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THE ROLE OF THE LEARNING STYLES IN BLENDED LEARNING

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Abstract

Education that is in line with the blended model and carried out with the help of videos enables, above all, flexible participation in study. Various participation modes enabled by video are suitable for different kinds of learners. The interaction when studying with videos differs from that in face-to-face teaching. Among other things, videos allow pauses in study and enable study in peace. This study examines the role of various learning preferences, so-called learning styles, in blended learning. The study is based on a learning style mapping made for students and on data collected over several years about their study participation styles in education that is in accordance with the blended model.

Keywords: Learning styles, blended learning, distance education.

1 INTRODUCTION

Traditional lecture-based teaching favours certain learning styles. Generally, in teaching arranged in this way, some students will be deprived of teaching reflecting their own learning style. However, by taking advantage of technologies available, it is possible to organize modern education in a way that pays attention to learners' individual tastes and necessities. This study investigates whether it is possible to adequately meet the necessities of different students with the help of teaching based on video and in accordance with the blended model.

The University of Jyväskylä, Kokkola University Consortium Chydenius is a university unit specialized on adult education. It has developed several different models that are suitable for the purpose. The education model of the Master's Education Programme in Information Technology is based on a cost-efficient and flexible blended model, which combines various teaching methods making good use of information and communication technology. The teaching solution employed is based, above all, on versatile use of video lectures realized with streaming technology, distance guidance tools and a Learning Management System (LMS). To enable flexible study is of utmost importance because the students of Master's degree in Mathematical Information Technology are all working adult students whose chances to participate in traditional education are very limited.

All teaching in the Master's degree program is arranged as face-to-face teaching in lecture halls. The courses are scheduled to be run as very compact entities in such a way that, typically, a single course is run over a few weekends. In practice, this means that the duration of a single lecture session equals that of 3-4 traditional lectures. The aim of these arrangements is to ensure that students who work would have realistic opportunities to participate, as needed, in face-to-face education within the time constraints.

All face-to-face teaching events are recorded and offered both as real-time and on-demand videos to students. In addition to participating in real time, the student can participate in the teaching provided by watching the videos produced from the face-to-face situation as on-demand videos, at the time of one's choosing. In connection with videos, a text-based interaction channel has been created between the lecturer and distance students. The messages of the chat channel can be seen also by other students watching the same real-time transmission; thus the channel also allows them to communicate among themselves during the lecture. The videos show all the lecture material presented in the lecture space, and all the discussions carried out in the lecture space can be listened to. In this way, participation with the help of video is envisaged to be as similar as possible to the participation in face-to-face study.

The students can, therefore, participate in the degree program in many different ways: face-to-face, with the help of real-time video transmissions or by using on-demand videos. In all these modes, the student can make use also of all written course material available. Moreover, it is possible to study just by getting to know the written material, without resorting to videos or face-to-face learning. An important basic principle is that the students of the degree program do not need to decide about their

participation mode beforehand; they can choose to participate in each lecture the way that is the most suitable in their own particular circumstances. Thus, the student can participate in the course study in many different ways by flexibly combining various alternatives.

In addition to videos, LMS is also available. It enables course-specific message lists as well as the storage of all course-specific written material and its distribution to students. Messaging in LMS's message lists is asynchronous. In addition to LMS and videos, web conferencing software is an important tool in the virtual education environment.

Education organized in a multimodal and flexible way described above does not provide flexibility only from the viewpoint of scheduling. In this kind of environment, the student can at will select the participation mode which is based on what suits the best to his/her own study habits. In study participation, the student can thus use the flexibility brought by technologies in such a way that the study is conducted in a manner that supports the student's study preferences. In this way, a multimodal environment of this kind supports different types of students better than lecture teaching alone.

With the help of real-time video, the student can study in peace; however, the chat-based interaction channel between the teacher and the student still remains available. Interaction is more challenging in a study of this kind. On the other hand, students who would like better interaction can select to participate in face-to-face teaching. When using an on-demand video, the student can select the place and time of study even better than when viewing a real-time video. Real-time interaction with the lecturer is missing, but the student can nevertheless study in chunks of desired size and make pauses in the study in accordance with his/her wishes. The pacing of study in this way enables for example momentary pausing and examination as well as consideration of the matter learnt and, equally, writing of notes and summaries. With the help of on-demand videos, the study offered can also be carried out in an order wanted. This makes it possible to form a general idea about the subject taught by first superficially browsing the course lectures before considering them deeper. When watching an on-demand video, the student can also repeat difficult points in the study as many times as he/she wishes. It should be noted that the on-demand videos and the benefits they bring are naturally available also to students who participate with the help of real-time video and face-to-face study.

For several years already, learning style mapping has been carried out for the students of the master's degree education in information technology. The idea behind the learning style mapping is to provide the student with a clearer picture of one's own way to learn. On the other hand, the information collected gives the provider of education some guidelines for the development of education.

The research examines students' learning style distributions based on the collected learning style results. The research data includes, in addition to active students, also students who have completed their studies and students whose studies in practice have become interrupted. By making comparisons among these student groups, the aim is to find out whether it would be possible to foresee advancement in studies based on learning style preferences or if the representatives of a certain learning style are in a weaker or stronger position in a multi-faceted education program like the one described. The research also examines possible differences in this respect between the genders and whether these should be taken into account in the development of education.

2 LEARNING STYLES

There are plenty of models that address students' tendencies and preferences in receiving and processing information in learning situations. We chose to use the Felder-Silverman model [1] because it is the most widely used model among engineering students and has parallels in other learning style models like the Kolb's model [2] and the Myers-Briggs Type Indicator [3]. The Felder-Silverman model includes four, in theory orthogonal, dimensions: active-reflective, sensing-intuiting, visual-verbal and sequential-global.

The active-reflective axis describes how students prefer to process information. Active students tend to learn while actively doing something, for example by discussing or trying things out. They also work well in groups. Reflective students prefer thinking things through before trying them out [1, 4]. The sensing-intuitive axis describes how students prefer to perceive information. Sensing learners favour information that comes in through their senses and intuitive learners favour information that arises internally through memory, reflection, and imagination [4]. Sensors like empirical facts, data and practical procedures. Intuitors prefer principles and theories. [1] Intuitors are better than sensors in dealing with symbols. Sensors have more patience for work tasks in which accuracy is required. [1]

Visual-verbal axis assesses the ways people receive information. Visual learners are best in remembering information presented through images, diagrams and multimedia. Verbal learners remember best spoken or written words. [4] Sequential-global dimension describes the progress of learning and understanding. Sequential learners learn at steady pace and acquire understanding of material in small connected chunks. They want to advance in logical steps to a more demanding level. Global students learn in fits and starts. In order to understand the new material, they need to link it to their prior knowledge and experience. [1, 4] All the characteristics of a particular learning style won´t manifest themselves necessarily in same person since every learner uses both sides of the dimensions in some situations.

The learning style preferences of the model are easy to assess with the Index of Learning Styles (ILS) questionnaire [5]. The questionnaire includes 44 questions with two alternatives; 11 questions for each learning style dimension. As a result, the questionnaire tells which learning style is the most pronounced on each axis and how strong the preference is. As the axes are continua, the preference can be mild, moderate or strong. A common way to analyse results is to compare the number of either a- or b-answers, and that practice is adopted also in this paper. Since the model was developed in the 80's from the traditional face-to-face teaching point of view, a greater emphasis is put on ILS questions' significance in our blended learning model in this research.

3 RESULTS

During master's degree application process, a Finnish language version of the ILS questionnaire is offered to students. For some of the students, the ILS questionnaire was offered as a paper version and for others as a web form. Most of the students find the learning styles interesting and respond to the questionnaire readily. The idea behind the learning style mapping is to provide the student with awareness of one's own way to learn and of learning styles in general. The aim is also to encourage students to use and improve their learning styles that are less dominant. When providing a student with his/her learning style result, it should also be emphasized that no learning style instrument is infallible when applied to individuals [6]. The learning styles can also be utilized when planning education. Knowing the students' learning style profiles may motivate their instructor to find new ways to present material [6].

3.1 Students' Learning Styles in the Degree Program

University students' learning style results are researched in various studies. In 2005, Felder and Spurling collected several published results together [6]. They observed particularly ten engineering student populations and noted that the majority of them were active, sensing, visual and sequential. To be precise, on average 61% were active, 63% sensing, 82% visual and 59% sequential. In this paper, the data consists of information technology students' learning style results; one may assume many similarities with the results that were collected in [6], especially when a large section of those information technology students have a university of applied science's degree in engineering as a background education. On the other hand, this master's degree education targeted adult students, and the average age of this paper's population is thus higher.

Our data includes 95 ILS questionnaire results for students that were accepted into the master's program after an application process. Some results were removed because the students had completed their studies before the current blended learning practices were deployed in the program. The distributions of the results are presented in Fig. 1. Divided in categories, there is a clear majority of sensors and visuals also in our population: that is, 80% sensors and 78% visuals. Fig. 1 shows that those dimensions are the most skewed ones. On the active-reflective and sequential-global dimensions, the results were distributed more evenly and the distributions are more symmetric. There were 49% of actives (with only one student more in the reflective group than in the active group) and 45% sequentials, global learners being thus the majority. The distribution of active and reflective students is more balanced than for example in Spurling's research. An education program enabling distance learning may attract more self-contained, reflective students than traditional education. The bigger share of global students may arise from the fact that the students in this research are adult students already with several years of work experience, which could give them a wider perspective in studying. The averages of the ILS results are presented in Fig. 2 with learning style axes.

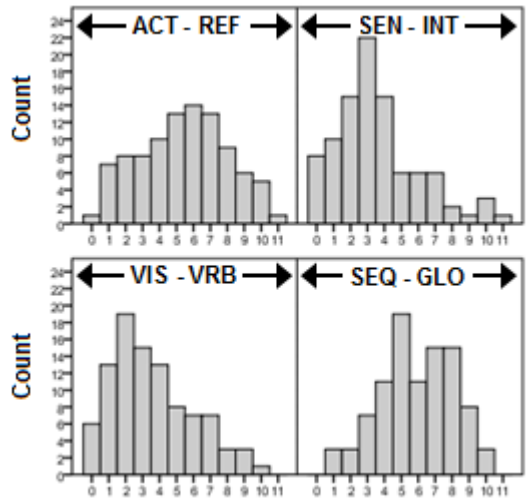

Figure 1. The distributions of learning style results of the master's degree students' in information technology (n=95).

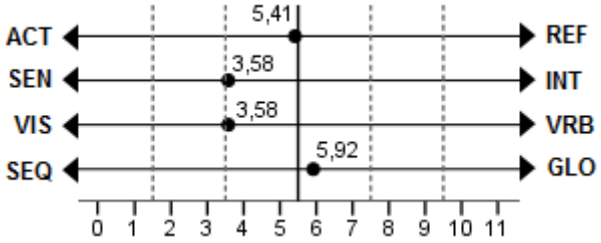

Figure. 2 The averages of the ILS results on each learning style axis.

Earlier research indicates that there are small differences between men's and women's learning style preferences among engineering students. Rosati [7] found out that both male and female engineering students show active, sensing, visual and sequential learning preference, but men were more active and visual than women, and women were more sequential than men. On the sensing-intuitive dimension, Rosati didn't find statistically significant difference. The study of Litzinger et al. [8] is in line with Rosati's research on the visual-verbal and sequential-global axes, but on the active-reflective dimension they didn't find statistically significant differences. Instead, their study showed that female engineering students are, on average, more sensing than male engineering students. On the other hand, for example Ku and Chang [9] concluded that there are no statistically significant differences in the four learning style dimensions, due to gender differences. Their learning style results were collected from four different academic disciplines: college of liberal arts, education, foreign languages and management.

There are 34 (36%) learning style results from women and 61 (64%) from men in the data. Fig. 3 examines the differences between the results. Based on the figure, the biggest difference is on the visual-verbal axis, men being more visual. The visual-verbal axis is also the only one where the difference between genders is statistically significant (Mann-Whitney U-test, N=95, p-value=0.014, 2-sided test).

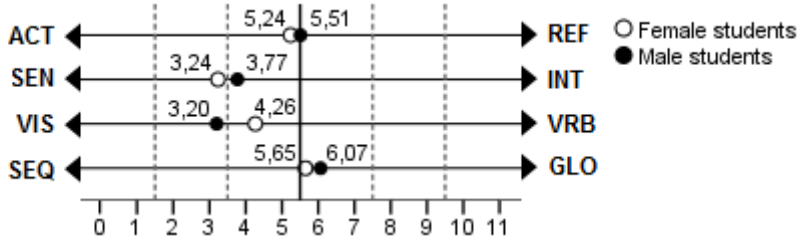

Figure 3. The averages of the ILS results for male and female students.

The 95 students can be divided in three groups based on their study phase. Of them, 32 are currently studying, 42 have graduated and 21 have abandoned their studies after studying first actively in the program. Their abandoning of studies may have a number of reasons. Some probably had difficulties in arranging enough time for study alongside their work and family. For some, the study program may not have turned out as expected. Usually, there are also mismatches between the learning styles of the students and traditional university teaching styles. According to Felder, this may cause students to become bored and inattentive, do poorly on tests, get discouraged about the courses, the curriculum, and themselves, and in some cases change to other curricula or drop out of school [1]. To exclude learning style preferences from factors that have bearing on dropping out, we compared the dropout students' and graduates' ILS results. In Fig. 4, the averages of the ILS results are presented for dropout students and the rest of the research population.

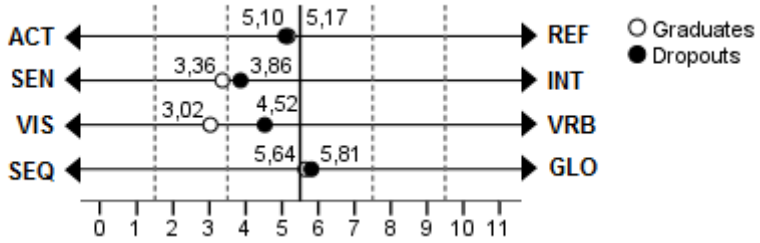

Figure 4. The averages of the ILS results for graduates and dropout students.

The only axis where the difference between ILS results is statistically significant is the visual-verbal axis (Mann-Whitney U-test, N=63, p-value=0.033, 2-sided test). Because the difference is on the same axis as the difference observed between genders, the group of graduates and dropout students are examined more detail in Table 1.

Table 1. The averages of women and men in graduate and dropout groups.

		N	Mean of ILS results
Graduates	females	13	3,85
	males	29	2,66
Dropouts	females	5	4,60
	males	16	4,50

In the graduates group, both male and female students in the ILS results are more visual than the students in the whole gender group on average. In addition, in the dropout students' group, both genders are more verbal on average than in the whole gender group, so the difference in the results isn't caused by the uneven gender distribution in groups. Although statistically significant, the result may not be substantial enough to be of practical importance. Both graduate and dropout students are still visual, the graduate students just a bit more on average. The relevance of the visual-verbal axis in blended learning environment is further considered in next chapter.

3.2 Impacts of Learning Styles in Blended Learning Model

In education made multimodal with videos and in line with the blended model, students can choose the way that suits best to their learning style in study participation. The learning style axes describe, from different viewpoints, the preferences related to the student's learning style. In the blended learning environment similar to ours, participation with the help of lecture videos was envisaged to be made as similar as possible to the participation with the help of face-to-face study. For instance, the learning material is the same in all participation modes. For this reason, not all the learning style axes necessarily have the same weight when we consider the impact of learning styles from the viewpoint of participation mode selection. In this chapter, we consider in more detail what kind of importance each learning style axis has in an environment similar to that described.

To examine students' study habits, the numbers of face-to-face teaching attendances and lecture video viewings were recorded with the help of an electronic system developed for the purpose. If a student had watched a video of the lecture she/he had attended, the viewing was considered as a revision and wasn't taken into account. Similarly, if the person had watched the lecture as real-time video, the viewings of the same lecture video on-demand weren't counted. In addition, the on-demand

viewings were divided into two groups based on the time the student had watched the videos; either before the next lecture (keeping up with the course schedule) or after it. Thus for every lecture, the student has one possible participation mode out of four.

The proportions of face-to-face teaching attendances and lecture video viewings for each student were computed. Since students' attending habits may chance through different courses, these proportions were computed per course and then the average of all of them was used in analysis. Only students who had participated at least in two courses where the attendance data was collected were accepted to the analysis. Thus the number of students decreased to 53. The average share of each participation mode for these students is presented in Fig 5. These are quite evenly distributed. Next, they are examined on each learning style axis.

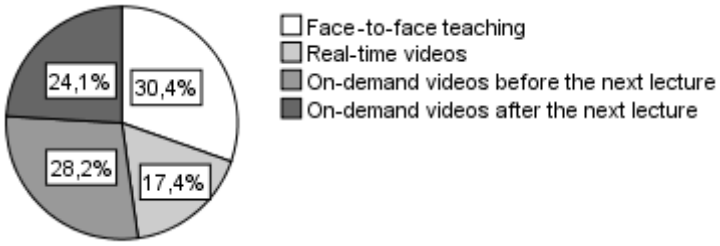

Figure 5. Students' average participation modes.

A common factor was detected on all the axes when the examination was limited to consider only mild learning style preferences. Participation on all axes was very similar from the real-time perspective in this case. This is well demonstrated in Fig. 6, which presents, for all the axes, the average participation modes of students with mild learning style preferences. These students can better switch between learning styles, in accordance with the situation. They can equally utilize both the participation mode that enables interactivity and the participation mode that limits it.

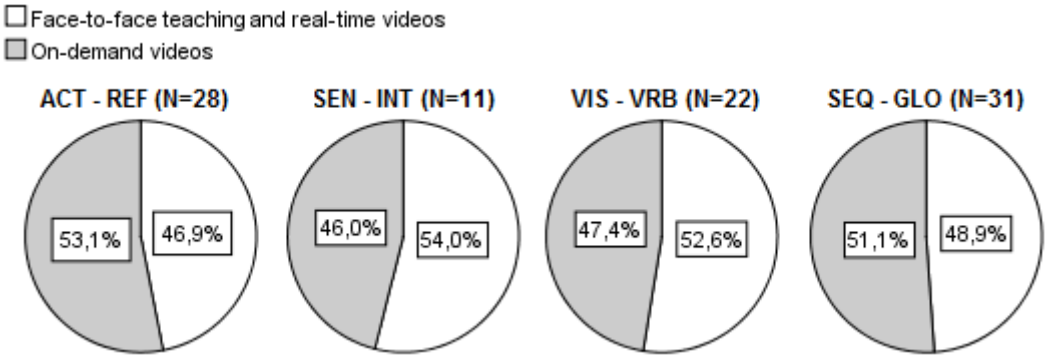

Figure 6. Average participation modes of students with mild learning style preferences.

3.2.1 ACT-REF Axis

On the basis of the ACT-REF axis definition, active students are extrovert, like conversations and group work and easily get acquainted with their student colleagues. This is the reason why social contacts in studies are important to them. In the education model under research, an interaction channel was implemented with the help of chat to run in connection with real-time video. However, the interaction realized in this way is not exactly as it is in face-to-face contact. With real-time video, interaction mainly takes place between the student and the lecturer. Also interaction between students is possible, but it is visible to all. Text-based interaction also is more limited than face-to-face interaction. It might be assumed, therefore, that active learners especially favor face-to-face teaching and would resort to real-time video only as a secondary preference. A reflective student, on the other hand, prefers studying alone and needs pauses during the lecture to consider the information received. Due to this, the reflective learner benefits from on-demand videos that can be watched at home and controlled with the player. Viewed from this perspective, in the environment under research, very active or very reflective students can choose a participation mode suitable for their own learning style. Fig. 7 depicts the ACT-REF axis from the viewpoint of participation modes. Students with mild learning style on this axis were filtered out from the data in the figure. The figure reveals that the participation of strongly or moderately active students actually gives priority to participation modes

enabling more interaction, whereas it seems that strongly or moderately reflective students prefer on-demand videos. This would support the assumption presented above about the importance of axes from the perspective of participation modes.

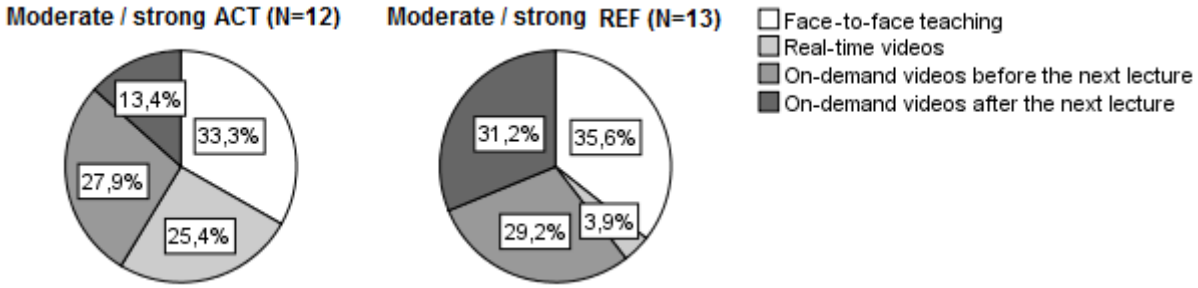

Figure 7. Strong/moderate active and strong/moderate reflective students' participation modes on average.

In theory, the student can thus choose the participation mode between real-time participation and on-demand video in a way that is best suited for him/her. In practice, however, especially in case of adult students, limitations of time occasionally make real-time participation impossible. In these cases, the student is bound to participate with the help of on-demand video. This could lead to a situation where the student has to study with a learning style that is not the one found the most suitable. This applies mainly to very active students who might yearn after interaction opportunities brought by real-time study. In connection with this research, we also wanted to investigate whether, among those studying principally with the help of on-demand videos, there would be students for whom these learning style sub-areas would have become emphasized. These kinds of students would possibly be students whom the teaching arrangements in accordance with the blended model would not be able to support in the best possible way. Fig. 8 reveals that in the degree program there are some students (black dots in the upper left corner) who clearly are active but would nevertheless participate mainly with videos. The figure also shows that some students (black dots in the lower right corner), who clearly are reflective, might benefit from the opportunities brought by videos to study in peace and to pace the lecture with pauses, but who nonetheless clearly participate mainly in real time.

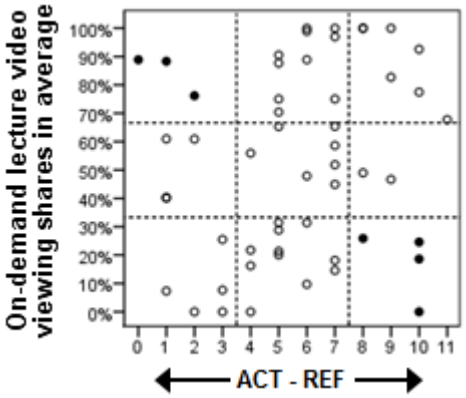

Figure 8. Scatter plot of students' average on-demand lecture viewing proportions and ILS-results on ACT-REF axis.

3.2.2 SEN-INT Axis

Sensing learners are at their best when studying facts. From the standpoint of their memorizing and learning, it would be important to see the connection between the subject under study and the real world. They may have difficulties with courses the subject matter of which is very theoretical. Intuitive students, on the other hand, more often than sensors, often find working with mathematical formulas and abstract matters easier. They are fond of inventing new possibilities for and connections between things.

Blended learning implemented with the help of videos brings, above all, flexibility to study participation. As participation with the help of videos is made as similar as possible with the participation in face-to-face study, the learning preferences on this axis do not have a clear connection to the participation mode in study. On the other hand, if we examine Fig. 9, we can see that the participation modes

clearly differ between strongly or moderately sensing learners and strongly or moderately intuitive learners. With intuitors, the role of on-demand videos and face-to-face study is clearly emphasized while the role of real-time video remains very small.

Learning style mapping has typically been interpreted from the viewpoint of face-to-face teaching. That interpretation does not fully support the study and participation modes arising in new modern learning environments. As far as this axis is concerned, the interpretation in modern learning environments must be made more accurate in future studies.

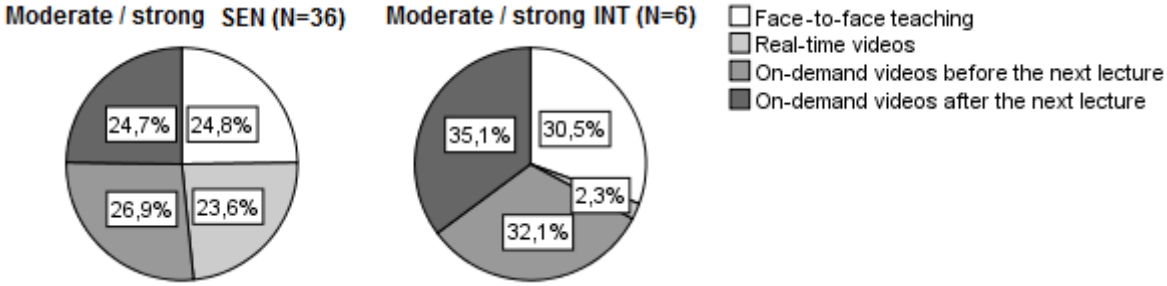

Figure 9. Strong/moderate sensing and strong/moderate intuitive students' participation modes on average**.**

3.2.3 VIS-VERB Axis

Visual learners remember best what they have seen: images, diagrams, decision trees and demonstrations. Verbal learners get more out of words, of written and spoken argumentation. The preferences of this axis, rather than being related to the participation mode, are more related to the study material used and the lecturer's way of teaching. The same study material and the same lectures are available to students, regardless of the participation mode. One might think that the verbal students would benefit more from overtly visual study materials if they discussed them with someone. On the whole, the importance of this axis, however, is not that great when we examine whether the education arrangement studied here supports different learner types. This is also apparent in Fig.10, where the average participation shares of strongly and moderately visual and verbal learners are distributed almost in the same way. The difference, noted in Section 3.1, between graduate students and dropouts on the visual–verbal axis can be better explained by that in the educational field a lot of visual presentation is employed in the study materials.

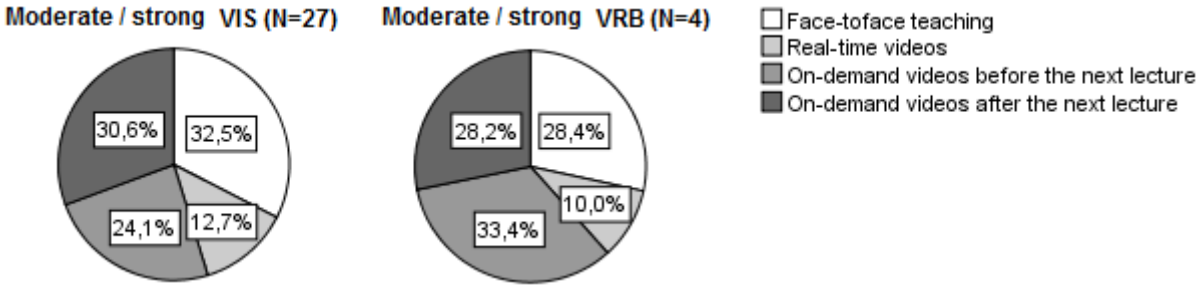

Figure 10. Strong/moderate visual and strong/moderate verbal students' participation modes on average.

3.2.4 SEQ-GLO Axis

Sequential students generally understand what they have learnt as linear steps, where each step is a logical consequence of the previous step. Most of traditional university teaching is taught in a sequential way. Global learners need to form an overall picture of the subject under study to be able to understand new information. To form an overall view, it is beneficial for them to first superficially familiarize themselves with the subject under study as a whole and immerse themselves into the subjects in larger chunks rather than study them in small pieces.

The blended model enables the choice of study time and pacing of study fairly freely. Studying with the course schedule can take place by participation in face-to-face study, by watching real-time transmissions or by viewing the on-demand videos before the next lecture. It is possible to participate also without paying heed to the planned scheduling of the lectures or the order of them. When

comparisons were made among students who were strongly or moderately global or sequential, it was discovered that sequential learners participated in study on average 11 percentage points less in the delayed mode (Fig.11). Although the difference was more or less as expected, it wasn't statistically significant. A similar situation was observed also on the ACT-REF axes, where the average share of participation in the delayed mode by strongly/moderately active learners was the smallest in the data set. In addition, participation in the delayed mode by all other strong/moderate learning styles was of the same magnitude as among global learners.

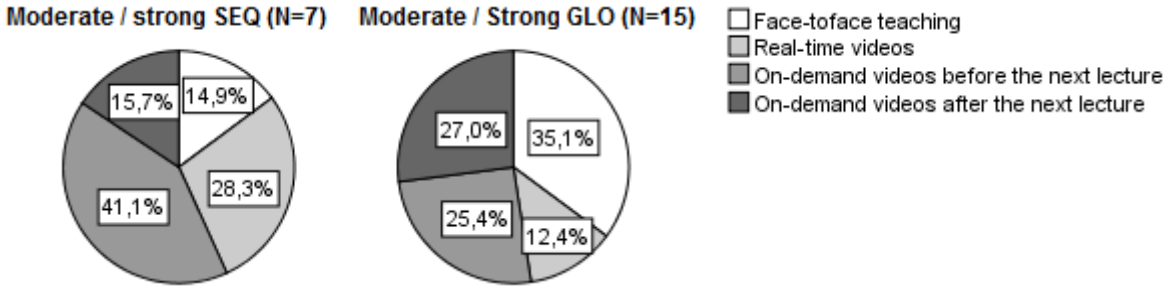

Figure 11. Strong/moderate sequential and strong/moderate global students' participation modes on average.

4 CONCLUSION

A blended model that is supported by videos enables, above all, increase in flexibility from the viewpoint of study participation. Study participation is possible by choosing the participation mode from among face-to-face study, real-time video and on-demand video. In this kind of environment, the student can choose the participation mode that best mirrors his/her preferences. One should keep in mind, however, that especially in case of adult working students the selection is affected also by many other factors, including scheduling problems due to coordination of family, study and work. A student of this type may have to resort to study with the help of videos, contrary to his/her learning preferences.

For several years already, learning style mappings have been carried out for the students of the Master Studies in Mathematical Information Technology at the Kokkola University Consortium Chydenius. The Felder-Silverman model has been used in them. This research wanted to clarify whether education supported by lecture videos provides support for different learners or whether some learners suffer as a result.

In the environment under study, it seems that the active-reflective axis has the greatest importance. This is influenced by the fact that active learners benefit from interaction, which is very different in different participation modes and is not present at all in some of them. On the other hand, reflective learners' preferences to study in peace and have study pauses can be supported with the help of on-demand videos. It seems, in fact, that strongly and moderately active learners resort more to face-to-face teaching than to real-time video, whereas reflective learners favor on-demand video.

For the learning preferences on the sensitive-intuitive axis, we find it difficult to see any clear connection to study participation modes. When the participation modes were brought under examination, it was nevertheless found that there are clear differences in the participation modes between sensing and intuitive students. To unravel the significance of the axis, further investigation in connection with blended learning is required.

In case of the verbal–visual axis, it can be said that the preferences on this axis are more related to the study material used and the lecturer's way of teaching than to the participation mode. When studying with the help of videos, the same study material as in face-to-face study is available. On this axis, the research found small differences both between genders and between graduates and dropouts.

It also seems that the sequential-global axis has some bearing on the selection of participation mode. Sequential students like teaching that proceeds linearly at an even pace. According to the results, sequential students seem to advance in accordance with the planned course schedule also when studying with videos.

So far in the degree program, apart from some experiments, mainly the contents of face-to-face teaching have been reproduced in lecture videos. The added value of the blended model, in this case, is seen, above all, as different participation mode possibilities. In the future, courses will be developed in such a way that they will better utilize the opportunities provided by the blended environment. Digital learning environments for the blended model enable the linking of various additional materials to the subjects studied. It would be possible to offer, as additional materials, for example visual elements, theories related to the subject or link the course contents with their help to the real world. Global students' study could be helped in the future by bringing the video contents, more clearly and diversely, alongside the lecture videos. This would make video browsing easier for forming an overall picture. The blended model would then perhaps provide more support to the learning preferences of all the axes.

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