Added Value Model of Collaboration in Higher Education

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Abstract

An important factor for developing quality multimedia materials is that future developers should know the learning preferences and applicable strategies of potential students in depth and should also be able to look critically on the products developed by others and to be able to evaluate the added value of their own and others contributions. This paper describes our teaching strategy using an online collaborative methodology with added value based on: (a) generating student profile, (b) online knowledge building and (c) evaluation strategy. The applied methodology integrates e-learning preferences of different learning style dimensions and takes into consideration students' expectations in learning situations as well as their background knowledge and skills. Knowledge building was realised by means of oral presentations and discussions and finalised within the online learning environment. Developing critical thinking and monitoring this learning progress was carried out by self-evaluation and peer-evaluation of one's own products and those created by others and final evaluation required summed performance to be divided among students upon negotiated merits.

Keywords: Technology enhanced learning, online collaboration, learning styles, web-based project method, knowledge building, assessment strategy

Introduction

The first step in developing an effective and quality online curriculum must identify the necessary skills and attitudes for learning (Holmes & Gardner, 2006). Improving problem solving skills, preparing to solve non-routine tasks, working in project teams, and keeping up with permanently changing requirements are expectations that higher education students can fulfil if they know their learning strengths and weaknesses and the strategies that are the most effective for their own learning processes**.** The integration of suitable teaching/learning methods into web-based educational environments used widely in higher education could well support collaborative learning effectively. When planning collaborative activities it is important to clarify the essential factors

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for creating student groups that could be crucial in producing effective cooperation between students.

In the present paper, a project-based collaborative e-learning methodology using an on-line learning management system is described that (a) takes into consideration individual differences and preferences, (b) provides opportunities for collaboration between students, (c) integrates active and collaborative knowledge building, and (d) promotes critical thinking and the continuous monitoring of one's own performance due to applied evaluation strategies. The online learning and knowledge-building model must be flexible, adaptable, and built on connectivism (Siemens, 2004) to satisfy the continually changing environment. E-education in most cases is not pedagogy- but technology driven, which, in many cases, actually worsens the effectiveness and efficiency of learning (Miyake, 2007). Most of the problems appearing during the practice of e-learning and blended-learning could be abolished upon careful analysis and right use learning theories.

E-Learning Preferences of Different Learning Style Dimensions

Over the past decades a lot of e-learning research has been dealing with the relationship between students' attitudes, online learning environments, and online learning materials. *Learning style* is the collection of cognitive features that have a relevant role in the learning process (Triantafillou, Demetriadis, Pombortsis, & Georgiadou, 2004). According to Felder, learning style means different strengths and preferences in the way of inputting and processing information (Felder & Brent, 2005; Felder & Spurlin, 2005).

Learning strategies are methods and processes that can be applied in case of an individual learning process. Learning strategy, unlike learning style, is a way of information processing that can be developed and acquired (Coffield, Moseley, Hall, & Ecclestone, 2004). There is no obviously proper strategy to be defined. Everyone has to create the steps and ways of acquiring and absorbing materials with regard to his or her own learning style that can be effective in the learning process. Ideal e-learning environments and contents can support different learning styles by applying multiple approaches and different sequences.

Which are the strategies that can strengthen the weaknesses of certain learning styles? To answer this question we have to identify the e-learning attitudes belonging to different learning styles. There are certain strengths and weaknesses in everybody's learning style that must necessarily be identified both for students and for teachers. If weaknesses are successfully identified, then effective learning strategies can be applied in order to decrease shortcomings. Some prefer to learn in teams, while others learn more effectively alone. Some grab ideas better by using more concrete, visible approaches, while others develop deeper knowledge using theoretical approaches.

The following table summarises e-learning needs and attitudes belonging to identified learning style models applied during our experimental course, together with the strengths and weaknesses of these styles (Béres, 2009; Coffield et al. 2004; Felder & Brent, 2005).

Table 1: E-learning attitudes and needs of different learning styles

Learning style model	Attitudes and needs of individuals during learning
Myers Briggs Type **Indicator** (MBTI) • Extraversion – Introversion **E-I** Method of concentration • Sensing – INtuition **S-N** Method of perception, getting information • Thinking – Feeling **T-F** Method of making decisions and judgments • Judgment – Perception **J-P** Method of relating to the outside world	**EI**: For e*xtroverts* it is important to give help and guidance, especially during individual work as it is difficult for them to work alone. *Needs*: team work, discussion, argument. *Introverts* can express themselves better in writing; they are more detailed and learn individually. *Needs:* individual work and responsibility. **SN**: The *sensing* people prefer to perceive data from their five senses. Sensors focus on facts, they perform well in routine tasks but they have difficulties when it comes to details. They solve problems by working through facts until they understand the problem. *Needs*: obvious, concrete information (task). The *intuitive* people are more interested in future possibilities. They are more susceptible to the relations and associations between the information already stored and they have big imaginations. *Needs*: tasks requiring creativity. **TF:** The *thinkers* are characterised by their logical way of thinking and they draw conclusions from basic principles. They are objective critical analysts. *Needs*: theoretical principles, analyses. The *feeling* types are usually intuitive as they judge their environment subjectively based on whether they like or do not like certain things. *Needs*: individual work and sequences. **JP:** *Judging* people prefer step-by-step approaches. This type likes making decisions; but before a concrete action they plan a lot of details and like knowing the deadlines (the further the deadlines, the better they work). *Needs*: project plan, project work. *Perceiving* people have a preference for keeping all options open and tend to be more flexible and spontaneous. They like mixing work and games, and when deadlines approach, they work better. *Needs*: games, simulations, flexible, free, varied tasks.

Felder – Silvermann Index of Learning Styles (ILS) (Felder & Silvermann, 1988)	**Active:** they learn best by working actively with the learning material, by applying the material, and by trying things out. They tend to be more interested in communicating and cooperating with others. *Needs:* arguments and negotiations, team work. **Reflective:** they prefer to think about and reflect on the material. They prefer to work alone. *Needs*: individual work, enough time for absorption, the press, print matters. **Sensitive:** they are sensitive, realistic, and practical. They like to solve problems with standard approaches. *Needs*: applications from real life and world. **Intuitive:** like theoretical materials and ideas. They prefer general principles rather than concrete examples. *Needs*: connections, mindmaps, open ended, speculative tasks. **Visual:** they remember best what they have seen, graphics or illustrated information. *Needs*: charts, diagrams, graphs, films, presentations. **Verbal**: they prefer textual representations, written or spoken facts. *Needs*: talks, verbal reports, writing projects, making presentations. **Sequential:** they learn in small steps. Prefer linear learning processes. They are interested in details. *Needs*: outlines, step by step presentations, problem solving step by step. **Global:** learners use a holistic thinking process and learn in large steps. They get the whole picture of the material to be studied. *Needs*: overviews, connections and references to other materials.

To create a successful learning/teaching model it is not enough to provide quality learning materials and taking the students' needs into consideration; the efficiency of the applied pedagogical method is also crucial (Béres, 2009). Our research objective was to survey how the students' learning processes are influenced by whether they get acquainted with the learning preferences of their own and that of others. We presumed that by analysing their own personality and learning styles more thoroughly, the students would be able to identify the barriers of their own learning and to eliminate them by using proper strategies.

The integration of technology into the learning process means that students have to be more autonomous learners; hence, the understanding of their own learning is essential. To create efficient e-learning, blended learning methodology, we have to understand how individuals learn. When

planning and implementing efficient student-based e-learning environments, the individual preferences of the students must be considered. It is difficult to decide which of the effective learning-theories to apply and which strategy can be integrated usefully as this depends on the objectives of education, the preliminary knowledge of students, their learning styles, etc. (Lowerison, Cote, & Lavoie, 2008). According to some research, student performance and satisfaction students can be improved by mixing various teaching methods; also a correlation has been shown with the application of a teaching/learning environment suiting their learning styles. (Morgan & Morgan, 2007).

Collaborative E-Learning Model

According to Vygotsky, real learning does not lie in specific knowledge acquisition or skills, but in mastering learning skills: clear, creative thinking, planning and implementation, and communicating individual understandings in different forms. Thus, he considered most important the emergence of those cultural tools that help in thinking and creating. Such tools are language and other various symbolic systems (into which we can today include the basic language of multimedia). In his most famous work, Vygotsky expressed his theories on the effects of thought and language on each other and introduced the 'zone of proximal development' (Vygotsky, 1978, 1986). Thus we can say that the different group learning methods emerged from this theory, since the basis of working together lies in effective communication and the differences in those working together, which allows the extension of each others' learning potential.

The latest research indicates that learning should be interpreted as a social process, where all individual participants, learners, and students are responsible for their own knowledge-building. Collaboration integrated within the learning process is one of the most effective teaching/learning strategies that has a wide range of theoretical and research backgrounds. By using collaborative learning, students become responsible for creating, improving, and increasing their own knowledge. In the case of online collaborative learning, the responsibility of individuals is greater as their activities are recorded; and students should be able to take part in building their own knowledge independently and actively (Miyake, 2007; Su-Ju Lu, 2007). Today the aim of learning is not to learn facts but to generate a flexible and creative knowledge-base that can be used in different situations (Carliner & Shank, 2008). To achieve this aim, apart from including the teachers' interactive orientation schemes, we have to be able to address students' differences, integrate student centered activities with problem-based approach, maintain high interaction building on connectivist theory, enforce reflection and evaluation, as well as trigger collaboration within the knowledge-building model.

Effective Learning Methods

There are several methods for individual or collaborative acquisition of knowledge. The content of a course can be defined using different structures building on each other. The following effective methods were chosen for our course, which correspond to different strategies recommended for certain learning styles:

- **Using mindmaps:** Mindmaps are suitable for visualising structures and concepts, which helps visual and global students (Buzan, 1996).
- **Learning from sequential and/or global e-learning materials**: Sequences can be implemented by the logical connection of content units, predefined instructions, and paths. The global approach helps to realize topic reviews and connections, and references to other materials (Felder & Brent, 2005; Reigeluth, 1999).
- **Problem-Based Learning:** Acquiring knowledge and the learning process are based on problem solving. Students themselves decide what kind of knowledge is necessary to

solve the given problem and task, i.e., develop a unit of material according to given principles. (Hmelo-Silver, Duncan, & Chinn, 2007; Jonassen, 1999).

- **Project-Based Learning**: Knowledge acquisition can be carried out by developing a product. Project-based learning methods can initiate autonomy in learning. Building teams can make use of individual differences (previously mastered skills or learning styles) producing differences in added values. By breaking the task into smaller sub-parts, students can decide who does which parts, depending on skills, knowledge, or preferences of individuals, in order to fulfil project activities. Planning skills can be also developed when working out project plans and distributing tasks and responsibilities at the very beginning. Communication between the students has vital importance. Competencies in communication, cooperation, and the handling of conflicts can be developed. Taking individual responsibility is a key factor as not keeping to a deadline can endanger the implementation of the whole project. (Jonassen, 1999; "Ordinance governing," 2001)
- **Inquiry-Based Learning**: Student-centered, active learning, based on research, critical thinking and problem-solving skills (Hmelo-Silver et al., 2007).
- **Evaluation strategy**: Evaluation methods, evaluating others, self-evaluation, assessing one's own and others' products. Defining the significance of contribution (one's own and that of others') in the project product can develop a critical way of thinking and invoke monitoring processes. (Miyake, 2007).
- **Multimedia**: During the online course, different media elements are used within the course material and in students' previous works and should be effectively used in project products: integrating text, video, audio, graphics, animation and simulations, while applying the principles of multimedia (Mayer, 2001).
- **Interactive games**: Presenting information by using interactive games/simulations can effectively support the learning of visual and global students (McFarlane, 2007).

Presenting the Applied Method and Context

In our blended learning model, special care was taken to implement the most preferred methods so all learning styles and types could find their preferred learning forms, tasks, and activities. At the same time, students not favouring offered directions could challenge themselves in new territories.

Applied Method and Technology

We worked out our collaborative teaching/learning model for the course 'Designing multimedia materials' at ELTE University, based on: (a) generating student profiles, (b) online knowledge building, and (c) evaluation methods.

Individual objectives: All students had to take part in learning style tests, introduce themselves online, collect best practice examples within their individual tasks, contribute to 'golden rules' based on their chosen chapters, prepare evaluations of former students work, take part in evaluation exercises and perform project work, fill out a questionnaire, evaluate their own groups' work, and take an active part in the face-to-face and online discussions.

Group work objectives: During the course, project teams (each containing 4 members) were formed by the students and each group had to develop multimedia materials processing a chosen chapter of the course curricula itself. As far as the composition of teams is concerned, we urged students to choose members by selecting individuals with different learning styles and different practical skills (HTML, Flash, visual skills, digital storytelling skills, etc.). The following tasks

were defined: developing a) a video or other storytelling element; b) a text-based web page and mind map for orientation; c) an interactive simulation; and d) graphics and animations. The project work of the teams consisted of the following: preparing a project plan, preparing a website on the specified topic, and finally presenting the finished project product - the multimedia material.

When developing our method, great care was taken that all students could find tasks, activities, and learning objectives suiting their preferences. The process contained the following steps:

- Precisely set learning objectives; the description of the skills and competencies that students can achieve by the end of the course.
- Introduction to the role of learning styles in e-learning and the weaknesses and strengths of certain style dimensions identified by literature.
- Creating a student profile generated on the basis of learning styles, preferences, attitudes, and expectations.
    - To define learning styles, students filled out online MBTI and Felder-Silverman tests, which were then discussed and strategies were recommended.
    - To share expectations and preliminary knowledge, online introductions took place during which the students described their preliminary knowledge in connection to course tasks, skills that can be useful during project work, and their expectations.
- To reach individual and group objectives - based on Bloom's taxonomy (Krathwohl, 2002) - active student and teacher knowledge building and evaluation methods were used. An online knowledge base was created online, including:
    - *knowledge*: Concise learning material was provided on how to design multimedia materials from which each group had to choose one chapter for processing as project work. Theory and practical inquiry guides were presented by course instructor during interactive lectures. Students created an online knowledge base by defining "golden rules" gained from the chosen chapters and face-to-face interrogative classes. Golden rules are important laws, principles, and instructions from the theory and practice of creating multimedia materials that had to be collaboratively compiled so that no rule appeared twice.
    - *comprehension*: Students learned how to make mindmaps and to use authoring environments with the help of sequential e-learning materials and seminar sessions.
    - *application*: These mastered tools had to be applied to express the elements of project work for compilations.
    - *analysis*: Team products of the previous year were critically analysed, both individually and collaboratively, and during the interrogative lecture, students actively assessed and analysed presentations together with the lecturer.
    - *synthesis*: Knowledge gathered during the course had to be applied in order to create a global chapter in team cooperation.
    - *evaluation*: Students collected good practical examples and evaluated their own work and that of others; the lecturer criticised group works. Then groups had the possibility of making corrections and adjustments, after which the final assessment took place.
- Critical evaluations reflected the awareness of rules within the overall material not just the chapter processed by a given group, which indicates that knowledge building is in-

deed happening while listening to the other groups' presentations or evaluating online materials.

- The applied assessment strategy is one of the more important parts of the model. In the case of the collaborative project work, a crucial issue is to solve how added value, performance, and knowledge acquired by the individuals can be evaluated individually. Peer evaluation and self-evaluation are given greater emphasis as the instructor is not able to judge who contributed to each detail. Students tend to support each other in case evaluation comes only from the teacher, but behave more critically if the final result also depends on others' works. Student teams were awarded a collective mark, which they distributed amongst themselves based on their own values added. Final individual evaluation could take place on these accounts and grades were actually awarded as all individual objectives were done and accounted for. The evaluation strategy we employed ensured that knowledge building, collaborative project work was evaluated fairly.
- Students' feedback ensured the quality and efficiency of the applied method. Students could express their opinions about their own learning styles, evaluate their own activities, products, and implement objectives in an online questionnaire.

BSCW (http://www.bscw.de/) was used as a virtual learning scenario. Figure 1 illustrates the teaching/learning, knowledge building, and evaluation model applied:

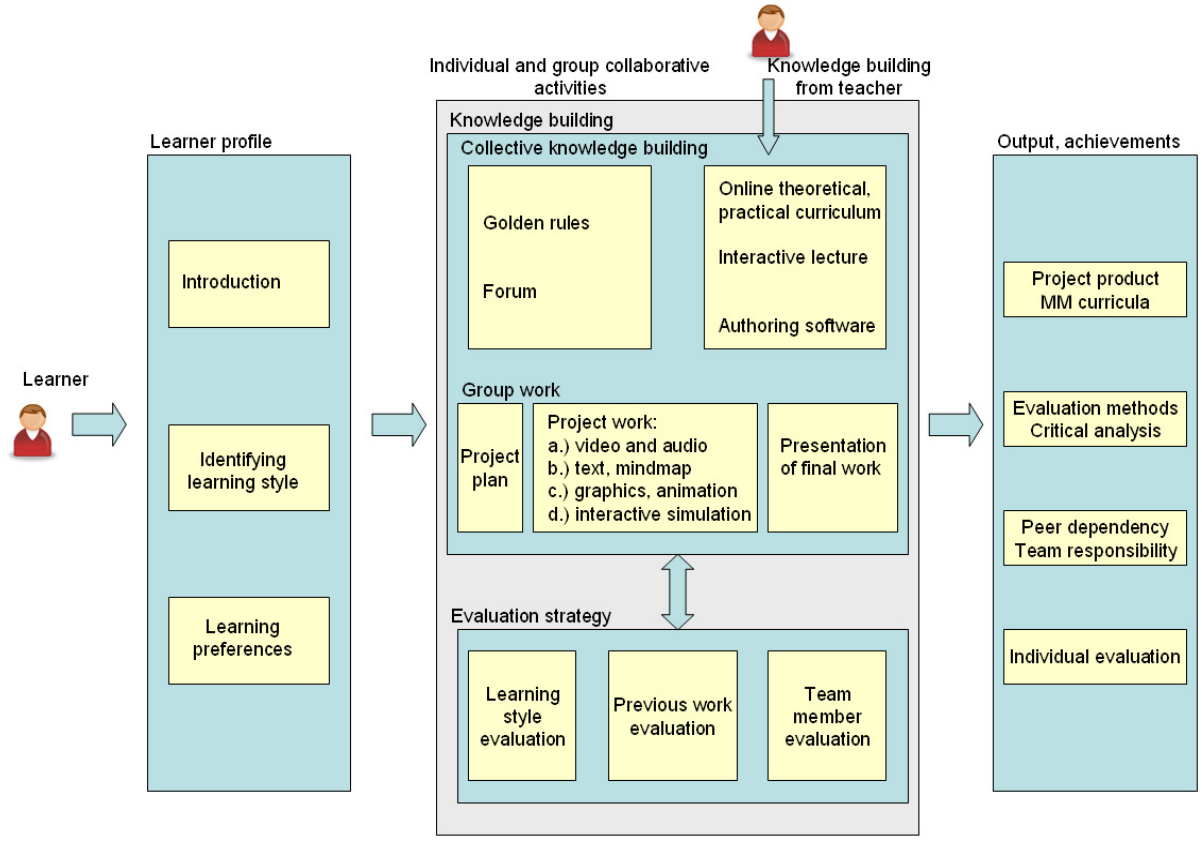

Figure 1: Project based online collaborative teaching/learning model

Objectives of the Research

The objectives of the research were:

(1) To effectively integrate the theory of learning style within the project work.

(2) To make students become acquainted with learning strategies that support their own learning styles.

(3) To encourage students to not only create products that support their own preferences but be able to consciously create and apply multimedia and interactivity elements supporting different preferences.

(4) To analyse students' attitudes, evaluations, assessments, results, and opinions using the applied methodology with regards to their own learning styles.

In developing the experimental course and creating the methodology, we wanted to explore what effect the identification of learning styles in online collaborative learning environment has on the student's attitude, efficiency and on the quality of learning and work products created during the project.

Participants included 32 fourth and fifth year university students majoring as IT teachers or programming mathematics, enrolled for the course titled Designing Multimedia Materials for a single semester (three and a half months) in the spring term of the 2008/2009 academic year, so the results are presented as a case study. Student backgrounds varied as they took different courses during their studies; nevertheless all groups managed to have experts in the task fields (HTML, graphics, Flash, digital storytelling skills, etc.)

Results

Student Profiles

The definitions of student profiles were generated online:

(1) Based on the MBTI test results, ISTJ (20%), ESTJ (12%) and ESTP (20%) types occurred most frequently. If we consider the frequency of single factors we can see that the Sensing (68%) and Thinking (72%) factors dominate. We have found these factors being also dominant in previous and further experiments and concluded that the specifics of the students' field of study (computer science) might well reflect this feature.

Based on the Felder-Silverman test, we can state that more than 80% of the students could be characterised as active, sensitive, visual types, so we cannot analyse these three types in more details. In case of the sequential/global types, the differences are greater: 52% are sequential while 48% are global types, respectively.

(2) Another part of the student profile, the online introduction, contained the information necessary for creating teams. On the basis of the introduction it was found that on behalf of the sequential students (75%) web development, audio development and video making are important skills for the project; the global students (72%) believed that previous project experiences and good team work were essential, which corresponds with the features described in the literature. It turned out from the introduction that 44% of the students had enrolled for the course only to gain credits, while the others had expected to gain skills and competencies that are useful in practice (33%) or getting to know the use of concrete software (17%).

Activity and Efficiency

The activity of the students was measured in terms of participation in knowledge building, discussions on forums, performance within assigned tasks, online evaluations, and tests. There are several advantages for creating project plans. By breaking the project work into sub-tasks the project work became more transparent for the students. Communication between students was also essential during activities and the persons responsible for the tasks and assignments were included in each project plan. With the help of the project plans the preferred activities of the students could be monitored. From the project plans it became clear that the sequential types ventured for project-leading tasks and interactive parts, while the global ones preferred the development of the design plan, integrating sub-tasks, and testing tasks.

Results of Evaluation

Evaluation of previous year's student works: Students evaluated the e-learning materials developed in the previous years by former students on a 14-point questionnaire. They could score each criterion from 1 (worst grade) to 5 (best grade). Based on the 51 evaluations altogether, the following can be concluded:

- The opinions of the students sometimes were very similar and in other cases totally contradictory. In terms of work graded with better grades, there was less deviation experienced and in the case of the weaker ones we could find both slighter and greater deviation. To sum it up, the students were better at agreeing what could be termed as a good solution than bad practice.
- The weakest evaluation was assigned to the efficient use of audio (1.7) followed by the detailed outline of the topic (3.4).
- The ability to navigate and the visual overall impressions were also ranked satisfactory in the analysed e-learning solutions.
- In the works evaluated, the proper integrity of the text was awarded the highest number of points (3.92).
- When assessing the previous terms' work, in most cases there was no significant difference between the global and the sequential students.
- The difference was greater in terms of assessing appearance as it was ranked 4 by the global students and 3.6 by the sequential ones on the average.

Evaluating performance of their own team workers: the attitude, individual performance, cooperation and sense of responsibility of the project members were assessed online:

- Students were very critical in cases of weak performance of team members as the whole project work could have failed. We were satisfied to hear critical comments from students as their classmates took criticism more seriously than if it came from the instructor, and they mainly had to admit their faults as there was nothing to hide.
- The deviation was huge when assessing team efficiency; however members evaluated their own responsibility and experience as satisfactory or good, which resulted in an average of 3.56. A slight majority (52%) of the students evaluated their own project product as good, but only 10% thought that it fully met the objectives they themselves set beforehand by generating and accepting the golden rules. We believe that self-evaluation was quite realistic as it pointed out the lack of following theory, which they admitted needed improvement.

Based on the results of previous semesters, we strongly believe that the critical view of students' own work and that of others has highlighted more the deficiencies of products and pointed out specific mistakes of individuals or the team as a whole, which leads to better understanding the objective of the course and overall rules.

Evaluation on the quality of the course: By using an online questionnaire at the end of the term, we asked for the students' opinions about the BSCW environment, about the e-learning material, and about reaching the targets and objectives needed to produce their own project products and the applied educational methods. We measured students' opinions on a five-point Likert scale (1 representing very little, and 5 meaning very much) in order to get quantitative results (Table 2.):

- According to students' opinions in the case of e-learning, it is important that students make progress at their own pace because this criterion can determine the success of studying.
- The role of learning styles in e-learning was also regarded as essential and 81% stated that it helped students get to know the strengths and weaknesses of their own learning styles.
- The results of the questionnaire showed that the respondents at present regard the blended learning method most effective.
- It turned out that 19% of the students think that the individually-developed study material takes into account the differences between students.

Table 2: Students' opinions on quality of course

	Very important, by all means
Progress at own pace	96 %
Role of visual elements supporting e-learning	81 %
Role of audio elements supporting e-learning	43 %
Availability of printed version of the study material	71 %
Great need for teacher support; blended method	67 %
Getting to know the features of learning style, the strengths and weaknesses of e-learning help individual learning	81 %
Making a project plan made the team work more efficient and transparent	67%
The individually-developed study materials takes into account differences between students	19 %

After each evaluation collaborative discussions took place in a face-to-face class which proved that: students managed to identify rules that were also outside their scope of processing; students graded each other more severely when their works depended on each other; and they finally agreed at the fairness of acquired grading.

Conclusions

Our teaching strategy using online collaborative methodology considering learning styles proved to provide added value based on: (a) generating a student profile, (b) online knowledge building and (c) evaluation strategies. The identification of learning styles can be an important factor in technology-supported education. In the case of individual learning, one can strengthen weaknesses by using specific strategies. This type of learning method requires a conscious and independent attitude from students. On the other hand, it alerts students to take into consideration the receiver as well when developing multimedia materials. Creating the student profile provides an opportunity for the students to select the proper team members and create efficient teams on the basis of differences in order to increase each others' learning potential. It can be seen from our research that the different types took part in activities to different extents. The educational methodology we applied uses various activities, interaction types, and individual and group assignments using various learning methodologies. The project work provides an opportunity for the students to select the most suitable activity for themselves so collaboration between students can be more effective. Collaborative knowledge building seemed to be more effective in identifying critical rules within the overall theory to be implemented even if not followed in practice. Integrating evaluation into the applied learning method develops critical thinking skills and the analytical abilities of students. Collective assessment and the division of grades proved to make fairer judgments of individuals' work and strengthened the rules that were supposed to be followed even if in practice they were not applied to the needed extent.

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