when they filled out the Computer Knowledge Evaluation Form.

A number of suggestions may be made for related future studies.

1. A similar study can be conducted on students in different classes to find out relationships among the knowledge of educational technology, the effectiveness of interactive instructional video and the level of classes.

2. The QVE and IVE tools and other learning tools can be used for teaching different course topics; such as, topics from History, Biology, Chemistry or a topic from English Literature, and then the impact of the learning tools on different topics can be investigated.

3. Instead of embedding questions, another interactive instructional activity can be embedded into a video-based environment to find out the impact on student achievement.

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