Youtube-Based Teacher-Created Videos For Online Mathematics Learning During The Pandemic And Its Effect To Students’ Mathematics Performance

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Abstract
With the abrupt shift of learning modalities from face-to-face to online learning, institutions, teachers, and students have to rethink and recalibrate their previous instructional approaches as a response to the educational limitations brought by the pandemic. This educational design research aimed to develop YouTube-based teacher-created videos as learning materials for mathematics online learning during the pandemic and determined its effect on students’ mathematics performance. It included 129 non-mathematics major first-year college students from a State University in the Philippines whose mathematics performance was measured through a validated researcher-made questionnaire. Data analysis tools employed for quantitative data were mean, standard deviation and Wilcoxon Signed-Rank test all processed through SPSS. A significant difference was found in the performance of the students before and after the use of teacher-created videos uploaded on YouTube in learning mathematics online which favored the performance after the intervention. Hence, teacher-created videos uploaded on YouTube are indeed effective means of helping the students maximize mathematics learning opportunities online in the new normal. The flexible, personalized, and student-friendly features of the videos suit the students’ need for comprehensive, efficient, and accessible learning materials during the pandemic.

Keywords: YouTube videos; teacher-created videos; online learning; mathematics learning; pandemic learning; mathematics performance

Introduction
The Covid-19 pandemic has drastically affected different educational institutions including millions of students around the world from basic to higher education (UNESCO, 2020). This has spawned teachers and students to migrate educational activities online (Syauqi et al., 2020; Crawford et al., 2020) and through remote learning modality (Hodges et al., 2020). Instructional delivery was revolutionized from classroom face-to-face interaction to online learning with the use of the internet (Radha et al., 2020). Learning institutions all over the world including the Philippines through the Commission on Higher Education encouraged institutions of higher learning to implement distance education methods of learning with the use of educational technology (Hallare, 2020). Online learning had been a widespread solution
during the pandemic in many countries around the globe (Goldschmidt, 2020). Wentling et al. (2000) defined online learning as knowledge acquisition and use as facilitated primarily by electronic means. This is where lessons are delivered through the internet and students can participate in courses anytime and anywhere (Ferreira et al., 2018).

Before the pandemic, several universities had been implementing a transition from traditional in-person teaching to online learning and blended learning (Bonk & Graham, 2012). However, the abrupt shift to online learning has caused many constraints (Crawford et al., 2020; Hodges et al., 2020). Issues like preparing online lessons, developing appropriate materials, and learning new strategies and approaches for online teaching and learning were advanced by teachers (Crawford et al., 2020; Dhawan, 2020). According to Sumartono et al. (2021), students have difficulty of understanding materials in internet-based distance learning while teachers lack teacher proficiency in delivering material through online learning. Aside from that, it is very evident that institutions were not prepared to move to online instruction (Bao, 2020; Crawford et al., 2020).

On the brighter side, the use of technology for online learning could be a significant factor to enhance quality teaching and learning in the 21st century through the use of electronically-enabled learning media in education (Bujang et al., 2020; Dewi et al., 2019; Aldulaimi et al., 2021). One way to face the challenges in education is through technology integration and the training of educators to be creative learning facilitators (Dewi et al., 2019; Makarova & Makarova, 2018). In addition, in this time of educational challenges, one way for the teachers to embody excellence is to utilize different strategies in teaching mathematics like the use of technology-based resources (Nabayra & Nabayra, 2021).

Moreover, the use of technology in mathematics education has been widely explored (Borba et al., 2016; Howard and Beyers, 2020; Wijaya et al., 2020). In this connection, videos as learning media in education have also gained focus from previous studies. Video lessons were helpful for the challenged students in mastering course content. It was also advanced that it could increase teacher to student interactive activities (Bergmann and Sams, 2014). Based on their experiences, students better understand mathematics concepts when teachers integrated videos into these topics (Nabayra, 2020). During the pandemic, students’ experiences with the use of videos in mathematics learning revealed that teacher-created videos were comprehensive, flexible, and student-friendly, with the virtual social presence of the teacher, and fitted to new normal learning (Nabayra, 2021).

In addition, the prevalence of different social media and learning platforms online like YouTube makes online learning efficient and effective which suits the learning styles of the techno-savvy learners of the 21st century. YouTube is an online website that is very common for all because of its accessible and free videos (Alwehaibi, 2015). Yaacob et al., (2021) concluded that the use of YouTube and video-Podcast is seen to be an effective teaching tool for enhancing comprehension among younger learners. Thus, the researcher preferred YouTube as a platform for the teacher-created videos which fits the multimedia resources in education making it easily accessible and flexible for Gen Z students.

With the challenges of the pandemic, teachers have to innovate new learning approaches and strategies for which they were not prepared, incorporating technology as one of the media in knowledge delivery, mainly through videos and online classes (Almonacid-Fierro et al., 2021). However, numerous factors need to be improved, such as learning resources presented in online learning, interaction with teachers, appropriateness of evaluation, and boons of online
learning (Bismula and Manurung, 2021). Educational institutions need training for educators on how to enhance online learning delivery, craft good learning resources, and make learning materials more interactive (Syauqi et al., 2020).

Hence, this study sought to explore the development of YouTube-based teacher-created videos for online mathematics learning amidst the pandemic which could be beneficial also in the post-pandemic system. The impact of these video-based materials was also determined to ascertain their potential effect on mathematics performance.

Related Studies
The rapid technological development has perpetuated the education system in the 21st century especially on the use of technology-enhanced course delivery and technology-based instructional material. Undeniably, the proliferation of the utilization of videos in education specifically in mathematics education has gained attention even before the pandemic. It is true that in the past few years, the availability and usage of online videos have grown exponentially.

Despite the challenges, it was obvious that the production and consumption of videos in education are growing. In 2014, Pai (2014) advanced that videos are considered the most powerful medium of learning. Allison (2015) found out that teachers use videos to reinforce, motivate, and provide authentic content. According to teachers, the advantages of using instructional videos are maximizing instructional time, using multi-modal instruction, and fostering motivation. However, previous studies on the use of videos in mathematics education and other fields presented varied findings and results. For Sharma (2018), the mathematics achievement of the classes receiving consistent exposure to videos and real-life activities was greater than classes receiving only some of the special instructional treatments. Students interviewed believed that instructional videos and real-life activities improved their understanding of the mathematical concepts involved in the study. To Wang (2021), it is surprising that the higher the number of videos watched, the lower the degree of improvement is seen in standardized testing. Considering this reflection, the content and organization of videos should be adjusted to accommodate only key theorems and questions without overlapping materials. According to Capuno et al. (2019), with the conclusion that there is no significant relationship between instructional media utilization and the academic performance of the respondents, it opened another avenue of the intellectual discourse of the effectiveness of technology among learners of a developing country like the Philippines.

Several recent advances, most notably the rapid growth in access to high-speed internet through homes, schools, and personal devices such as tablets or smartphones, have had a significant impact in changing the learning environment and accelerating video use in higher education. Researchers note an explosion in online courses and a rapidly changing comprehension of how video can be used effectively to enhance learning. According to Lalian (2019), even though the use of videos has more emphasis on cognitive aspects, it can also increase the interest and motivation of students in the learning process. It is also believed that students who have high motivation or interest in learning will be able to achieve learning objectives easier. The utilization and selection of appropriate and effective learning media in the learning process dramatically affects the learning process itself. Therefore, learning media is a supporting aspect of student achievement in the learning process from the cognitive, affective, and psychomotor aspects. One effective and practical learning medium used in
education is video media. A video is a series of moving images that combine the elements of audio and visual. The element of audio is the sound that allows students to be able to receive learning messages through the sense of hearing, while the visual element is moving images that can be seen by visualization. To Darling-Hammond et al. (2014), when mathematics teachers use technology strategically, more students, especially those students who struggle, are allowed to learn math skills effectively, close their achievement gaps, and have a better chance for a productive future. Using technology, such as video tutorials, can improve student achievement in mathematics by providing multiple means and methods for learners to grasp traditionally difficult concepts.

By embracing the strategic use of technology to assist in the teaching of mathematics, Kahrmann (2016) produced her teacher-made video tutorials for her math students and researched the effect of these video tutorials on students’ perception and achievement in mathematics. The video tutorials provide the students with resources that can build their self-confidence. The student is no longer alone trying to solve problems; they have these instructional tutorial guides to refer to and boost their belief in their capabilities.

For Hermita et al. (2021), video-based learning has become a trend in teaching methods. Video learning media are continuously developed to facilitate teaching and learning activities and get satisfying results. However, while the use of computer-assisted instruction has drastically increased over the last few years, there is little empirical research evaluating those computer applications (Lloyd & Robertson, 2012), hence this study.

**Methodology**

This study employed educational design research. Educational design research can be defined as a genre of research in which the iterative development of solutions to practical and complex educational problem also provides the context for empirical investigation (Mc Kenney and Reeves, 2012). Educational design research is particularly concerned with developing what Lagemann (2002) referred to as usable knowledge, thus rendering the products of research relevant for educational practice. Hence, this research design was well suited to this study because it aimed to develop YouTube-based teacher-created videos for online mathematics learning during the pandemic and determined its effect on the mathematics performance of the students.

The participants of the study were 129 first-year non-mathematics major college students from a State University in Western Visayas in the Philippines who were selected through cluster sampling. These three group sof students are taking Mathematics in the Modern World (MMW), a general education subject in the Higher Education curriculum which was the content of the videos, during the conduct of the study.

In terms of data gathering methods and procedure, the researcher utilized a 50-item researcher-made test on mathematics performance which was validated by experts and was found reliable using Kuder-Richardson 20 (KR 20 = .87). According to (Priyatno, 2013), the instrument is reliable if the reliability coefficient value is greater than 0.6. A table of specifications (TOS) was done before the test construction to ensure content validity. The original number of items in the test was 70 but after the item analysis and reliability analysis, it was reduced to 50. Furthermore, the researcher administered the test on mathematics performance at the start of the second semester AY 2020-2021 by February through Google form. A total of eight (8) teacher-created videos ranging from 30-40 minutes per topic/video
were uploaded to the YouTube account of the researcher.

During the implementation, the researcher used the videos as asynchronous lecture materials covering eight selected topics from chapters 1-4 of MMW. One video package was utilized per week as a lecture material with integrated assessment within the video, hence, the implementation lasted for eight (8) weeks also. The link to the videos was posted in the FB Social Learning Group of the three groups of non-mathematics major students for them to view the videos at their most convenient time within the week. Sample activity sheets were also provided for them to practice and apply the knowledge that they’ve learned from the videos.

This study used the model of Mc Kenney and Reeves (2012) in conducting educational design research which has three phases: analysis and exploration, design and construction, and evaluation and reflection.

Descriptive statistics namely mean and standard deviation were employed to determine the mathematics performance of the students before and after the use of teacher-created videos. A Shapiro-Wilk test was also performed to identify the normality of the distribution of the difference in test scores on mathematics performance before and after the use of teacher-created videos. After finding out that the distribution of the difference of scores was not normally distributed, the Wilcoxon Signed-Rank test was used to compare the performance of the students before and after the implementation of videos. All of these statistical analysis techniques were processed through SPSS. Results

Results

The Developed YouTube-based Teacher Created Videos

![Sample YouTube Videos for Online Mathematics Learning in MMW Course](image)

**Figure 1.** Sample YouTube Videos for Online Mathematics Learning in MMW Course

The teacher-created videos followed the usual format of a lesson exemplar consisting of the lesson content, learning outcomes, content discussion, assessment, and the key to the corrections of formative evaluation embedded in the videos. These were uploaded on YouTube and were used as asynchronous lecture materials in the course Mathematics in the Modern World (MMW).

**Mathematics Performance of the Students Before and After the Use of YouTube-based Teacher-created Videos in Learning Mathematics Online**
Table 1. Mathematics Performance of the Students Before and After the Use of YouTube-based Teacher-created Videos in Learning Mathematics Online

<table>
<thead>
<tr>
<th>Mathematics Performance</th>
<th>Mean</th>
<th>SD</th>
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<tbody>
<tr>
<td>Before the Use of Teacher-created Videos</td>
<td>18.43</td>
<td>4.08</td>
</tr>
<tr>
<td>After the Use of Teacher-created Videos</td>
<td>28.82</td>
<td>7.41</td>
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</table>

As indicated in table 1, the mathematics performance of non-mathematics major students after the use of teacher-created videos ($\mu=28.82$, $\sigma=7.41$) is higher than before its implementation ($\mu=18.43$, $\sigma=4.08$). The low standard deviations also imply that the performance of the students is close to the mean performance and nearly homogeneous.

Table 2. The difference in the Mathematics Performance of the Students Before and After the Use of YouTube-based Teacher-created Videos in Learning Mathematics Online

<table>
<thead>
<tr>
<th></th>
<th>N</th>
<th>Median</th>
<th>Z</th>
<th>Sig.</th>
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<tbody>
<tr>
<td>Before</td>
<td>129</td>
<td>18</td>
<td>-9.055</td>
<td>.000</td>
</tr>
<tr>
<td>After</td>
<td>129</td>
<td>29</td>
<td></td>
<td></td>
</tr>
</tbody>
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A Wilcoxon Signed-Rank test result shows that there is a significant difference in the mathematics performance of the students at .05 level of significance before (Md = 18) and after (Md = 29) the use of teacher-created videos in learning mathematics online in favor of the performance after the video intervention ($Z = -9.055$, $p = .000$). It implies that teacher-created videos are indeed effective in improving the performance of the students in learning mathematics online in the new normal through YouTube-based videos.

Discussion
The results of this study revealed that YouTube-based teacher-created videos are indeed effective online learning resources to help students learn mathematics despite the pandemic. The virtual presence of the teacher made knowledge construction a social process despite the limitations caused by the pandemic. It aligns with the study of Ramkis soon(2020) in which the e-learning platform should be less of a passive learning advocate and more of an interactive and user-friendly one. Moreover, online learning tools must promote the social construction of knowledge whereby students may share their ideas.

In addition, studies found that online learning during the pandemic cannot fully attain the learning outcomes in underdeveloped and developing countries like the Philippines where most of the students have limited internet connectivity and are financially challenged (Adnan, 2020; Aboagye et al., 2020). These challenges are further aggravated with the students’ adjustment problems, other household chores, and poor teacher-student communication (Baticulon, et al., 2020). Thus, using videos in mathematics online learning will help these kinds of students as evinced in the results of this study since the participants were from a rural state university in the Philippines. Due to the statistically significant difference in their
mathematics performance as mentioned above, YouTube-based teacher-created videos indeed exemplify usability defined as the effectiveness, efficiency, and satisfaction with which the student achieves learning outcomes in an online learning mode (Caro-Alvaro et al., 2018). Moreover, as part of an effort to improve the quality of education in the twenty-first century, the presence of technology in the learning process like videos provides various types of convenience and benefits for students (Budiarto et al., 2021).

The significant effect of videos on mathematics performance agrees with the study of Lloyd & Robertson (2012) who found out that the students taught with the screen cast tutorials scored significantly better than the students taught with the traditional instructional techniques. In addition, in the study of Sharma (2018), the evidence suggests that instructional video and real-life activity-assisted instruction do make a statistically significant difference in students’ mathematical achievement. Sharma (2018) concluded that both instructional video and real-life activity, individually as well as combined, affect students’ mathematical achievement.

Furthermore, Kahrmann (2016) advanced that the use of graphics/visuals in videos generally makes a marginal difference to students’ judgment of their likely learning performance; their attention, interest, and engagement levels; and their eventual learning performance compared with videos with no graphics/visuals. Factors that students thought enabled the videos to be effective included the videos being available on their phones so they could watch them anywhere, anytime. The teacher’s voice is an effective design feature of the videos which manifest his/her social presence. Even before the pandemic, the students, based on their learning experiences with the video-based e-modules, found it to be unique and interesting, has immediate feedback with rich examples, flexible and efficient, effective, and easy to understand in learning the concepts of mathematics in nature (Nabayra, 2020). These teacher-created videos indeed embody the multimedia, learner-control, personalization, and modality principles of Mayer et al. (2015) thus making it suited to the new normal way of learning.

**Conclusion**

With the abrupt shift of learning modalities from face-to-face to online learning, institutions, teachers, and students have to rethink and recalibrate their previous instructional approaches as a response to the educational limitations brought by the pandemic. One of the ways to make the most of the teaching and learning process specifically in mathematics courses amidst the pandemic is the integration of technology like videos.

Based on the results of this study, it can be concluded that teacher-created videos uploaded on YouTube are indeed effective means of helping the students maximize mathematics learning opportunities in the new normal. The flexible, personalized, and student-friendly features of the videos suit the students’ need for comprehensive, efficient, and accessible learning materials during the pandemic. Video-based instructional material indeed served its purpose to address the needs of the 21st-century learners of a technology-enhanced instructional material suited to the new normal way of learning which would facilitate their construction of knowledge through videos and uphold inclusive, quality, and equitable mathematics education online despite the crisis.

**Acknowledgment**
The author would like to express his heartfelt gratitude to the Aklan State University Research
and Development Services Unit, the College of Teacher Education and the administration for their unyielding support to the research endeavors of the researcher.

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