

TO WHAT EXTENT DOES THE BLENDING OF DIGITAL LEARNING VIDEO CLIPS IMPROVE LEARNING PROCESS IN MATHEMATICS, PHYSICS AND CHEMISTRY?

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Abstract

Problem solving and critical thinking are the two twins of modern education, and many researchers believe that they are linked – stating that problem solving may be one of the purposes for which we engage in critical thinking. The counter argument is that problem solving in general is an action performed, and if so it may not always be performed by thinking in a critical manner. Linked or not, both can be enhanced and improved through online learning videos. The purpose of this research was to investigate the use of YouTube learning videos and similar online videos created by course instructors as supplementary lectures to enhance students learning of course material and improve their problem solving and critical thinking skills. The research is carried in Prince Mohammad bin Fahd University. The respondents were 225 students. Data was collected using a questionnaire approach. In this paper, we quantitatively focus on ‘How many students use online video for their learning?’ and qualitatively on ‘How satisfied are they with the usefulness of these resources in improving the quality and diversity of their learning skills and exam results in and outside the classroom box?’ We found that about 64% of students do use the online videos for their learning, and about 89% of students widely agreed that the videos were a useful learning resource.

Keywords: blended (or integrated) learning, business and engineering mathematics, natural sciences (physics and chemistry), online (blackboard) educational video clips, YouTube.

1. INTRODUCTION

1.1 Problem Solving Skills— Literature Review & Evaluation

In today’s digital age, social media not only impacts social life but can equally influence academia. Dangers associated to social media and its impact, especially on young learners are undeniable.

Nevertheless, in respect to mathematics and science many research studies report that social media, among them YouTube, can enhance the teaching and learning of these subjects; and improve the quality of problem solving. Social media’s positive impact has enhanced the quality of both teaching and learning in the sciences. The reasons for this are multifaceted and can be attributed to common features found in different social media platforms: a) increased interaction, b) quick feedback, c) diverse audience, d) flexibility, and e) increased access

to content (Penmann and Thalluri, 2014).

We believe that digital numeracy and literacy can be improved via all channels of connection, mainly through Facebook, Twitter, and YouTube.

This work focuses on the role of YouTube in math and natural science education. Unlike other social channels, YouTube is a video sharing site that allows users to upload user-created content onto a customized YouTube Channel. It also allows the user to view videos created by other users by providing a list from which uploaded videos can be chosen. There are a variety of further features on YouTube that makes it especially appealing to users. These include comment threads on one's channel, user-managed videos, and a counter that allows users to keep track of who is watching their videos. YouTube was established in the mid-2000s and the majority students today can be said to belong to the "YouTube Generation" or "Generation Connected" (Barry et al. (2016).

Most students use YouTube to find supplementary material in addition to faculty recommended textbooks and lecture notes. Confirming this, Barry et al. (2016) found that while the great majority of medical students search for supplementary material on social media over three-quarters use YouTube as their primary source. They point out that with greater awareness of animal rights concerns, environmental campaigners, and other restrictions to physical specimens YouTube is an essential source to research for anatomy-related video clips. In regard to PMU, a survey was conducted of third year undergraduate engineering students and the degree to which they utilized YouTube for calculus learning. The PMU survey seems to confirm the results found by Barry et al (2016). A significant number of students had employed web-based platforms to source information with about 82% using YouTube as their primary source of calculus-related video clips (Elgeddawy, Al-Ameen, 2020). Similarly, YouTube clips in other areas of the sciences (astronomy, physics, chemistry, oceanography, geology etc.) will undoubtedly be utilized by learners and teachers who need to engage in actual observation but cannot do so due to logistical, financial and resourcing constraints.

Can YouTube, other than serving as a source material, be used for authentic assessment?

Rose and D. Pecay (2017) believe yes. To check this possibility, PMU year three engineering students were given the option of submitting a YouTube project video on Newton's 2nd law instead of a written assignment. Perhaps predictably, the students who chose to submit their own videos found it much more enjoyable than those who wrote traditional articles on the topic. Furthermore, the former also gained more from the project because they were able to develop their social engagement skills, presentation skills, and in enhancing their creativity.

To enhance and improve problem solving skills, we asked the same PMU engineering students to create a YouTube homework problems bank in selected math and physics topics as part of a class project. It was found that the improvement in grades achieved by students using the bank exceeded the grades achieved by students completing traditional textbook homework problems that covered the same material.

The survey asked some of the faculties involved, 'To what extent homework YouTube bank videos selectiveness can help their objectives in enhancing the effectiveness of their lecturing and teaching methods?' Answers were mixed, but all faculties agreed that the video banks not only benefited the viewer (the students) in learning but also assisted the video creator (the instructors) in teaching experiences that break down barriers such as student and campus location.

The PMU survey agrees with a number of previous studies (Taslibeyaz et al, 2017; Ramlogan et al, 2014) in that: When it comes to cost, video learning is cost-effective. When it comes to location, video teaching is location-free and flexible. When it comes to time, video learning can be available at all hours.

1.2 Critical Thinking Skills— Literature Review & Evaluation

Vander Ark and Schneider (2013) argue on the macro components of deeper learning that are enriched with the use of digital technology. Critical thinking is one of 4 components they identify; namely, communication, learning to learn, and content knowledge. Also, in agreement with Halx and Reynold (2006) the PMU survey found that critical thinking has often been cited as the most important outcome of education.

In an extensive study of exams and analyzing those exam results with the students participating in those exams, PMU researchers found that students could be mainly grouped in two groups: one group is made up of students

who are able to do math and physics well as far as computation and explanation of the results are concerned, yet fail in answering 'Why the formulas used in their answers work?' The other group is made up of students who are able to explain why the formulas work.

The group failing to explain why the formulas work seem unclear about the logical steps involved in order to reach their answers. These logical steps were either unknown or unclear in their cognitive thinking. On the other hand, students who are taught how to think and analyze critically are able to explain why a formula works. Not only are students from this second group able to solve a problem, they can crucially explain the logic behind processes they use in order to reach a solution.

It turned out that the first group of students were taught under instructors who followed a traditional teacher-centered approach to education while, in contrast, the second group were taught by instructors who followed a student-centered approach to education. These findings confirmed Delisle (1997) and Lemke (2001), who were scathing in their condemnation of the traditional approach in failing to develop critical thinking and problem solving skills among students.

When video is incorporated into student-centered learning activities, it can inspire and engage students, increase their motivation, enhance their communication skills and gain them higher marks overall (Willmot et al, 2012).

Can a YouTube-centered learning and teaching foster problem solving and critical thinking skills among the learners?

In our digital age, we believe yes it can; but only if teachers and learners are well acquainted with social media platforms, especially and specifically YouTube.

Since the 1990's, teacher-centered classrooms have been steadily replaced by student-centered classrooms. With the advent of the present digital age, we suggest exchanging the traditional chalk-and-talk lecture technique for YouTube video-style lectures. This approach would provide more time for student interaction in the classroom. This is essential as such teacher supervision would avoid students passively and uncritically watching a video. By having students spend a significant amount of the lecture time watching short motivating videos that would give the highlights and introduce students to the lecture material before starting the lecture.

1.3 Conceptual Framework

In a constructivist learning environment, it is assumed that the frequent usage of relevant educational videos in learning math, physics, chemistry and social sciences has the potential to develop students' problem solving and critical thinking skills. Consistent with this insight, videos from YouTube and blackboard facilities are being perceived as digital tools that have the potential to promote active and constructivist learning (Facione, P., 2011; Pecay, R. D., 2017; Ramlogan, S., Raman, V. and Sweet, J. 2014). The conceptual framework of the current study is depicted in terms of the relationship between two independent variables and one dependent variable. This study conceptualizes the relationship between the perceived integration of constructivist learning through the usage of social media and the development of college students' critical thinking and problem solving skills. Figure 1 visualizes this relationship.

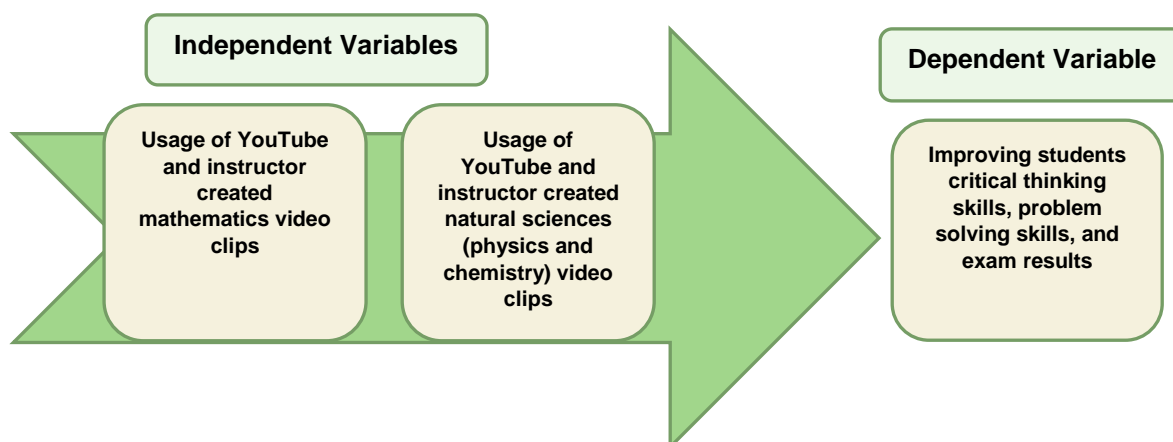


Figure 1: The relationship between two independent variables (usage of YouTube and/or blackboard educational videos in math and natural sciences of physics and chemistry) and one dependent variable (improving student problem solving skills, critical thinking skills, and exam results).

1.4 Statement of the Problem

Research indicates that social media, especially the usage of YouTube, is becoming integral part of the teaching-learning process of the 21st century classroom (Barry et al., 2016). We further go and suggest the need to move from teacher-and/or learner-centered teaching and learning pedagogy to a more innovative **learner-digital teaching and learning** centered pedagogy where students collaborate to discuss and reflect on their constructed knowledge in and outside the classroom box. While a growing body of research spotlights the popularity of social media (YouTube in particular) usage in higher education, few studies have examined the impact of integrating digital learning on university students' development of critical thinking and problem solving skills especially in mathematics and natural sciences classes. Identifying university students' perception in this domain of influence has the potential to help curriculum designers, policy makers, instructors and educators to identify strengths, weaknesses and opportunity for improvement related to the blending and integration of educational social media in higher education.

2. METHODOLOGY & RESULTS

Building on previous results in this field of research (Elgeddawy, Al-Ameen, 2020) we asked the students to indicate whether they had used the You Tube and blackboard video clips for their learning. If the students indicated that they had used the videos for learning, then we asked them to provide a rating for their overall level of agreement with the statement "The YouTube videos and/or blackboard video clips were a valuable learning resource". The level of agreement was measured on a 6-point, with possible ratings: 1 = Strongly Disagree (SD); 2 = Disagree (D); 3 = Mildly Disagree (MD); 4 = Mildly Agree (MA); 5 = Agree (A); 6 = Strongly Agree (SA).

Below, Figure. 2 summarizes overall student satisfaction with the videos (cf. Table 1, 4th column).

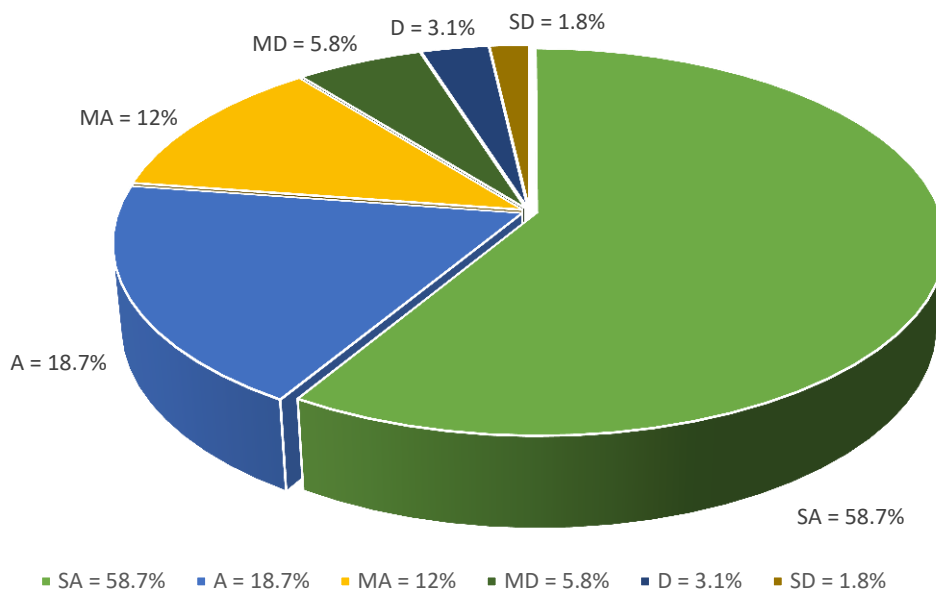


Figure 2: Student responses to the statement "The YouTube and/or blackboard video clips are a valuable learning resource." Strongly Disagree (SD); Disagree (D); Mildly Disagree (MD); Mildly Agree (MA); Agree (A); Strongly Agree (SA).

Below, Table 1 summarizes the percentage use of the videos and student satisfaction data, within specific courses.

Course	Number of survey respondents	Percentage who used the videos	Mean satisfaction (MS), rating out of 6, with the videos as a valuable learning resource to develop problem solving skills, critical thinking skills, and improve exam results	The videos creators
Finite math	25	30%	MS = 4 SA = 5/25; A = 10/25; MA = 4/25; MD = 3/25; D = 2/25; SD = 1/25.	You Tube
Calculus for Business students	25	85%	MS = 4.8 SA = 20/25; A = 2/25; MA = 2/25; MD = 1/25; D = 0/25; SD = 0/25.	Instructor of the course
Calculus I	25	56%	MS = 4.2 SA = 15/25; A = 5/25; MA = 2/25; MD = 2/25; D = 0 /25; SD = 1/25.	MATHWAY; You Tube; Khan; Search engine
Calculus II	25	92%	MS = 4.75 SA = 23/21; A = 1/21; MA = 1/21; MD = 0/21; D = 0/21; SD = 0/21.	You Tube; Blackboard recorded classes furnished by the instructor
Calculus III	25	80%	MS = 3.7 SA = 15/25; A = 2/25; MA = 2/25; MD = 3/25; D = 2/25; SD = 1/25.	You Tube; CHEG; Khan; Other
Algebra	25	25%	MS = 6 SA = 25/25; A = 0/25; MA = 0/25; MD = 0/25; D = 0/25; SD = 0/25.	My Math Lab
Differential Equations	25	100%	MS = 5.75 SA = 1/25; A = 13/25; MA = 11/25; MD = 0/23; D = 0/23; SD = 0/23.	You Tube; Blackboard recorded classes furnished by the instructor
Chemistry	25	68%	MS = 5 SA = 7/25; A = 6/25; MA = 4/25; MD= 4/25; D = 3/25; SD = 1/25.	You Tube; Blackboard recorded classes furnished by the instructor

Physics	25	75%	MS = 5.5 SA = 21/25; A = 3/25; MA = 1/25; MD = 0/125; D = 0/25; SD = 0/25.	You Tube
All	225	64.56%	MS (overall) = 5.08 SA = 123 / 225; A = 42 / 225; MA = 27 / 225; MD = 13 / 225; D = 7 / 225; SD = 4 / 225.	Not Applicable

Table 1: Data for student feedback regarding usage and the statement “The YouTube and/or blackboard video clips are a valuable learning resource in math and natural sciences courses.” Strongly Disagree (SD); Disagree (D); Mildly Disagree (MD); Mildly Agree (MA); Agree (A); Strongly Agree (SA).

3. DISCUSSION

Figure 2 shows that about 89.4% of PMU respondents either “Mildly Agreed”, “Agreed” or “Strongly Agreed” with the statement that “The YouTube and/or blackboard video clips are a valuable learning resource in math and natural sciences courses.” This further is reflected in Table 1 where an overall of 5.08 (out of 6) mean satisfaction (MS) is conveyed by the respondents, in a good agreement with (Tisdell, 2016). Therefore, we have a high degree of confidence that students agreed with the statement “The YouTube and/or blackboard video clips are a valuable learning resource in math and natural sciences courses.”

Compared with previous results in this research field (Elgeddawy & Al-Ameen, 2020), it can be seen from the final row (3rd column) in Table 1 that 64.56 % of 225 PMU students in the study self-identified using the optional educational videos for their learning. On the other hand, the courses with participation rates above 86% were courses where the video creator was also an instructor of the course. This seems to suggest that students were more willing to use learning resources if there is a strong connection between the resources and the instructor of the course, most likely because instructor-made videos make instructor written directions, lectures and problem solution details easier to understand, more equitable and provide accommodations.

Visualization is an important tool in promoting problem solving skills, rather than critical thinking skills. For the uncritical student YouTube and/or blackboard video clips are simply a platform to solve problems without contesting the wisdom of their teachers. For critical thinkers, YouTube and/or blackboard video clips are both -- a platform to solve problems and to actually analyze, and even question, the material they are being taught and are expected to learn. Not all students possess critical thinking skills and some are not interested in developing them.

4. CONCLUSION

YouTube and blackboard educational video clips are an effective, serious and engaging way to learn and present information. It has gained enormous popularity as an educational resource across schools and universities in recent years, especially during the Covid-19 pandemic and the discontinuation of direct teaching in the classrooms.

The outcomes of this study seem to suggest that students are more inclined to use supplementary learning resources furnished by social media channels, such as YouTube videos, and blackboard facilities, if there is a strong connection between the resources and the courses they study formally, especially when the videos creators are also instructors of the course (preferably from their own institution and/or department) most likely because instructor-made videos can be a more friendly approach to support all students, tailor the instruction and lecture content to the needs of the students and the learning outcomes of the topic, and also bring a personal connection to the online learning environment.

If blended learning is a combination of personal activities, tools, and digital resources designed to provide the best possible learning and teaching experience, and the use of learning tools can occur before, during, or after an in-person session and support a variety of educational purposes and goals to enhance problem-solving and critical thinking skills and improve exam results, then the results of this research strongly support the use of

blended learning and teaching in our higher education workplaces.

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