

# Using Short Video Lectures to Enhance Mathematics Learning – Experiences on Differential and Integral Calculus Course for Engineering Students

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**Abstract.** Mathematics' skills and knowledge lay the basis for engineering studies. However, the resources targeted to mathematics' teaching are in many cases very limited. During the past years in our university the reduction of mathematics' contact hours has been significant while at the same time the study groups have grown. However, the mathematical proficiency of incoming students has not increased. Consequently, during the contact hours, the learning of basics requires more time and the need of personalized learning is increasing.

In this article a method based on short video lecturing to enhance mathematics' learning is presented. The study explored how the students experienced the mathematics' studying from videos. In addition, it was investigated if the video lectures have an influence on students' motivation towards mathematics' learning. Overall, the results were encouraging and the short video lecturing seems to be worth considering while developing methods for mathematics' learning. This paper summarizes the observations during the examination.

**Keywords:** educational technology, mathematics' learning, short video lecturing, enhance learning.

## 1. Introduction

At the same time as the international PISA assessments (e.g. Pisa, 2003, 2009) have evaluated Finnish 9<sup>th</sup> grade pupils to be the top ones in OECD countries when measuring mathematical literacy, there has been a discuss about engineering students' mathematical skills and knowledge. The both Universities of Applied Sciences and Universities in Finland have encountered problems with starting level of students' mathematics' skills at the beginning of their studies. It has been reported that students have major problems for instance with basic algebraic routines. (Huikkola *et al.*, 2008; Kinnari, 2010; Mannila, 2009; Näätänen, 2005; Tuohi, 2009) However, the good algebra skills lay the foundation

for mathematics' learning. For instance in Differential and Integral Calculus, the good algebra skills are prerequisite for exercising of differentiation rules.

On the other hand, for example in our university, the teaching groups are large and heterogeneous. In fact, the students' mathematical background may vary between comprehensive school and advanced syllabus studied in high school. This causes that some of the students may have good basic skills of algebra while the others have major problems with it. Thus, the need for more personalized teaching is obvious.

Practically in mathematics' courses, the lower the students' prior knowledge levels are, the less time can be spent on applying the topics of content. This leads to the situation that there are large amount of students that only know a separate collection of information without holistic view. And as a consequence, they can't see the importance and relevance of mathematics (Mannila, 2009) as they are not able to combine the learnt content on prior knowledge. This often causes a decrease in motivation towards mathematics.

The lack of contact hours and students' decreasing mathematics' skills in concert with the heterogeneity of study groups have increased the need of personalized teaching. The emerging methods and models available in teaching need urgently to be developed and adapted. This study examined a method based on short video lecturing in mathematics context. The short video lectures such as video exercises and the voice over slides were utilized to enable more personalized learning during Differential and Integral Calculus course. In addition, the pre- and post-lecture activities were used to enable blended learning.

## 2. Studies Related to Video Lectures

Different types of video materials have been used for educational purposes for years. However, the utilization of videos in education and, especially in mathematics, is still quite rare. Thus, they are not used regularly and consistently (e.g. compared to the usage of calculators or computers). Anyhow, the developments in technology are constantly bringing more possibilities also for educational perspectives. For example the touch screen tablet computers with hand writing features offer opportunities to conveniently and easily represent mathematics and make learning materials e.g. in a video format. The new technology is bringing more and more applications of high usability and at the same time, the threshold for utilizing these applications gets lower and lower.

In generally, the capturing and recording of lectures to enhance learning outside the classroom have been investigated e.g. (Bollmeier *et al.*, 2010; Day and Foley, 2006; Green *et al.*, 2012; Karnad, 2013; McGarr, 2009; Mettiäinen and Karjalainen, 2012; Owston *et al.*, 2011; Pinder-Grover *et al.*, 2011; Prodanov, 2012; Pursel and Fang, 2011; Secker *et al.*, 2010 and Soong *et al.*, 2006). The videos and audio recordings have been used especially in blended learning environments with different circumstances. The studies have mostly concentrated on two perspectives: how the students perform after using the video content and how the students prefer to utilize the video materials.

Many investigations have concentrated on videoing the face-to-face lectures. This means that the exact same lectures as contact lectures are provided but in a video format and online. Bollmeier *et al.* (2010) made recorded lecture slides available for students online but they restricted the availability of videos. In their experiment students were able to check the lecture slides combined with audio recording for until 72 hours after each lecture.

Prodanov (2012), as well, has reported the experiment of voice-over slides where the screen capture was used as recoding the in-class explanations of lecturer. In addition, Mettiäinen and Karjalainen (2012) provided both the audio recordings and PowerPoint slides with lecturer's voice explaining the topic. They didn't record the authentic classroom lectures but instead provided lecture summaries recorded by four teachers.

The general review studies have also been implemented to explore the used methods, the influence and the purpose of video lecturing in education. McGarr (2009) has examined the podcastings and identified three types of use for them: substitutional (provided after lecture), supplementary (additional resources) and creative use (students' generated podcastings). In addition, Pursel and Fang (2011) and Karnad (2013) have provided comprehensive reviews of studies related to lecture captures. Pursel and Fang (2011) pointed out that in most of the nearly 50 articles they examined the used method was face-to-face lecture capture. Only the study of Day and Foley (2006) used flipped classroom method. In mathematics context e.g. Hsin and Cigas (2013) have used short videos in their online course. Anyhow, based on the literature, it appears that the studies and experiments have mostly concentrated on the videoing face-to-face lectures. In fact, not that much research has been done related to short video lectures or its benefits on learning.

Concerning the impact of video lectures many benefits have been reported. Hsin and Cigas (2013) highlighted that with the student groups using video lectures the drop-out rates of class decreased and the course grades increased. Also Day and Foley (2006) have reported positive influence of web lectures related to grades.

Soong *et al.* (2006) have reported that combination of lecture captures, face-to-face lectures and online course materials are more preferred by the students. Moreover, based on the literature, the video lectures have also been utilized in preparing to the exam (Green *et al.*, 2012; Mettiäinen and Karjalainen, 2012; Prodanov, 2012; Pursel and Fang, 2011) and to better understand the key content (Green *et al.*, 2012, Kinnari-Korpela and Korpela, 2014).

Despite the positive feedback of students related to the video lectures, Soong *et al.* (2006) and Pursel and Fang (2011) revealed that most of the students only watch the selected part of the recording instead of watching the whole lecture. This finding supports the idea of short video lectures. Furthermore e.g. Hsin and Cigas (2013) and Kinnari-Korpela and Korpela (2014) have reported encouraging results related to short videos in mathematics and science contexts (see also Green *et al.*, 2012 and Pinder-Grover *et al.*, 2011). However, for the most part of literature focus on studies related to videoing the face-to-face lectures.

### 3. Experiment

During this study, the experiment of utilizing video materials in mathematics teaching and learning was implemented. The study was carried out at Tampere University of Applied Sciences (TAMK) in Finland for the study groups of Mathematics 2 course. The most of the participants were first year engineering students majoring in mechanical engineering and electrical engineering. The course consists of the Differential and Integral Calculus.

#### 3.1. Purpose of Experiment

The purpose of this experiment was to examine *the short video lecture method* in order to explain:

- Is it a suitable method in mathematics context to present certain contents?
- Does the use of short video lectures have an influence on students' motivation towards mathematics learning?
- How do the students experience the mathematics learning from short videos?

In this study the short video lecture is e.g. audio file synchronized with PowerPoint slides or voice over hand written video implemented with iPad. The videos of study are not face-to-face video capture of in-class lecture but they include the key issues of the certain topic in a form of theory slides or examples incorporated into lecturer's voice. Typically the maximum length of short video lecture is about 15 minutes. The shortest video lectures were only few minutes.

During the experiment the short video lectures were planned to be utilized in following ways:

- As an introduction to new topics (pre-lecture activity).
- As a revision of topics (post-lecture activity).
- As additional examples (post-lecture activity).
- As an additional material of challenging topics (pre- and post-lecture activity).
- As a model solution of some exercises (post-lecture activity).

#### 3.2. Planning of the Video Materials

The planning process of video materials started with analyzing the content. In addition, some essential requirements for videos were set. One main requirement of videos was the usability. In fact, there was a doubt that students are not taking advantage of videos if they are too complex to use or if the watching requires some special software installations. Consequently, students should be able to avoid any installation. As the videos released through TAMK's Moodle virtual learning management system, the videos had to be able to be watched with web browser through Moodle.

Another detail worth considering was the length of videos. The videos were planned as short as possible without losing any critical content. Furthermore, there was a doubt

that students would not utilize the materials if watching the videos takes too much time. Also the literature provided the references to this. E.g. Soong *et al.* (2006) and Pursel and Fang (2011) pointed out that the students only watch the topics that are the most useful for their learning purposes. In addition, it has been investigated that from student's point of view the most suitable length of the videos is only about 6 minutes (Kinnari-Korpela and Korpela, 2014).

### 3.3. Level Test, Short Video Lectures and Repetition Exercises

The background studies of Universities of Applied Sciences' students in Finland vary. While some of the students have studied e.g. the derivatives in their early studies the others have not even heard of it. This often causes challenges for mathematics' point of views. In order to be able to produce more personalized video materials, the students were decided to be tested with *short level test*.

At the beginning of the first lecture related to the differentiation, the short level test was accomplished. The aim was to explore the depth of substance knowledge, and based on that, get guidelines for planning the video lectures. The goal was to produce only the videos that serve the students the most.

Based on experiences of early courses in addition with the results of the short level test, the topics for *short video lectures* and *repetition exercises* were selected. Short video lecture means a short theory video mostly less than 15 minutes. These videos include e.g. slides that are explained by lecturer. In this experiment, Echo360 and Tech-Smith Jing softwares were utilized for producing the short video lectures. The repetition exercises were recorded with iPad using Showme and Educreations softwares.

In this experiment the repetition exercise (a part of a repetition exercise is in Fig. 1) denotes a mathematical exercise or an example that is in a video format. Repetition exercise includes step-by-step solution with spoken explanation of lecture. These exercises were produced with tablet computer using hand writing feature. With repetition exercises the model solutions of exercises and examples were offered to the students.

Fig. 1 presents one screenshot of 12 minutes video. This repetition exercise is related to the basic examples of derivatives. The video contained different examples of substance presented in step by step and including lecturer's explanations. For example, this video was published before students needed to return their written assignments of derivative exercises.

During the experiment, overall 18 short video lectures were released for student use in concert with the ordinary contact hours to enable blended learning in Mathematics 2

$$\begin{aligned}
 & D[(3x+1)^4] \\
 &= 4(3x+1)^3 \cdot D(3x+1) \\
 & \qquad \qquad \qquad = 3 \cdot 1 + 0 = 3 \\
 &=
 \end{aligned}$$

Fig. 1. A part of repetition exercise produced with iPad.

courses. Approximately this means that 1,3 videos were released per each of the course's teaching weeks. The published materials provided introductions to new topics, revisions, additional materials and model solutions. The length of videos varied but the most of them were shorter than 15 minutes. The materials were planned to be effective and succinct in order to be watched by as many students as possible. The early studies have revealed that instead of watching the whole face-to-face video lecture, students prefer to watch only the content they need (Soong *et al.*, 2006; Pursel and Fang, 2011).

#### 4. Background and Analysis of the Questionnaire

At the end of the course, the feedback of videos was collected in addition within the classroom discussions. The feedback was collected in a form of online questionnaire. A total of 27 questions of the electronic survey were planned under the themes background, attitudes, mathematics and self-esteem, learning, and use of videos. The most of the questions were in a form of statements. Furthermore, some of the collected information will be utilized outside of this study.

The questions related to background theme explored the student's early studies and the amount of mathematics' courses in high school. The attitude pattern included questions related to attitudes towards mathematics learning. The early studies were utilized in designing of these questions (Huikkola *et al.*, 2008; Tuan *et al.*, 2005; Pohjolainen *et al.*, 2006). In addition, mathematics and self-esteem pattern contained items that explored the students' perceptions of their mathematics' skills and the learning pattern identified how students prefer to study mathematics. On the perspectives of this study, the research questions were mostly related to the use of videos pattern. These questions identified in what ways the video lectures served or enhanced the students' learning. In addition, this pattern included qualitative question in order to explore more precisely the opinions of students regarding to the video content.

The most questions in patterns were scaled with 5-point Likert scale in addition with the "don't know/haven't tried" option (1 = fully agree, ... 5 = fully disagree, 6 = don't know/haven't tried). By this way, we wanted to find the students who had actually tried the certain method. Thus, in some cases the sixth option (don't know/haven't try) was removed from the data analysis depending on the type and meaning of question.

#### 5. Results

The quantitative data was analyzed statistically in addition with the qualitative responds. The research methods included cross tabulation and comparison of means. Some conditions have been used to identify the results between the different groups (e.g. low motivated & low proficiency vr. highly motivated & high proficiency). Both the single variables and sum variables were interpreted. As the primary purpose was to explore the usability of the short video lecturing method in learning purposes, the principal component analysis were not seen useful. On the contrary, the used sum variables were formed

in such a way that their meaningfulness was ensured. The reliability of sum variables were measured with Cronbach's alpha (the reliability coefficient  $> 0,7$  was accepted and is in brackets). The utilized sum variables were proficiency (self-assessment) and motivation (0,77) and attitude towards mathematics (0,86).

### 5.1. General Statistics

Of the 54 course participants, 83% responded to the questionnaire. The total of 91% of respondents was males and 9% females. In TAMK this is the typical gender frequency of study programs concerned. Two-thirds of respondents were majoring mechanical engineering and the rest electrical engineering. One-third of students informed to be early studied in high school (including the students with double degree). Thus two-thirds had only vocational studies background. Those who had studied in high school, 40% had studied advanced syllabus in mathematics. Based on early experiences and national curriculums, only students with advanced syllabus have studied e.g. differentiation rules other than the derivatives of polynomials or topics of integrals. However, these topics are central to this course.

Related to the attitudes pattern, 93% of respondents agreed (or fully agreed) that "studying mathematics is useful" (mean = 1,42, std = 0,69). However, 22% of total didn't agree that "I'm motivated to study mathematics" (mean = 2,13, std = 0,92). In addition, one-third didn't agree that "I'm anxious to study mathematics" (mean = 2,36, std = 0,83).

In mathematics and self-esteem pattern students were asked to estimate their skills of mathematics. On the scale 1 to 5 (1 = weak..., 5 = excellent) the mean was 2,84 (std = 0,95). The most of the respondents estimated their skills as satisfactory (29%, corresponding 2) or average/good (42%, corresponding 3). Furthermore, 18% valued their mathematics skills very good (corresponding 4). Only few students estimated their mathematics skills as weak (7%) or excellent (4%). In addition, almost two-thirds of respondents evaluated that early success in mathematics defines mostly their motivation towards mathematics' studying. The responds of this statement deviated slightly more than averagely (mean = 2,51 and std = 1,22).

### 5.2. Statistics Related to the Short Video Lecturing

89% of total felt that learning mathematics from videos had been meaningful. On the contrary, 4% of the respondents disagreed the meaningfulness. Furthermore 93% thought that they had learnt new things by watching course videos. In addition, 82% of total fully agreed that in terms of learning the repeatability of videos was meaningful. One notable finding was that 65% of total felt that the using of videos as teaching method increased their motivation towards the course. In that statement only 5% of respondents disagreed or fully disagreed that their motivation towards course had increased as a consequence of videos.

By comparing different learning methods in Mathematics 2 course, students were asked to rank the methods whereby they think that they had learnt best (Table 1). In this ranking, the contact teaching reached the first place. It's worth of noting that watching short videos was ranked more important in terms of learning than doing homework on they own time, even though 78% of the respondents agreed that in generally they learn mathematics by doing homework. Learning from theory materials were considered less important.

As already mentioned above, almost quarter (22%) of the students can be seen not that motivated to study mathematics. However, 80% of not motivated students considered that "It was meaningful to learn mathematics through videos". On the other hand, 16% of the respondents didn't agree (or fully agree) that "studying mathematics is meaningful". However 43% of those assessed that using the videos increased their motivation towards the course. Furthermore, over quarter of the students agreed that their difficulties in mathematics decrease their motivation. Though, three quarters of them agreed (33%) or fully agreed (42%) that the video materials increased their motivation towards the course.

The results have also been compared between the different student samples with sum variables. Three quarters of the total that considered (self-assessment) to be low proficient in mathematics and were low or average motivated (abbreviation LPLM), felt that it was meaningful to study mathematics from videos. In addition, 100% of LPLM students reported that in terms of learning, the repeatability of videos was meaningful. However, only 38% of LPLM representatives thought that using videos increased their motivation.

On the contrary, three quarters of low proficient but motivated (LPHM) students felt that the videos increased their motivation towards the course. LPHM group also totally agreed (100%) both the meaningfulness of repeatability and that learning from videos was meaningful. By comparing also the high motivated and average/high proficient (HPPM) to the previous groups, 93% of the students representing HPPM group felt that it was meaningful to learn mathematics from videos. Moreover, almost three quarters of HPPM group considered that the videos increased their motivation. There were no students evaluated to be high proficient with low motivation (HPLM).

The students' attitudes towards mathematics (abbreviation ATTI) learning were also measured. 92% of the students with positive ATTI felt that learning mathematics from videos had been meaningful. Almost three quarters of students represent-

Table 1  
The learning methods ranked by the students

Rank	Learning method
1	Contact teaching
2	Exercises during lectures
3	Watching short videos
4	Doing homework on my own time
5	Reading theory on my own time



ing positive ATTI group thought that using videos increased their motivation towards the course. On the contrary, one third of students with negative or neutral ATTI felt that videos had increased their motivation towards the course. However, two thirds of negative or neutral ATTI representatives felt that learning mathematics from videos was meaningful.

### 5.3. Qualitative Feedback

In addition to the quantitative data, also qualitative feedback was gathered with the questionnaire. During the course implementation, also oral feedback from the contact hours was taken into account. However, this paper includes only the feedback from questionnaire.

In addition to the multiple choice questions, the students were asked if they had any comments or improvement suggestions related to the video materials. In generally, the feedback was very positive. According to the students, they used the materials for theory learning, revising for the exam, while doing homework and to learn content on their own time. Based on the feedback, students especially appreciated the repeatability of materials. Moreover, several students pointed out that the video materials do not replace the in-class teaching. Furthermore, they considered the video materials as valuable additional resources. The following summarizes the central feedback.

#### 5.3.1. Step-by-Step Solutions and Revising for the Exam

Students reported that they utilized the materials before or while doing the exercises.

*“At first I tried to solve the example exercises by myself. Then I checked from the video, how the exercise should have been done. In this way, I better learn things.”*

*“The model solutions [of exercises] were important to me, as I was able to try the exercise step by step and then watch what went wrong.”*

The step by step solutions including the explanations of lecturer were considered particularly valuable. With this method the student can get immediate feedback of their proficiency. This emphasizes the student's self-reflection. In addition, the students reported the benefits for revision.

*“Because of the videos, doing homework and studying in generally were remarkably easier. In addition, the videos helped to revise the content before exam as taught by the teacher. “*

*“As I prepared for the exam, I learnt much more from the step by step solutions [including the explanations] than from the ready-made solutions. The more difficult is the exercise the most value I would put on this.”*

### 5.3.2. Explanations and Time to Think

Related to the repeatability, several students pointed out that the feature of pausing and replaying the videos gave more time to think things through and understand the content. Furthermore, the feedback revealed that the voice-over repetition exercises were experienced almost as if the teacher would have presented and taught the content.

*“In my opinion, the examples were the best ones. If I didn’t understand something, I was able to pause the video and then I had time to think things through.”*

*“The repeatability of videos was a good thing. I was able to watch the videos as many times as I needed or to pause the video to take time to internalize and understand.”*

The repeatability seems to be highly valuable especially for those who need more time to comprehend the task at hand. By this way they had much more time to think and internalize the taught content.

One major benefit mentioned in feedbacks was the lecturer’s explanations on the videos. Especially, students seem to appreciate the videos containing a succinct and short enough content including the explanations.

*“The model solutions of recap exercises were especially helpful for me. As I saw the [step by step] solution including [the teacher’s] explanations, I understood much more than only reading from the paper.”*

*“The videos were great as they included step by step explanations of exercises.”*

*“As there were the audio explanations, the content was much more understandable than by reading it by myself.”*

It appears that the students prefer the example exercises in a form of videos with audio narration than the ordinary paper and pencil solutions. Furthermore, based on the feedback students thought they learnt more from the videos than for example seeing the same solution on paper without the explanations.

### 5.3.3. Non-Binding the Place or Time

Students also put the value on blended learning as not all the “teaching” was situated in the classroom. In fact, it is the ever growing conception about learning to have possibilities to study and learn in various learning environments or e.g. flipping the classroom.

*“... One good thing was that I was able to watch the videos several times whenever and wherever I wanted.”*

*“The videos made it possible to go through the materials at my own pace whenever I wanted.”*

#### 5.3.4. Additional Resources

Moreover, the students commented that the video materials serve well as additional resources but they can't replace the contact lectures.

*"The videos are suitable for teaching the basic things."*

*"The videos are very good additional resource. They can't replace the contact hours."*

While some students prefer to have only basic content in videos the others prefer to have more video content (theory videos, example exercises and content related to the difficult topics). And some students even wish to have video content for every topic of the course.

*"It would have been nice, if the difficult topics of the course had been covered more extensively [with the videos]."*

*"The doing of homework would have been easier if some very simple video example as a model solution of current topic had been available. I would have started my homework with that video."*

In addition, some of the students had taken a stand on the length of the videos. Based on the comments, it seems that students prefer the short videos (only few minutes) over the longer ones.

In the end, the open feedback from students was largely encouraging. According to the students, the method presented in this paper seems to be useful. The video content seems to provide benefits for the students in various forms. Some students utilize the video materials e.g. while doing homework or revising the content for exam, while the others use the materials as support substance. The students in the need of support are watching and replaying the content in order to understand and internalize the tasks at hand. As the most of the students studying at University of Applied Sciences' level need face-to-face lecturing and exercising, the optimal usage of video materials seems to be as e.g. a recap material and an additional resource to enhance pre-lecture or post-lecture activity especially.

#### 5.4. Lecturer's Feedback

From lecturer's point of view the diversity of videos enhanced the course content. It was an enriching experience to plan, produce and use the video materials in order to enhance students' learning experience. As one aim of the videos was to present the key content of subject matter in a nutshell, instead of videoing the whole in-class face-to-face lectures, the content of the videos required precise planning. Accordingly, before recording the videos the lecturer needed to go through the topic taught even more specifically than preparing for the usual contact lectures. Furthermore, lecturer needed to consider more precisely, what is the key content of the topic, and what is the simplest

way to present the content without losing any essential part of it. In addition, it appeared that the video materials' content was planned in more detail compared to the contact lessons' content, as even the oral explanations needed to be contemplated in detail.

Even though the planning and making of videos took more time than preparing the ordinary lecture, the extra work was worthwhile. The pre-lecture introductory videos left more time to concentrate on the most essential part of theory and exercises at contact hours. Furthermore, due to the pre-lectures, students seemed to be surprisingly well-prepared for the contact lessons. Therefore, the pre-lectures also increased the interaction during the contact lessons as the number of questions presented by the students clearly increased. In addition, students appeared to be more receptive than usually. In the literature, among others Kolari and Savander-Ranne (2007) and Chen *et al.* (2010) have reported positive influence related to the pre-lecture activity.

One essential benefit of short videos was the repeatability. For example, the students without any earlier experience of derivatives were able to watch the basic differentiation rules with specific examples and concentrate on the most difficult content for them. The large and heterogeneous study groups mostly prevent the lecturer to concentrate on students' individual difficulties during the contact hours. The experience has shown that any support material seems to be important especially for those who have low proficiency in mathematics. Thus, the video materials were seen as essential part of course content also from the lecturers' point of view.

On the other hand, the video lectures were also utilized as additional examples. If a lecturer somehow failed to present some of the planned examples during contact hours, students were offered video materials including the planned example. These videos were released after the lecture session. This increased the flexibility during the course implementation.

## 6. Conclusions

Altogether the problems encountered in classroom environments have forced the lecturers to develop new ways to personalize teaching and enhance learning. The computerized world and the strongly extending field of information technology have brought a wide range of possibilities also from the perspective of education. The emerging technologies have expanded the opportunities and enhanced the ways to learn, teach and study.

This paper examined the short video lecturing method in Mathematics 2 courses at Tampere University of Applied Sciences. The short video lectures were e.g. audio files synchronized with PowerPoint slides or video examples produced with iPad. The short videos were recorded before and after the lectures to enable blended learning and to provide more possibilities for personalized learning.

The feedback from the students was collected during classroom activities and at the end of the course with electronic survey. This paper summarized the results of electronic survey in addition with the lecturer's observations.

One important research question was to clear up how the students experience the mathematics learning from short videos. Based on the results, the most of the students (89%) felt that mathematics' learning from videos is meaningful. Four-fifths of the students put value on the repeatability of videos in terms of learning. This issue rose up also from the open responses. In addition, step by step solutions including the explanations of lecturer were considered particularly valuable. The results revealed that some of the students even felt the video content almost as if the teacher would have been presenting and explaining the content for them. Students also reported that with the video materials, they had had more time to think and understand the content. These findings inevitably underpin the usage of short video method in mathematics context and may also encourage replacing some of the course content with video content.

One notable finding was that 65% of total felt that the using of videos as teaching method increased their motivation towards the course. As the students were asked to rank different learning methods used during Mathematics 2 course, the watching of videos was ranked more important in terms of learning than doing homework on they own time. This is a quite significant finding as traditionally doing homework is recognized one of the most important factors for improving students' mathematics learning. Usually when low proficient students are making homework they are not sure if they are using correct methods or procedures in their solutions. And as a consequence, they may think they are doing things right even though they are not using the correct methods. However, more research is needed to analyze if the video materials improve the learning of mathematics in these circumstances.

On the other hand, it seems to be evident that the participants of the study were aware of mathematics' importance in their engineering studies. Nevertheless, there is a group of students bearing a lack of motivation and eagerness towards mathematics as almost a quarter of the students were not that motivated to study mathematics. However, 80% of not motivated students considered that mathematics learning from videos had been meaningful. Furthermore, over quarter of the students agreed that their difficulties in mathematics decrease their motivation. However, 75% of them agreed (or fully agreed) that using the short video lectures increased their motivation towards the course. All these findings seem to indicate that the use of short video lectures influence positively on students motivation towards mathematics learning which in fact was another important research question.

Overall, the experiment was encouraging and the results seem to indicate that the usage of short video lecture method in mathematics context is meaningful and necessary. The feedback from students revealed that they used the videos for example to have more time to internalize and understand the content. Especially the step by step solutions and explanations were seen valuable. According to students' experiences, the result was almost the same as if the teacher would have been physically teaching the content. Thus, for example the students with low proficiency in mathematics had more time to think and replay the explanations. Based on the feedback and results it seems that using short videos is suitable method to present mathematics contents.

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## **Trumpų vaizdo paskaitų taikymas matematikos mokymuisi turtinti: inžinerinės pakraipos studentų patirtis mokantis diferencialinio ir integralinio skaičiavimo**

Hanna KINNARI-KORPELA

Inžinerinių studijų pagrindas yra matematinės žinios ir įgūdžiai. Vis dėlto, daugeliu atvejų išteklių matematikos mokymui yra riboti. Per pastaruosius metus kontaktinių valandų universitete reikšmingai sumažėjo, tačiau tuo pat metu studentų grupės didėjo. Pastebima, kad įstojusių studentų matematiniai gebėjimai nekylo. Todėl kontaktinių valandų metu matematikos pagrindų aiškinimui reikalinga skirti daugiau laiko, taip pat didėja personalizuoto mokymosi poreikis. Straipsnyje pristatomas vaizdo paskaitų metodas siekiant praturtinti matematikos mokymąsi. Tyrinėta studentų, besimokiusių šiuo metodu, patirtis. Taip pat buvo nagrinėta vaizdo įrašų įtaka studentų motyvacijai mokytis matematikos. Rezultatai rodo, kad trumpos vaizdo paskaitos vertingos matematikos mokymuisi. Straipsnyje pristatomi atlikto tyrimo rezultatai ir išvalgos.

