Evaluation of an Educational Video Production Environment

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***Abstract*—In this paper, a cloud-based solution for the easy production and meaningful distribution of video-based learning material is presented and evaluated. Using this system, lecturers can produce video material with their own computers anywhere, at any time. The system enables the production of longer lecture videos as well as short videos, each containing only one of the course's topics. The system also handles video sharing for students automatically in a meaningful way through the course's table of contents. An evaluation of the first production version of the video production and distribution system was carried out by collecting qualitative material from the lecturers and students.**

Keywords—educational video, video production, blended learning, distance education

I. INTRODUCTION

Changes in work and technological development require constant upgrading of employee skills. One way to respond to this change in working life is through continuous learning, which refers to the development and renewal of knowledge at different stages of life and career. Responding to new needs for expertise requires flexibility and personalization of education systems. Education organizers are increasingly faced with difficulties in reaching out to students using location-based classroom education. In this kind of educational environment, arranging lectures in a classroom at certain times and places is not necessarily meaningful anymore. The diminished role of lecture-based teaching requires technological solutions that support the implementation of a new kind of teaching.

The videos are well-suited for educational purposes and have in many occasions become natural part of the implementation of teaching. Videos can be used in many ways. Educational videos have potential to promote deeper cognitive learning by combining auditory and visual information in a presentation [1]. Videos can be utilized for example as online lectures (e.g., [2]), as additional materials to supplement lecture-based teaching (e.g., [3]), and as supplementary materials, such as demonstrations and illustrations (e.g., [4]).

Videos can be based on traditional lectures and be watched instead of participating in face-to-face or they can include just the slides used as teaching materials with additional voice-over narration [5]. With the help of videos lecturer can also offer supplementary materials like summaries of lectures or demonstrative supplementary videos or explanations of specific problems in video form as working examples [5].

Educational videos can be used in many pedagogical ways [5]. In the most common use, learners are passively viewing learning materials. This kind of viewing involves, for example, rewinding videos or repeating important topics. Another way is to design videos to explain to students how to solve specific problems. This kind of videos are typically used in mathematics. Videos can also be designed and produced by the students themselves, although this approach is still relatively rarely used [5].

In educational videos interactivity is an important feature. However, it does not only mean the interactivity between the lecturer and the learner but also the interaction between the learner and the learning material. Merkt and Schwan [6] found out that this kind of interactivity in instructional content increases learning outcomes. Interaction between video material and student can take place, for example, by controlling the video [7]. By controlling the video material student can influence the pace of learning and the order of the things to be learned. Learners can, for example, pace their learning by stopping the video at difficult points to get more time to think and process. When using this kind of interactivity, learner's role changes from passive to active processors of the material.

As a technological solution for increased flexibility, educational videos have become widespread. Lecture videos are typically produced from a live lecture situation from the classroom. Hence, video production itself is still typically tied to physical space, even though videos are often used to make studying time- and place-independent. Site-bound video production limits the utilization of video technologies in diversified educational environments. This restriction is reflected by, above all, the fact that lecturers must be in certain physical locations. Short video clips can be produced, for example, in a studio environment or by using a suitable computer. In that case, the production site can be chosen more freely. Video distribution is also perceived as challenging because it involves resolving issues such as storage locations for videos, the file format and quality in which they are distributed, means of managing access to them, and ways of monitoring their use when needed.

The above-mentioned needs for video production and distribution are important in our Master's Program in Mathematical Information Technology at the Kokkola University Consortium Chydenius as well. The degree program students are all adults. Thus, the challenges in their studying are primarily related to lack of time for studying. Students have to allocate their time for work, family, and study. For many years, the education program has been offering flexible opportunities to attend classes based on video technologies. Participation has been possible through real-time and on-demand video, in addition to traditional lectures. Previous studies have found that students prefer on-demand video as a participation mode [8]. This trend has become noticeable in practice in the form of empty classrooms. Thus, traditional lectures held at specific locations at given times

could now be deemed unnecessary. In the past, videos were produced in live lecture settings. The new situation, where learning material does not need to be recorded in classrooms during lectures, enables the production of video-based learning material that is independent of time and place. The challenge was that video production should be easy and effortless so that a single lecturer could do it independently. In addition, videos should be distributed and integrated with existing learning management systems easily and meaningfully.

In this paper, we present and evaluate the first production version of a cloud-based video production and distribution system called CiNetCampus. The system has been developed specifically for easy production and meaningful distribution of video-based learning material. The system was piloted in connection with the Master's Program in Mathematical Information Technology in the spring of 2018. The pilot version of a system was presented earlier in [9]. The design science research (DSR) methodology [10] has been followed in developing the video production environment. Based on the experience gained from the piloting, the first production version, which has been preliminary evaluated in this study, was implemented in the autumn of 2018.

The evaluation focused on evaluating the functionality, usability, and usefulness of the solution. For the evaluation, review meetings were held with the lecturers who used the system. For the students, the system appears so that the subject of the lecture determines the length of the video and videos are available according to the topics. The meaning of this was also evaluated with the help of qualitative material collected from the students.

This paper is structured as follows. The second chapter discusses the starting points and goals of the development work and presents the technological solution itself. The third chapter presents the research methodology used. The evaluation of the solution is presented in the fourth chapter. The last chapter contains conclusions.

II. VIDEO PRODUCTION ENVIRONMENT

A. An Explication of the Problem

Continuous learning brings with it the need to educate adults and often students who are also employed. Previous studies have found that the challenges faced by employed adult students are largely related to time-management problems [11][12]. Sharing time between work, family, and leisure leads to a lack of time for studying, especially for attending face-to-face teaching. For this reason, teaching must be carried out in a way that allows for flexible participation.

In the Master's Program in Mathematical Information Technology, a flexible opportunity to participate in studies using video technology has long been offered. (see e.g., [13][14][15]). Until this year all the teaching has been arranged as face-to-face teaching and lecture videos have been produced from the classroom situation. Students have been able to choose their own way of participating according to their preferences and life situation, including face-to-face lectures, real-time videos, and on-demand recordings.

Over the years, student participation has moved more and more towards video participation (see e.g., [15][16]). At first, participation using real-time video gained popularity [8]. Since then, the trend has been that participation in real-time video has decreased, and the focus has shifted to studying with the use of on-demand videos. The change has been so significant that, in practice, only a few individual students took advantage of face-to-face teaching and real-time videos in last year. Due to this, teaching at a specific time and location is no longer necessary.

The abandonment of teaching in a face-to-face setting has led to major changes in education based on lecture videos produced from live lecture situations. If teaching is not organized as face-to-face instruction, the video-based learning material must be produced in some other context. When the lecture situation no longer works as a production site, the length of the videos is no longer determined by the length of the lectures. When education is based on face-to-face instruction, it also limits pedagogical solutions. So, giving up on traditional face-to-face teaching means producing a completely new kind of learning material, and thus creating new opportunities from a pedagogical point of view.

Technological solutions for video production have been available for years. The bigger challenge is that video-based learning material must also be distributed to students in a meaningful way, considering, e.g., usability, copyrights, and ease of sharing.

B. Requirements for the Solution

When producing video-based learning material, both video recording and distribution are integral parts of the production process. Thus, video production and distribution require an overall solution that can be used to handle distribution in pedagogically meaningful way. The solution must therefore be viewed from the perspective of both the lecturer and the student.

Both video production and distribution must be easy for the lecturer. Also, lecturers who are not technically oriented need to be able to produce videos. The ease of production and distribution can be significantly increased by automating as many functions as possible. For example, distribution should be automated so that after the video is produced, the lecturer does not need to worry about the distribution at all. Video production tools should be intuitive and unnecessary features should be eliminated wherever possible. Video production must be successful on all devices, anywhere, without significant installation. The number of required software and accessories must be kept to a minimum. The student, in turn, must be able to access the videos in a meaningful way. At its best, the user interface should support the learning process.

C. The Solution

As a solution to the challenges outlined above, the video production and distribution application called CiNetCampus was developed in connection with the Master's Program in Mathematical Information Technology at the Kokkola University Consortium Chydenius. The application is a cloud-based web application used in the browser. The application is used by the lecturers to produce videos and by the students to watch videos.

The CiNetCampus video production and distribution application is integrated with the Learning Management System (LMS) so that all user management is handled in the LMS. Students enter the CiNetCampus system via the LMS and can only see videos of the courses they are entitled to in the LMS. Similarly, lecturers can produce videos on CiNetCampus only for the courses in which they are marked as lecturers in the LMS.

Typically, the lecturer begins to produce a video by building a structure according to the topics of the course. This structure is presented in a table of contents and is used as a navigation menu for students. At the beginning of the recording phase, the video is associated with a topic. In addition, its type is given as metadata. Possible types include a lecture, exercise assignment, exercise response, introduction, summary, or additional material. Using this metadata, the video is displayed as desired in the navigation menu for students. Lecture-type videos are linked to the course structure after recording. Other videos are displayed in their assigned location in the navigation menu and can be viewed when the student chooses the topic to which they are linked.

After the metadata has been provided, the actual recording is done with customized web conferencing software. An online conference, which does not include other parties, is automatically saved. During recording, the lecturer can share the digital learning material he or she wants. Sharing a camera image is also possible, as is the sharing of an image produced by a document camera or other accessory attached to the computer. When the lecturer closes the video conferencing software, the produced video is automatically transferred to the cloud service for the video codec. The video codec receives the video, adapts it for different devices and bandwidths, and automatically transfers it to the media server for sharing.

The CiNetCampus site automatically generates a user interface that allows students to access the video on the media server. The user interface for course videos is created based on the structure of the course topics and the video-related metadata provided by the lecturer (Fig. 1). By default, the video produced is not automatically visible to the students; the lecturer can activate the video at the desired time. Videos can also be removed or replaced with a new video. If desired, the lecturer can produce several videos on the same course topic and activate the desired version according to his or her needs.

III. Research Methodology and Methods

The development of the video program presented and evaluated in this paper follows the Design Science Research (DSR) approach. DSR attempts to create models that serve people's needs and are thus evaluated based on their utilization. One of the most commonly used DSR frameworks was presented by Johannesson and Perjons [10]. It includes five activities: explicating the problem, outlining the artifact and defining requirements, designing and developing the artifact, demonstrating the artifact, and evaluating the artifact. The DSR research method is inherently iterative. The evaluation activity provides essential feedback to the development activity. The development of the CiNetCampus system is currently in the evaluation phase of its first iteration. The results of this evaluation study will be utilized during the next iteration.

The environment of this study is the Master's Program in Mathematical Information Technology at the Kokkola University Consortium Chydenius. The problem's explication and the requirements for the video production system were based on practical experiences within this environment. The artifact is a cloud-based CiNetCampus system for producing and sharing video-based learning material. The demonstration of the artifact following its construction was realized by implementing the solution in the Master's Program in Mathematical Information Technology in the spring of 2018. Based on the experience gained, the first production version was implemented in the autumn of 2018. This study has focused on evaluating the functionality, usability, and usefulness of this first production version. The results of this evaluation will be used in future development work.

The evaluation was carried out by reviewing the CiNetCampus system several times during the winter and spring with developers and with lecturers who had used it. During the reviews, the necessary development and functionality issues were recorded. In addition, structured interviews were conducted in the spring of 2019 of three

Fig. 1. Videos are offered to students according to the structure of the course

lecturers who had actively used the system in order to identify the usefulness of the system and how it would change the lecturers' work. All the lecturers who participated in this research had also lectured in the education program using the previous video production system. At that time, the videos were produced from face-to-face situation using an automatic video recording system integrated into the lecture room. Thus, the recording of teaching and the use of videos in teaching were familiar to all the lecturers who participated in this research. The usefulness of the CiNetCampus system from the point of view of the students was assessed by distributing a qualitative questionnaire to the students who had used it. Seven students responded to the questionnaire and the information received was used to identify students' opinions about the added value of shorter lecture videos.

IV. RESULTS

A. Experiences of Lecturers

The lecturers' interviews clearly identified the general benefits of producing learning material in a new way and of some of the development targets. When looking at the educational model based on the thematic educational videos, the evaluation did not raise the issue of the development targets, but rather the benefits that the educational model brought. The emerging development targets, in turn, concerned the technical environment and the improvement of its usability and its suitability for learning material production.

According to the results, a positive aspect of the solution is that the lecturer is no longer tied to a particular time or place. Teaching can be given at the lecturer's convenience. Thus, the scheduling of teaching is more flexible than when utilizing traditional lectures.

Some of the lecturers produced videos before the beginning of the course and some did so weekly during the course. When videos were produced before the beginning of the course, the lecturer might have more time for guiding students, for example. When videos were produced during the course, flexible video production was seen to facilitate work scheduling within the week.

With the help of the CiNetCampus system, video recording could be done in short periods. The lecturers pointed out that it was easier to concentrate on the subject of the video when the preparation could be made in small allotments. In the event of a mistake, it is possible to re-record short videos with little effort, and thus to create better learning material. Learning material might be more carefully prepared and corrected and thus qualitatively improved. It was also positive that an entire topic could be handled at one time in one video.

This kind of modularized video is also more reusable and easier to connect to other teaching material than videos produced during live lecture settings. It is easier to refer to them in the context of other lectures and to attach additional material or exercises in written or video format. Short videos are also easier to update or to use in the future in another context.

In the interviews with the lecturers, it emerged that if the lecture material had previously been designed to fit traditional lectures, there was a greater need to redesign the material to better fit the short thematic videos. However, the system also makes it possible to make traditional lecture-length videos if the lecturer so wishes.

The first version of the software used to produce videos was quite good in terms of its usability, although some suggestions for improvement were raised during the pilot, including clarifying the user interface of the production system. In addition, some new functionalities such as the automatic numbering of chapters were desired. Automatic numbering would make it easier to move chapters around and edit the numbering significantly. The existing three-level hierarchy for chapters was also seen as a limiting factor for some courses. Lecturers hoped for four- or five-level hierarchies for chapters and sub-chapters. It was also hoped that additional material on the external server could be linked to chapters.

B. Experiences of Students

Students in the education program are used to viewing lecture videos in their studies. Previously, the duration of traditional lectures defined the length of the educational videos, which were produced in the context of face-to-face instruction. In the solution presented in this paper, the length of the videos and the fact that they were produced outside a lecture format was new to the students. What was also new was that each video contained only one topic and was distributed through a new interface that looked like a table of contents.

Students thought the lectures were easier to watch in shorter clips with only one topic. Previous videos were so long that the students anyway had to watch them over several sessions. The challenge was then to find the point where you had stopped watching previously. The choice of shorter study sessions was partly due to students' difficulties with watching long videos, but also the time adult learners spent on studying was more fragmented. When reviewing, short videos also made it easier to find things that were considered difficult.

According to students, the introduction of shorter videos did not have any negative effects. The CiNetCampus system was also considered as usable. The content-oriented navigation menu helped students form a good overall picture of the course. However, they wanted the system to clearly show which videos have already been viewed. Likewise, it was hoped that the system would remember where the video was stopped during a previous session. Others wished that the size of the video window could be changed more dynamically. Now students have the option to choose a default video size or full screen. One of the students would have preferred to watch videos produced in a classroom. Others were not disturbed by the fact that the videos were produced elsewhere.

C. Post-Evaluation Development

The lecturers' requests for functionality and usability were implemented during the spring and published in May 2019 in a production environment. Functions were combined and re-grouped to increase usability. Automatic chapter numbering was added to the system to facilitate the removal or reorganization of chapters. A four-level hierarchy for chapters and sub-chapters was also implemented with the option of adding a fifth level to the hierarchy later. The lecturer's interface also included the ability to add attachments to the chapters from external servers. These attachments can be any kind of material that a web browser can open or direct to another program. Likewise, various backup and roll back options were added to the system to prevent the occurrence of possible errors, for example, when removing videos.

The new course management tool consists of three tabs. In the chapter tab, the lecturer can manage course structures by adding, deleting, and renaming chapters and adding attachments (Fig. 2). In the record tab, the lecturer can start software to record sessions (lessons, introductions, exercises, etc.) and bind them into the chapters. In the videos tab, the lecturer can manage the recorded videos. It is possible, for example, to set videos one-by-one to "inactive" to hide them from students (Fig. 3).

The ideas for development raised in the student survey will be implemented into the system during the summer of 2019. The most development areas will improve the usability of the students' navigation view.

Teaching staff hold regular meetings to discuss issues such as the best practices related to a new kind of video-based learning material that relate both to video production and their use in teaching. Hopefully, the best practices will spread among lecturers.

V. Conclusions

This paper presents a new CiNetCampus solution for producing and distributing video-based learning materials. The study evaluates the added value, usefulness, and usability of the solution through the feedback collected from lecturers and students.

The video production and distribution solution presented in this study has been used in connection with the Master's Program in Mathematical Information Technology at the Kokkola University Consortium Chydenius since the spring of 2018. In the solution, video-based learning material is produced in small entities, each containing only one course topic. Production can take place from any computer connected to the Internet, at any time. For example, the lecturer can easily produce video-based learning material using his or her own computer at the most convenient time. Videos are automatically distributed to students using the interface, which resembles a content list of course topics.

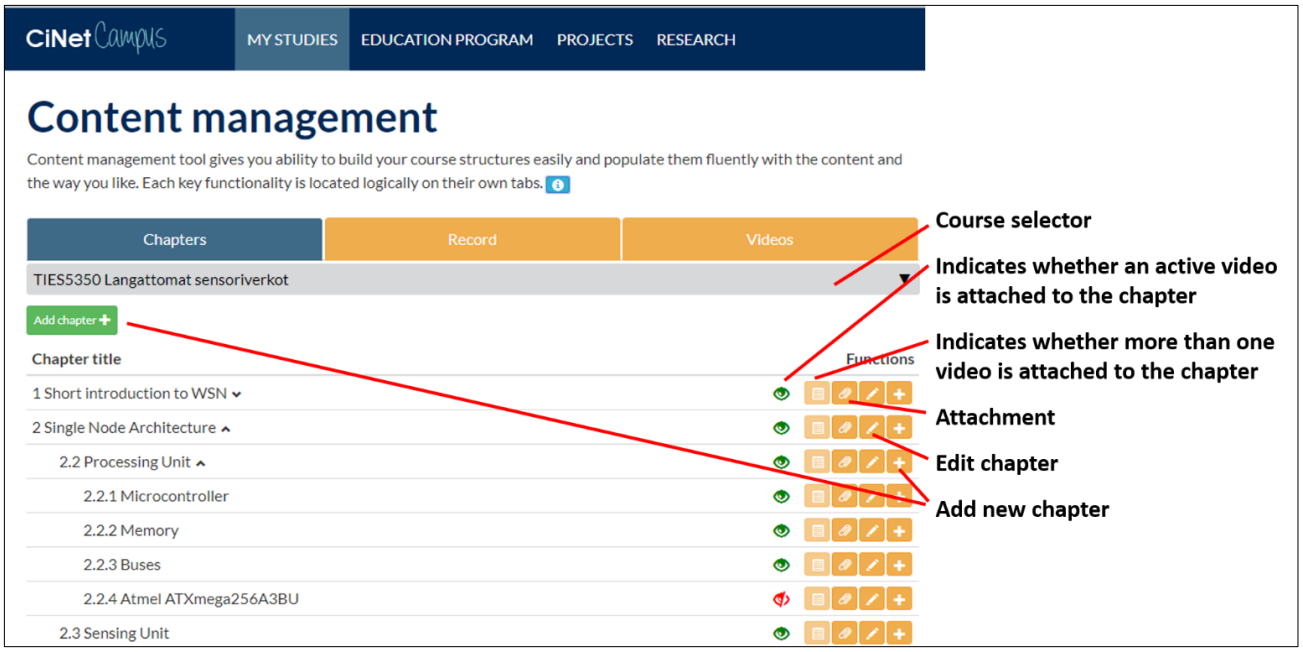

Fig. 2. The management tool for course structure after the post-evaluation development.

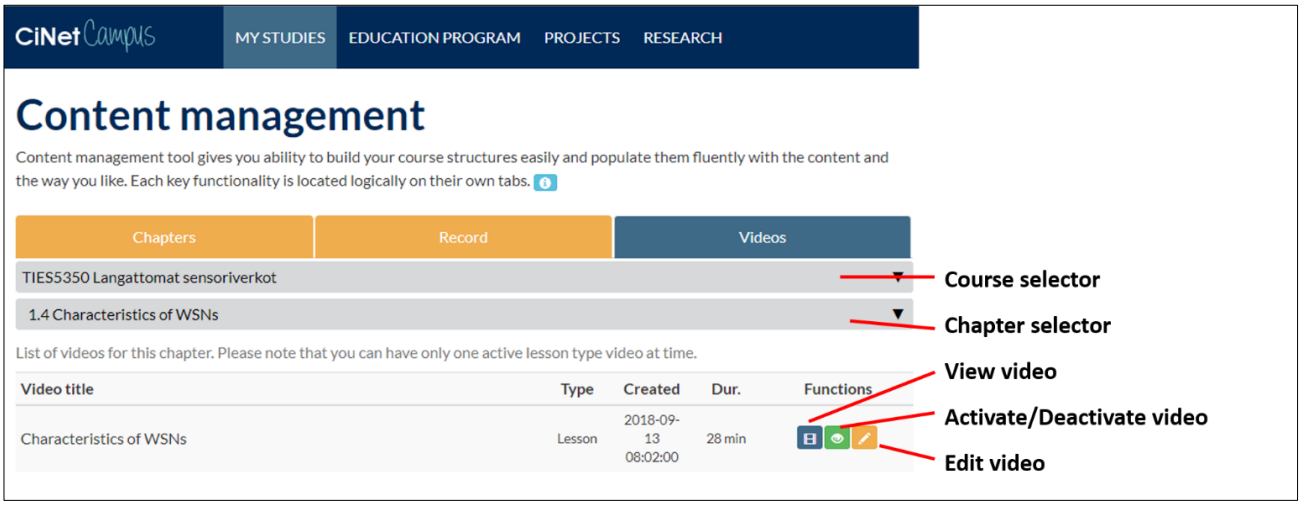

Fig. 3. The management tool for recorded videos after the post-evaluation development.

From the point of view of the lecturers, a new way to produce video-based learning material increases their work flexibility. It is easier to concentrate on the teaching and preparation of short segments. Short videos can also be easily updated. These factors are likely to improve the quality of the learning material. These sorts of versatile videos, which are easy to produce, also enable the course to be implemented in a completely new pedagogical manner. For example, lecturers can shift the focus of teaching to web-based work rather than long lectures. Short thematic educational videos are also easier to connect to other learning materials.

From the students' point of view, it is positive that the topics to be studied are not divided into more than one video, and one video contains only one subject. This facilitates the sequencing of learning and the reviewing of topics. Short videos are also better suited to adult learners than long lecture videos in terms of time use. The navigation menu that resembles a content list of course topics facilitated students' understanding of the course as a whole.

From an education provider's point of view, it may also be important that the solution presented in this paper makes it possible in some cases to significantly reduce the cost of teaching facilities.

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REFERENCES

[1] B. Mitra, J. Lewin‐Jones, H. Barrett, and S. Williamson, "The use of video to enable deep learning," Research in Post-Compulsory Education, vol. 15, no. 4, pp. 405-414, 2010.

[2] S. A. Jensen, "In-class versus online video lectures: Similar learning outcomes, but a preference for in-class," Teaching of Psychology, vol. 38, no. 4, pp. 298-302, 2011.

[3] B. R. Stockwell, M. S. Stockwell, M. Cennamo and E. Jiang, "Blended Learning Improves Science Education," Cell vol. 16, no. 5, pp. 933–936, 2015.

[4] A. Leijen, I. Lam, L. Wildschut, P. Simons and W. Admiral, "Streaming video to enhance students' reflection in dance education," Computers & Education, vol. 52, no. 1, pp. 169-176, 2009.

[5] R. H. Kay, "Exploring the use of video podcasts in education: A compre-hensive review of the literature," Computers in Human Behavior, vol. 28, no. 3, pp. 820-831, 2012.

[6] M. Merkt and S. Schwan, "How does interactivity in videos affect task performance?" Computers in Human Behavior, vol. 31, pp. 172-181, 2014.

[7] R. Moreno and R. Mayer, "Interactive Multimodal Learning Environments," Educational Psychology Review, vol. 19, no. 3, pp. 309-326, 2007.

[8] I. Hakala, T. Härmänmaa, S. Laine and M. Myllymäki, "How Do Students Blend Their Studies Based on Time and Place?" 9th International Conference on Education and New Learning Technologies, L. G. Chova, A. L. Martínez, and I. C. Torres, Eds. Barcelona: IATED Academy, 2017, pp. 2481-2489.

[9] M. Myllymäki, I. Hakala and T. Härmänmaa, "A New Way to Produce Video-Based Learning Material" 29th Annual Conference of the European Association for Education in Electrical and Information Engineering, Reykjavik, Iceland, 2018.

[10] P. Johannesson and E. Perjons, An Introduction to Design Science. Cham, Switzerland: Springer International Publishing, 2014

[11] M. Myllymäki and I. Hakala, "Video-based Blended Learning Practice in Master Studies", Proceedings of the Iasted International Conference on Web-based Education, V. Uskov, Eds., Insbruck, Austria: IASTED, 2013, pp. 872-878.

[12] T. M. van Rhijn, D. S. Lero, K. Bridge and V. A. Fritz, "Unmet needs: Challenges to success from the perspectives of mature university students," Canadian Journal for the Study of Adult Education, vol. 28, no. 1, pp. 29-47, 2016.

[13] I. Hakala, P. Impiö and M. Myllymäki, "The use and production of video lectures in the Chydenius Institute's master programmes," 15th Annual Conference of the European Association for Education in Electrical and Information Engineering, Sofia, Bulgaria, 2004.

[14] I. Hakala and M. Myllymäki, "Video lectures alongside with contact teaching," 18th Annual Conference of the European Association for Education in Electrical and Information Engineering,, Praha, Czech Rebublic, 2007.

[15] I. Hakala and M. Myllymäki, "From face-to-face to blended learning using ICT," Proceedings of 2016 IEEE Global Engineering Education Conference, pp 409-418, 2016.

[16] I. Hakala and M. Myllymäki, "A Blended Learning Solution and the Impacts on Attendance and Learning Outcomes," International Journal of Emerging Technologies in Learning, vol. 6, special issue, pp. 42-49, 2011.