Journal of Education and Learning; Vol. 10, No. 3; 2021
ISSN 1927-5250 E-ISSN 1927-5269
Published by Canadian Center of Science and Education

Text-Based Video: The Effectiveness of Learning Math in Higher Education Through Videos and Texts

Yaron Ghilay[1]

[1] The Neri Bloomfield School of Design and Education, Haifa, Israel

Correspondence: Yaron Ghilay, the Neri Bloomfield School of Design and Education, Haifa, Israel. E-mail: yghilay@gmail.com

Received: March 2, 2021 Accepted: April 8, 2021 Online Published: April 13, 2021

doi:10.5539/jel.v10n3p55 URL: https://doi.org/10.5539/jel.v10n3p55

Abstract

The Text-Based Video (TBV) model is a particular case of the more general Video-Based Learning (VBL) model in which an instructor's curriculum is fully covered by high-quality videos and texts. The aim of this study is to test the effectiveness of the TBV model by examining and comparing its two main components: Videos and texts.

The model is based on the creation of high-quality texts which form the basis for high-quality video clips. It is designed to improve learning in quantitative courses in higher education.

The research was based on a sample of students $(n = 70)$ who enrolled in the course Mathematics for Business Administration at the Neri Bloomfield School of Design and Education, Haifa, Israel that was based on the TBV model. The course was given during the five academic years 2016–2021 using different teaching formats: face-to-face learning, distance learning and blended learning. Learners were asked to answer an online questionnaire that assessed the characteristics and advantages/disadvantages of TBV.

The findings show that although students preferred watching videos based on texts over reading those texts alone, students opined that the combination of video and text was by far the most effective instructional method. All results were identical regardless of whether face-to-face, distance or blended learning was used.

Keywords: blended learning, distance learning, higher education, math, screencast, TBV (Text-Based Video), VBL (Video-Based Learning), video capture

1. Introduction

1.1 General Background

Video technology is excellent for online learning, especially as an asynchronous replacement for or supplement to face-to-face learning. The two main ways for producing video clips are using a camera or technology called video capture or screencast (Ghilay, 2018a; Ghilay, 2018b; Ghilay, 2017a; Ghilay, 2017b).

A screencast is a digital recording of computer screen output, usually containing audio narration. While a screencast is comparable to a screenshot, the latter generates only a single image of a computer screen whereas the former creates a movie of the changes that a user sees over time on a computer screen. This movie can be enhanced by audio narration and captions (Screencast, 2021). The aim of such screencasts and video tutorials is to teach specific subject matter by demonstrating the actions associated with that content area (Ghilay & Ghilay, 2015).

The combination of sound and images within a screencast enhances online learners' experiences and can be a powerful method for communicating content in an online setting. Mayer's (2001) theory of multimedia learning suggests that combined animated and audio presentations (essentially moving pictures and sound) provide a more effective learning experience than still pictures accompanied by text, the more traditional approach. This corresponds to Paivio's (2007) dual coding theory wherein information processed through discrete input channels—both linguistic and non-linguistic—improves the learning experience.

After recording a screencast, it can be edited to produce additional changes, including splitting and merging sections, hiding and exposing parts of the screen or adding photos, titles or subtitles (Ghilay, 2018a; Ghilay, 2017a; Ghilay, 2017b). A screencast is superior to a video camera recording and can give learners even more dynamic and exciting content (Ruffini, 2012).

Videos can make class time more productive for both teachers and students who can use this tool to create videos to explain content, vocabulary, etc. Screencasts increase student engagement and achievement and provide time for students to work collaboratively in groups. Screencasts help students think by means of cooperative learning. In addition, screencasts allow students to move at their own pace since they can pause or review content anytime, anywhere. Screencasts are excellent for those who need oral as well as visual explanations of the course content (Screencast, 2021).

The enormous increase in smartphones and tablets allows students to overcome constraints of time and location by watching educational videos anytime, anywhere (Campbell, Grossman, Kris, Kazer, & Rozgonyi, 2010; Ghilay, 2018a; Peterson, 2007). An additional advantage of screencasts is that digital video presents expert's actions simultaneously accompanied by their audio commentary (Wouters, Paas, & van Merrienboer, 2008) making screencasts pedagogically equivalent to face-to-face instruction. It has been shown that videos help students understand and assimilate content in quantitative courses (Ghilay, 2019; Pang, 2009; Traphagan, Kucsera, & Kishi, 2010).

By using screencasts as opposed to conventional printed media, information can be delivered and processed effectively (Lloyd & Robertson, 2012). Processing printed media involves complex cognitive functioning because texts compete with illustrations, both of which use the same visual channels (Mayer, 2005). By using screencasts, the load on visual and verbal channels of working memory is minimized. This, in turn facilitates more effective learning.

Nowadays, educators use screencasts in diverse disciplines such as computer programming languages (Yuen, 2007), instructional design and technology (Sugar, Brown, & Luterbach, 2010), object-oriented programming (Lee, Pradhan, & Dalgarno, 2008), mathematical modeling (Ellington & Hardin, 2008), nursing (Phillips & Billings, 2007) and more. These screencasts and video tutorials demonstrate specific actions associated with particular content area.

The use of screencast technology does not require significant investment in technological infrastructure or in software development teams. The lecturer needs to learn the educational and technical aspects of video capture and then with minimal equipment—a personal computer and microphone, suitable software and access to Learning Management System (LMS) and file-sharing sites such as YouTube or Vimeo—the instructor can experiment with the technology (Ghilay, 2017a; Ramli, Yunus, Mohid, Abas, & Baharudin, 2017).

Screencast technology augments a teacher's live lesson. The multimedia lesson becomes a cognitive tool that supports, guides, and mediates the cognitive processes of learners (Kong, 2011). A teacher's entire multimedia curriculum can be made available to students outside the school as a flipped classroom, namely, by studying the course principles at home via screencast technology following by guided practice in class (Smith & Smith, 2012).

1.2 Text-Based Video (TBV): The Conceptual Framework of the Study

Video-Based Learning (VBL) is a method in which a course syllabus is fully covered by video clips, either as a replacement for or as a supplement to live lectures. Recent studies indicate that the VBL model has significant advantages for learning quantitative subjects in higher education: The learning process ensures greater flexibility and higher satisfaction among learners (Ghilay, 2019; Ghilay, 2018a; Ghilay, 2018b).

The Text-Based Video (TBV) model is a particular case of the general VBL model wherein the curriculum is fully covered not only by high-quality videos but also by full texts (Ghilay, 2018a). In TBV, texts have several main functions: they are read by students, they are the basis for class lectures in face-to-face learning and they also serve as a basis for the videos. Both texts and videos cover the same items. The model is designed to improve the learning process in theoretical, quantitative higher education courses such as math, regardless of the mode of instruction: Face-to-face, distance or blended.

In TBV, all clips are produced by a professional screencast tool (such as Camtasia Studio or the equivalent) based on the following procedure (Ghilay, 2018a; Ghilay, 2017a):

1) For each main topic, a text file is prepared and uploaded to the course website (in PDF format). All texts are produced via a combination of a word processor and a specific tool designed for writing mathematical expressions and formulas (MathType or an equivalent). These tools function within the word processing application and enable mathematical expressions to be written conveniently and accurately.

2) The PDF text files are divided into sub-topics and are uploaded to the course website. They are also the basis

for the video clips as well as the lectures (in face-to-face learning). Each clip covers one subtopic.

3) Before starting the video capture process, a title page is prepared that includes information about the institution, the lesson, the instructor, etc. Then PDF text pages are zoomed in in full-screen mode. Every page is completely captured and the lecturer's explanations are recorded using the cursor for pointing out all relevant expressions and formulas.

4) During the editing stage, each page is partially hidden and then gradually exposed to synchronize with the recorded lecture. The page exposure can be horizontal, vertical or both, giving the viewer a feeling similar to an instructor writing on a blackboard. However, in distinction to an instructor's nearly illegible handwriting, the mathematical expressions in the video are clear and easy to read. The capture process is simple and further changes can be made later during the editing phase.

5) After saving each clip to a file, rigorous quality control is applied during the editing stage. Corrections can be made in several ways depending on the type of mistake: In a case of an unnecessary segment, it is deleted. If an error occurs in the audio explanation, the soundtrack of that particular section can be deleted and a new explanation recorded. Usually, there is no need to repeat the whole process of capturing a complete clip. Instead, segments are repaired or improved.

6) After the editing process, a final clip is produced in a common format (Mp4 or the equivalent) and shared on the course website.

The present research, a five-year study, examines usage of the TBV model in an academic setting in order to determine whether there is an advantage to videos over texts and if so, whether texts can be eliminated.

1.3 Examining the TBV Model

Quantitative courses such as math require a deep understanding of complex terms, abstract ideas and complicated procedures necessary for solving mathematical problems (Ghilay, 2018a; Ghilay, 2018b). Recorded videos of lectures and solutions to problems produced by screencast technology can be either asynchronous substitutes for or additions to live lessons. Therefore, such clips are suitable for distance as well as face-to-face learning. In both types of learning, recorded lessons can be viewed several times, either entirely or partially, according to learner preference.

The present study compares the characteristics and advantages of TBV in higher education in various instructional modes: Distance, face-to-face and blended learning. Five groups of students who studied the course "Mathematics for Business Administration" at the Neri Bloomfield School of Design and Education, Haifa, Israel were examined. The syllabus was comprehensively covered by videos produced by screencast technology as well as by full texts. The course included the following topics/subtopics:

1) *Functions*: Definition, set of points, operations with functions, linear functions, graphic description of a straight line, quadratic functions, increasing and decreasing functions, single-valued functions, inverse functions, images, compound functions, even and odd functions.

2) *Linear inequalities*: Attributes, systems of inequalities, union and intersection of inequalities, inequalities including roots and absolute values.

3) *Quadratic inequalities*: Attributes, the inequality that exists for every *x*, quadratic inequalities including roots/absolute values, inequalities with fractions, third and fourth-degree inequalities.

4) *Exponents and roots*: Definition, rules and properties of exponents, zero/negative exponents, laws of roots, fractional (rational) exponents, exponential equations.

5) *Logarithms*: Definition, logarithmic identities, change of base, particular bases, logarithms on both sides of an equation, logarithmic equations.

6) *Arithmetic sequence*: Definition, the n^{th} term, the sum of the members.

7) *Geometric sequence*: Definition, the n^{th} term, the sum of the members, infinite geometric series, cyclic fractures.

8) *Derivatives*: Limits, definition of a derivative, geometrical meaning, derivatives of polynomial functions, derivatives of constant time functions, derivatives of a constant, derivatives of the sum/difference of two functions, product rule, quotient rule, derivative of a composite function, derivative of a logarithmic function, derivative of an exponential function, the tangent equation passing through a point not on the graph of the function, increasing and decreasing functions, maxima and minima.

The course included 317 HD video clips whose total duration was 19 hours 49 minutes. The videos comprehensively covered Topics 1–8 (lectures and solutions for all exercises) as presented in Table 1.

Table 1. Characteristics of the videos

No.	Type	Number of clips	Duration of clips	
			Hours	Minutes
1	Lectures	33	6	36
2	Solutions for exercises designed for preparation before submissions	149	7	5
3	Solutions for exercises submitted to instructor for grading (published after submission)	135	6	8
	Overall	317	19	49

All clips were produced by Camtasia Studio based on the TBV procedure mentioned in Section 1.2.

2. Method

2.1 Framework of the Study: Examining the TBV Model

Students' views towards TBV were examined in a study undertaken at the Neri Bloomfield School of Design and Education, Haifa, Israel.

The study examined 70 students who studied in the first year of the Department of Business Management and who were enrolled in the course, "Mathematics for Business Administration." The course, consisting of two academic hours per-week was given during the years 2016–2021 in both semesters and was based on the TBV model.

2.2 The Research Questions

The research questions were structured to measure students' views of the effectiveness of the TBV model:

1) What is the added value of Text-Based Video (TBV) beyond textual learning for quantitative courses (such as mathematics)?

2) Is there a preference for one of the two methods (video or text) or a combination of the two?

2.3 Population and Sample

Population: All higher-education students studying in courses based on the TBV mode.

Sample: 70 students (academic years 2016–2021) as presented in Table 2:

Table 2. The study groups

No.	Year	Instructional Method	No. of students
1	2016–17	Face-to-face	17
2	2017–18	Face-to-face	29
3	2018–19	Blended: Face-to-face and distance	7
4	2019–20	Semester A: blended, Semester B: Distance	8
5	2020–21	Distance	9
	Overall		70

Students were asked to fill in a questionnaire at the end of the year/semester indicating their view of the TBV model. The questionnaire was anonymous and the rate of response was 100%.

2.4 Tools

Respondents were asked to respond to an online five-point Likert scale questionnaire consisting of 43 items and one open-ended question that examined students' attitudes toward the above research questions. The scale was:1—strongly disagree, 2—mostly disagree, 3—moderately agree, 4—mostly agree, 5—strongly agree. The open-ended question asked: "In conclusion, note additional comments about learning math through videos compared to reading written material."

2.5 Data Analysis

The 43 items in the questionnaire were divided into six factors. Cronbach's alpha was calculated in order to test the degree of homogeneity of each factor's constituent items.

These are the six factors and their constituent items:

1) **Video quality**: The quality of the lecturer's explanations and voice, the pace at which lectures progress, the clarity of presentation of various components, the degree of coverage of lectures and exercises and the efficacy in presentation of all required topics

2) **Text quality:** The clarity of the written explanations, the degree to which lectures and exercises are covered by text and the efficacy in presenting all the required topics

3) **Videos added value as compared to texts:** The ability to re-learn unclear issues after reading by viewing visual and auditory information that gradually exposes the components of the lesson, focusing on relevant topics, providing explanations and interpretations of the text and focusing on various elements such as mathematical expressions, graphic displays, etc.

4) **Preference for videos:** The degree of substitutability of videos for texts, the ability to understand course topics by watching the videos, the ease of learning and the clarity of explanations

5) **Preference for texts:** The degree of substitutability of texts for videos, the ability to understand course topics by reading the texts, the ease of learning and the clarity of explanations

6) **Preference for a combination of videos and texts:** The extent to which there is added value by combining videos and texts.

Table 3 presents all the factors, their internal reliability and the questions in the questionnaire that address each factor. It should be noted that the Cronbach's alpha for all factors is higher than 0.7 and for four factors, it is higher than 0.8. This indicates very high reliability.

Table 3. Factors and reliability

Factors	Questionnaire questions
Video quality	The lecturer's explanations in the videos are clear.
Alpha = 0.729	The lecturer's words (in the videos) are clearly enunciated.
	The lecturer's explanations are presented at a moderate pace (not too fast).
	Mathematical formulas, graphs and tables are clearly presented.
	The videos fully cover the course lectures.
	The videos fully cover the exercises in the course.
	The videos present and illustrate all the topics required for study well.
Text quality	The written explanations are clear.
Alpha = 0.827	Mathematical formulas, graphs and tables are clearly presented.
	The texts include full coverage of the lectures in the course.
	The texts fully cover the exercises in the course.
	The texts present all the subjects required for study well.
Videos added value as compared to texts	The videos allowed me to go back and understand topics I did not understand when reading the text.
Alpha = 0.863	The solutions to exercises presented in the video allowed me to understand issues that I did not understand by looking at the written solutions.
	The videos are an important complement to the written materials.
	The videos allowed me to understand what I could not understand after reading the written material.
	Videos make a unique contribution because they combine visual and auditory information.
	A video is unique in that it exposes the components of the lesson gradually as opposed to text that shows everything all at once.
	The videos make a unique contribution in that they allowed me to focus specifically on a point that was being discussed at a specific moment in the recorded lesson.
	The videos make a unique contribution as compared to the text as they clearly explain and interpret everything that appears in the text.
	Video is unique in that it allows you to listen in a focused way to different explanations while the cursor points at mathematical expressions, graphical display, tables, relationships between different elements and trends from numerical or graphical data. You are requested to express your agreement to the above statement for each item individually:
	- Mathematical expressions
	- Graphic display
	- Tables
	- Relationships between different components
	- Trends arising from numeric or graphic data

Preference for Videos Alpha = 0.801	When videos covering all the material are provided, no written material is required. I would rather mainly study by watching a video than by reading the text. Videos are a complete substitute for written material. I understand most of the topics presented in the video better than reading the material in the text. It's easier for me to concentrate while watching a video than it is to read written material. Videos better present ways for understanding mathematical problems than do texts. Videos have the advantage of explaining mathematical issues more clearly than reading text does.
Preference for Texts Alpha = 0.869	I prefer to learn mainly by studying written material. When I am given written material that covers the entire syllabus, there is no need for videos. I can understand most of the topics in text format better than I can by watching videos. It is easier for me to concentrate on reading a text than it is to concentrate on the video. Texts present ways of understanding mathematical problems better than videos do. Reading texts has the advantage of explaining mathematical issues more clearly than do videos.
Preference for a combination of videos and texts Alpha = 0.764	Each of the two ways has advantages and disadvantages so it is best to combine them. There is a significant advantage to combining videos and texts that cover the entire syllabus. Watching videos and reading texts complement each other and, therefore, both are important. I prefer to learn with a combination of videos and text readings. It is advisable to add videos to the texts of the course.

For each factor, a mean score and standard deviation were calculated. In addition, the following statistical tests were performed ($\alpha <= 0.05$).

1) Analysis of Variance (ANOVA): To check if there were significant differences in all factors among the groups of students enrolled in the course over the course of five years.

2) Paired Samples T-test: Conducted to check if there were significant differences between Video Quality and Text Quality and between the three pairs of Preference for Videos, Preference for Texts and Preference for a combined approach.

3. Results

Students were asked about the six factors characterizing TBV mentioned above.

There was no significant difference in the mean scores of all factors in the different instructional groups during the five academic years studied (ANOVA, $\alpha <= 0.05$). This indicates that results found in academic year 2016–17 were replicated in all the subsequent years. This gives greater validity to the findings. Table 4 shows the mean scores of the five groups aggregated with the ANOVA test, showing that the differences between these groups are not significant:

Table 4. Mean scores, standard deviations, and ANOVA for each factor

No.	Factor	N	Mean	Std. Deviation	ANOVA
1	Video quality	70	4.82	.24	$F_{(4,65)} = 1.590, p = .188$
2	Text quality	70	4.75	.37	$F_{(4,65)} = .470, p = .803$
3	Videos added value as compared to texts	70	4.81	.24	$F_{(4,65)} = 1.710, p = .159$
4	Preference for videos	70	4.12	.71	$F_{(4,65)} = 1.193, p = .322$
5	Preference for texts	70	3.34	1.05	$F_{(4,65)} = 1.738, p = .152$
6	Preference for a combination of videos and texts	70	4.76	.36	$F_{(4,65)} = 1.254, p = .297$

Since the basic requirement of TBV is the inclusion of high-quality videos and texts, a prerequisite for the research was checking the quality of the videos and texts. If this condition held, the effectiveness of the model could be tested. The findings show that the quality of these resources was high: learners gave the video an excellent mean score of 4.82 out of 5 while the quality of the texts also received a high mean score of 4.75 out of 5 (Table 4, Items 1–2).

A paired sample T-test ($\alpha \leq 0.05$) examined video quality and text quality. Results showed no significant differences between them. Video quality was rated at 4.82 and text quality at 4.75: $t_{(69)} = 1.429, p = .157$

3.1 The First Research Question

The first research question explored the hypothesis that Text-Based Video (TBV) had an added value beyond text-based learning. The third item in Table 4 confirms that assumption. According to students' views, the factor "Videos added value as compared to texts" ranked high, receiving a score of 4.81 out of 5. According to students' views, videos have great importance in addition to reading texts. Students say that video clips make it possible to re-learn issues that were unclear after reading. The videos successfully combine visual and auditory information, focus on relevant topics, and provide explanations and interpretations of the text. The open-ended question strengthens the closed-items relating to the first research question. Students emphasize that videos made a significant contribution to the learning process beyond just reading texts. The following students' quotes from the open question convey this notion:

> "Videos are ten times better than reading texts because they explain, clarify and contribute greatly to creating more interest in the learning process."

> "In my opinion the way of studying the course is excellent. The videos are a great addition to the texts and have added value in their ability to explain, interpret, demonstrate and clarify."

3.2 The Second Research Question

The second research question was designed to determine whether there was a preference for one of the two methods, or a combination of both. According to Table 4 (Items 4–6), students preferred watching videos over reading texts. However, they preferred learning by combining both ways rather than using only one. These three factors were ranked as follows: Preference for videos - 4.12, preference for texts - 3.34 and preference for a combination of texts and videos - 4.76.

A paired sample T-test ($\alpha \leq 0.05$) examined all combinations of pairs relating to these three factors. It elucidated significant differences among these factors:

- Preference for videos (4.12) and preference for texts (3.34): $t_{(69)} = 5.003, p = .000$
- Preference for a combination of text and video (4.76) and preference for video (4.12): $t_{(69)} = 6.525, p = .000$
- Preference for a combination of texts and videos (4.76) and preference for texts (3.34): $t_{(69)} = 12.192, p = .000$

This indicates that in students' views, learning through videos is significantly better than learning through texts. Yet, the best way to learn is through a combination of both. As each way has its advantages and disadvantages, it is best to combine them.

Responses to the open-ended question are relevant to the second research question. Students claim that the combination of videos and texts made a direct contribution to learning and understanding. The following student quotes convey this:

> "The way of learning is excellent, and the combination of videos and texts is very important."

> "I understand well by watching the videos. Nevertheless, I think it is very desirable to combine the two methods and certainly not to learn only through texts."

4. Discussion

Quantitative courses in higher education such as mathematics are difficult and demanding because they involve complex principles and procedures and students are required to solve complicated problems. There is significant challenge in designing courses that support comprehensive acquisition of such knowledge. The Text-Based Video (TBV) model meets this challenge by combining the resources of high-quality videos and high-quality texts, with both dependent upon the other: texts have dual use; they are used for learning and teaching and they are the basis for the videos.

As noted earlier, recent studies have found that the general VBL (Video-Based Learning) model has made a significant contribution to the design of quantitative courses in higher education (Ghilay, 2019; Ghilay, 2018a; Ghilay, 2018b). However, studies have not tested the effectiveness of full text coverage as compared to comprehensive video coverage. Moreover, no study has yet answered the question of whether videos are a substitute for texts or whether both tools are needed.

The current five-year study examined the TBV model by measuring its effectiveness with different modes of learning: Distance learning, face-to-face learning, and blended learning. The objective was to determine whether high-quality videos that comprehensively covered an academic course had clear added value over the same coverage by high-quality texts. If so, it is worthwhile to determine whether learning with videos only is sufficient or whether there is an advantage in combining the two resources.

The findings show that there is significant added value to learning through high-quality videos that cover the entire syllabus (average score: 4.81) compared to similar coverage by texts. The reasons are: Videos allow learners to go back and understand topics that were unclear initially because they combine visual and auditory information. Compared to the texts, videos clearly explain and interpret everything that appears in the text. This allows students to listen to different explanations in a focused way while pointing out different elements such as mathematical expressions, graphical display, tables, etc.

That the video alternative was preferred (4.12) over the text alternative (3.34) raises the question as to whether texts are unnecessary and if it is better to learn only through videos or through a combination of videos and texts. The study shows that there is a clear preference for the video/text combination as compared to learning via either resource separately. Each has advantages which serve to complement the other.

5. Conclusion

Studying quantitative courses in higher education is difficult because learners must assimilate complicated theories and acquire the ability to solve complex problems. Combined coverage with videos and texts in a TBV course supports the acquisition of such abilities.

The current five-year study found that a TBV course has significant advantages: Full video coverage makes a dominant contribution to the learning process and a combination of videos and texts is more successful than use of each individual component alone. The findings also show that even using different modes of instruction (face-to-face, distance, blended) the results are stable.

6. Recommendation

As the findings show, the TBV model makes a significant contribution to quantitative higher education courses such as mathematics. Therefore, it is advisable to adopt this model in the relevant faculties. This requires the development and implementation of training programs to enable the academic staff to become familiar with the technology of screencasting and digital pedagogy. The principles of screencasting, as well as additional skills required for online learning can be acquired via the Training for the Management of Online Courses (TMOC) model (Ghilay, 2017a; Ghilay & Ghilay, 2014).

References

Campbell, S., Grossman, S., Kris, A., Kazer, M., & Rozgonyi, J. (2010). *Screen capture classes for student learning and success* (pp. 5579–5584). EDULEARN 10 Proceedings.

Ellington, A. J., & Hardin, J. R. (2008). The use of video tutorials in a mathematical modeling course. *Mathematics and Computer Education*, *42*(2), 109–117.

Ghilay, Y. (2017a). *Online Learning in Higher Education*. Nova Science Publishers, New-York.

Ghilay, Y. (2017b). ODL: Online distance learning of quantitative courses in higher education. *Advances in Social Sciences Research Journal*, *4*(18), 62–72. https://doi.org/10.14738/assrj.418.3698

Ghilay, Y. (2018a). Video-based learning of quantitative courses in higher-education. *Journal of Educational Technology*, *15*(2), 16–27. https://doi.org/10.26634/jet.15.2.14302

Ghilay, Y. (2018b). Math courses in higher education: Improving learning by screencast technology. *GSTF Journal on Education* (JEd), *4*(2), 1–6.

Ghilay, Y. (2019). Quantitative courses in higher education: Effectiveness of a comprehensive course website. *Journal of Online Higher Education*, *3*(3), 2–19.

Ghilay, Y., & Ghilay, R. (2014). TMOC: A model for lecturers' training to management of online courses in higher-education. *Journal of Educational Technology*, *11*(2), 6–16. https://doi.org/10.26634/jet.11.2.2917

Ghilay, Y., & Ghilay, R. (2015). Computer courses in higher-education: Improving learning by screencast technology. *Journal of Educational Technology*, *11*(4), 15–26. https://doi.org/10.26634/jet.11.4.3148

Kong, S. (2011). An evaluation study of the use of a cognitive tool in a one-to-one classroom for promoting classroom-based interaction. *Computers & Education*, *57*(3), 1851–1864. https://doi.org/10.1016/j.compedu.2011.04.008

Lee, M. J. W., Pradhan, S., & Dalgarno, B. (2008). The effectiveness of screencasts and cognitive tools as scaffolding for novice object-oriented programmers. *Journal of Information Technology Education*, *7*, 61–80. https://doi.org/10.28945/179

Lloyd, S. A., & Robertson, C. L. (2012). Screencast tutorials enhance student learning of statistics. *Teaching of Psychology*, *39*(1), 67–71. https://doi.org/10.1177/0098628311430640

Mayer, R. E. (2001). *Multimedia Learning*. Cambridge University Press. https://doi.org/10.1017/CBO9781139164603

Mayer, R. E. (2005). Cognitive theory of multimedia learning. In *the Cambridge handbook of multimedia learning* (1st ed., pp. 31–48). NY: Cambridge University Press. https://doi.org/10.1017/CBO9780511816819.004

Paivio, A. (2007). *Mind and its evolution: A dual coding approach*. Mahwah NJ: Lawrence Erlbaum.

Pang, K. (2009). Video-driven multimedia, web-based training in the corporate sector: Pedagogical equivalence and component effectiveness. *The International Review of Research in Open and Distance Learning*, *10*(3), 1–14. https://doi.org/10.19173/irrodl.v10i3.629

Peterson, E. (2007). Incorporating screencasts in online teaching. *The International Review of Research in Open and Distributed Learning*, *8*(3). https://doi.org/10.19173/irrodl.v8i3.495

Phillips, J. M., & Billings, D. M. (2007). Using webcasts for continuing education in nursing. *Journal of Continuing Education in Nursing*, *38*(4), 152–153. https://doi.org/10.3928/00220124-20070701-06

Ramli, R., Yunus, S. A. M., Mohid, S. Z., Abas, H., & Baharudin, H. (2017). *A review on the innovative use of screencast technique for learning 3D animation software*. Proceeding of IC-ITS 2017 e-ISBN:978-967--2122-04-3, International Conference on Information Technology & Society, July 31st & August 1st, 2017, PENANG, MALAYSIA.

Ruffini, M. F. (2012). *Screencasting to engage learning*. Educause. Retrieved Mars 11, 2021, from http://www.educause.edu/ero/article/screencasting-engage-learning.

Screencast. (2021). *Wikipedia*. Retrieved Mars 11, 2021, from https://en.wikipedia.org/wiki/Screencast

Smith, J. G., & Smith, M. R. L. (2012). Screen-capture instructional technology: A cognitive tool for designing a blended multimedia curriculum. *Journal of Educational Computing Research*, *46*(3), 207–228. https://doi.org/10.2190/EC.46.3.a

Sugar, W., Brown, A., & Luterbach, K. (2010). Examining the anatomy of a screencast: Uncovering common elements and instructional strategies. *International Review of Research in Open and Distance Learning*, *11*(3), 1–20. https://doi.org/10.19173/irrodl.v11i3.851

Traphagan, T., Kucsera, J. V., & Kishi, K. (2010). Impact of class lecture webcasting on attendance and learning. *Educational Technology Research & Development*, *58*(1), 19–37. https://doi.org/10.1007/s11423-009-9128-7

Wouters, P., Paas, F., & van Merrienboer, J. G. (2008). How to optimize learning from animated models: A review of guidelines based on cognitive load. *Review of Educational Research*, *78*(3), 645–675. https://doi.org/10.3102/0034654308320320

Yuen, S. (2007). *Integrating screen-capture based instructional videos into instruction*. Learning Technologies. Retrieved Mars 13, 2021, from http://scyuen.wordpress.com/2007/11/24/integrating-screen-capture-based-instructional-videos-into-instruction/

Copyrights

Copyright for this article is retained by the author, with first publication rights granted to the journal.

This is an open-access article distributed under the terms and conditions of the Creative Commons Attribution license (http://creativecommons.org/licenses/by/4.0/).