Lessons Learned from Use of Web Conference in Teaching Programming

Samra Mujačić  
Faculty of Electrical Engineering & University Centre for Distance Education Development, University of Tuzla, Tuzla, Bosnia and Herzegovina  
samra.mujacic@untz.ba

Samira Mujkić  
College of Computer Science and Business Communications eMPIRICA, Brcko, Bosnia and Herzegovina  
samira.mujkic@empirica.ba

Muhedin Mujagić  
College of Computer Science and Business Communications eMPIRICA, Brcko, Bosnia and Herzegovina  
miko.mujacic@empirica.ba

Juliija Lapuh Bele  
B2 d.o.o., Ljubljana, Slovenia  
julija.bele@b2.eu

Abstract—This paper analyses the use of web conference enabled lectures for programming courses within Engineering Informatics study programme, for two different groups of students: regular face-to-face students and blended learning students. Web conference offers the opportunity for the participants in the distance learning environment to be brought into a joint virtual environment regardless of their location, and also offers interactive and collaborative possibilities which facilitate the process of acquiring collective knowledge. The paper presents the comparison of mostly used web conferencing tools nowadays, based on several criteria: functionality, security, software installation, meeting setup and usability. Main aim of this paper was to evaluate the effectiveness of using web conference in teaching programming, for face-to-face and blended learning students. Web conference lectures were applied in the class on four out of ten courses in total, in the second year of the studies. The summative analysis of the pass rate and the average mark for both groups of students has been carried out in these courses. Then the results that the students achieved in the courses where the web conference was used were compared to the results that they achieved in the courses where the web conference was not used. Based on students’ evaluation, the paper also presents formative analysis of efficiency and usefulness in using web conference in the class. Finally, guidelines for the efficient use of web conference in delivering programming courses have been proposed.

Keywords—web conference, collaboration, interaction, summative analysis, formative analysis

I. INTRODUCTION

Web conference offers the opportunity of connecting a group of participants who occupy different locations via usage of modern telecommunication networks. A wide variety of different solutions and tools have been developed so as to ensure high quality web conference services, enriched with various different features which eliminate potential obstacles due to distance and lack of a F2F (face-to-face) contact. Owing to these tools, a web conference becomes a modern teaching method whose features contribute to the development of a high quality tertiary education realised via e-learning technology. Web conferencing tools provide educational process with new, higher quality manner of eliminating spatial dimension in the process of acquiring knowledge and skills. It is vital for a modern, flexible, distance learning institution to provide staff and students with efficient communication tools to support pedagogical innovation and research activities. Initial evaluation findings reveal that through web conference, external students feel engaged and connected, which may lead to better student evaluations, higher university ranking and additional government funding [1]. Web conference has the potential to bring distance learners closer together, build community and enable interactive and collaborative activities that facilitate a joint construction of knowledge [2]. The process of learning and cognitive development is dependent on social interaction. Students also learn through problem solving under adult guidance or in collaboration with more capable peers. In [3] it is deemed that adults learn most effectively when they get to apply knowledge in their own working environment, to reflect on that experience and pose questions to their peers and subject matter experts. By using a web conference, students can simultaneously interact with the professor, learning materials and other students. The level of interaction is largely dependent on professors’ deftness in the new environment, as well as the appropriate scenario selection for the lectures.

A large number of higher education institutions use one of web conferencing tools in conducting classes, regardless of the type of the studies, with which they have excellent experiences. Northampton Community College in Bethlehem, Pennsylvania, is using web conferencing products such as Elluminate Live to host virtual open houses facilitated by admissions staff and faculty. Other institutions use web conferencing tools for
course instruction. For example, East Carolina University in Greenville, North Carolina, offers construction management, nursing, safety classes, art, and many others with Saba Centra; students feel as if they are in a real-time environment. Some colleges and universities are using web conference to provide online tutoring services for their students. Northampton Community College and the Connecticut Distance Learning Consortium use Elluminate Live and Adobe Connect Professional, respectively, to provide synchronous online tutoring to students [4]. Blackboard Collaborate is used at Harvard Extension School for conducting interactive online courses and evening classes. It is also used at other universities for achieving a better online collaboration between colleges and students of online, blended and mobile learning model.

According to the National Center for Education Statistics 31% of the postsecondary institutions were offering online courses in 2006-2007 using synchronous Internet-based technologies. Professors have also used web conference to simulate F2F classroom experiences [5].

For the successful application of a web conference, which is nowadays considered to be one of the most applicable forms of video conference in the educational process, planning and practice are mandatory, so specific guidelines are suggested for teachers, those being [6]:

- Focusing on the process of studying,
- Specifying expectations,
- Preparing additional materials,
- Preparing various interactive activities,
- Facilitating communication between students,
- Conference success rating.

Application of web conference in teaching programming is particularly significant, primarily since the enhanced web conferencing tools features contribute to a better understanding of the basic programming concepts during lectures. Features such as chat and raise hand enable students to address the professor directly with their questions and ambiguities regarding specific part of a code, report detected mistakes and they can also voice the problems encountered in their attempt to solve specific problems. On the other hand, features such as live pooling, pass the ball (control takeover) and sharing resources makes lectureship considerably easier for professors for the programming courses and their continual usage is vital. With desktop and application sharing students have an insight into overall resources used by the professor during the lectures, while sharing documents ensures that students included in the session can take control over documents, receive tasks and other additional materials necessary in the process of conducting lectures and for the individual work. Receiving feedback from students in due time is very important so as to by acting at the right moment the problems and ambiguities encountered by the students can be solved. Live pooling enables for professor to create an enquiry for the whole group and receive useful feedback, such as the degree of acquired knowledge or problems students encounter in the process of attaining knowledge in the lectures that can influence the further class dynamics. However, a direct inclusion of students in solving specific problems is achieved best by passing the ball, i.e. giving control over some applications and contents to the students themselves. The aforementioned feature that ensure the interactivity during the web conferencing lectures has proved to be useful primarily for students, but also for professors, and in [7] there are guidelines for the best way of its implementation.

This paper describes the use of the web conferencing software, Cisco WebEx Meeting, in teaching programming at eMPIRICA College, with F2F and blended learning students. To assess the effectiveness of the class realised through the usage of this tool, the analysis of exam success rate in both groups of students has been carried out, as well as the comparison of the results achieved in courses realised via web conference and courses where the aforementioned tool was not used in class.

II. COMPARISON OF WEB CONFERENCE TOOLS

Web conference is a contemporary Internet-based approach that includes video and audio components and also extends to a variety of features that enable more enhanced interaction through the desktop environment [8]. Special advantage and significance of web conference in terms of education in relation to other technologies is the fact that web conferencing software ensures a complete tool package within a single environment [9]. The advent and rapid development of web conferencing tools have contributed to a greater application of web conference not merely in education but for the purpose of various trainings, presentations and educative seminars. In comparison, video conference required significant infrastructural investments. In the past, video conferencing equipment could be housed only in designated classrooms; today, software can be accessed from a server so that an individual can join a web conference if he or she has a desktop or laptop computer and can share audio and video with the addition of a microphone and a webcam [4]. To select an adequate web conferencing tool it is necessary to do a comparison of features, advantages and downsides of different tools. In [10], there is a comparison of web conferencing software of different manufacturers irrespective of recommendations and influence of the manufacturer and other parties, and according to multiple criteria which can be grouped as follows: functionality, security, software installation, usability and meeting setup. Each of these general criteria is comprised of a series of characteristics and capabilities that are analysed. Functionality of web conferencing tools is analysed by assessing features such as desktop sharing, schedule meeting, application sharing, interaction, video conferencing, audio conferencing, functionality for organizers, and integration with other software solutions. Web conferencing tool security verification is conducted by analysing the achieved level of security present while accessing the web conference and during the document sharing, which depends on the type of encryption applied. The analysis of factors such as software installation, usability and meeting setup is conducted by assessment of possible ways of installation, meeting setup before the session commencement as well as the level of complexity of web conferencing tool usability.
Table I shows the comparison of five web conferencing tools of different manufacturers: Microsoft, Cisco, IBM, Adobe and Team Viewer GmbH. For each criterion there is a scale from 1 to 5, wherein 1 is the lowest and 5 the highest grade [10].

**TABLE I. COMPARISON OF WEB CONFERENCING TOOLS**

<table>
<thead>
<tr>
<th>Criteria</th>
<th>TeamViewer 9</th>
<th>Cisco WebEx Meeting</th>
<th>Adobe Connect 9.2</th>
<th>IBM SmartCloud Meetings</th>
<th>Microsoft NetMeeting</th>
</tr>
</thead>
<tbody>
<tr>
<td>Functionality</td>
<td>2</td>
<td>4</td>
<td>4</td>
<td>3</td>
<td>1</td>
</tr>
<tr>
<td>Usability</td>
<td>5</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>5</td>
</tr>
<tr>
<td>Meeting Setup</td>
<td>5</td>
<td>5</td>
<td>5</td>
<td>5</td>
<td>1</td>
</tr>
<tr>
<td>Software Installation</td>
<td>5</td>
<td>5</td>
<td>1</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>Security</td>
<td>4</td>
<td>5</td>
<td>4</td>
<td>4</td>
<td>1</td>
</tr>
</tbody>
</table>

Based on features and grades attributed to every criterion in [10] a general grade of web conferencing tools is formed, whereby the criteria assessed have partaken in the final grade with different percentage. Criteria that have the greatest influence on formation of the final grade are functionality and usability of a web conferencing tool. The results show that Cisco web conferencing software ensures a wide spectrum of features with the best service quality, while the highest final grade went to Team Viewer. The remainder of web conferencing tools have received satisfactory grades criterion-wise but due to a smaller number of features and higher complexity level in usability, meeting setup and software installation, the final grade placed them at a lower rank in relation to Team Viewer and Cisco WebEx Meeting. In [11] the comparison of web conferencing tools has been carried out along similar criteria but the assessed factors had different share in the formation of the final grade in relation to comparison from [10], which ranks the same web conferencing tools differently in these two sources. Analysis of web conferencing tools in [11] concludes that web conferencing software should come with built-in help menus and systematic guides for every stage of a meeting, from initiation to termination. The comparison of a considerably larger number of web conferencing tools can be found in [12] as well, but only in the format that shows which features are enabled and which are not for each tool. The majority of web conferencing tools offer very similar features, so that the matters such as security, manner of implementation, the complexity of tools become important factors for comparison and decisions as to which web conferencing tool to apply.

III. THE USE OF WEB CONFERENCE AT eMPIRICA COLLEGE

Following the comparison of web conferencing tools presented in the previous part eMPIRICA College has decided to use Cisco WebEx Meeting for holding web conference lectures. Though WebEx Meeting is often used in higher education institutions as Software-as-a-Service (SaaS), as in that case no additional hardware and other IT resources are needed, eMPIRICA College opted for the local installation of the software, which enables better performance if there is broadband LAN/WAN Internet access available. In this way, professors and students are ensured to have a high quality and secured web conferencing service in all situations and complete control over the system resources. Participants of the web conferencing lectures are not required to download, update or maintain the software; it is only required to have the Internet connection and tool usage is enabled through web.

Security with using web-based tools and services is always questionable and different solutions are needed in order to enhance it. WebEx Meeting can be additionally secured by setting up a password-protected session. When sharing documents or doing a presentation, coding is done via Universal Communications Format (UCF), which is Cisco technology that optimises shared data. WebEx Meeting also ensures data encryption. In the case of data transmission from clients 128-bit SSL (Secure Sockets Layer) is used and end-to-end encryption is enabled, whereby the whole content exchanged between participants is encrypted by using the Advanced Encryption Standard [13].

The aim of introducing web conference into teaching at eMPIRICA College is that students are provided with real-time lectures from visiting professors and IT experts regardless of where they are currently, so that the need for them to come to the school headquarters is eliminated. Within its Engineering Informatics study programme eMPIRICA College applies two learning models. F2F model is based on the traditional class conduction while in blended learning model, e-learning is a dominant component (80%) while F2F component makes up 20% of the classes and is mainly targeted at conducting lab practice and classroom tutorials. All e-learning aspects are carefully analysed and implemented, which with the growing trend of ICT almost daily receives a new form, primarily through new multimedia and interactive elements and content. The content, instruction and continuous assessment are delivered to blended learning students in the first place via LMS/LCMS system eCampus. According to Vygotsky, the process of learning and cognitive development is dependent on social interaction. Due to the previous piece of information, it is necessary to incorporate different interaction categories into the e-learning component of blended learning model, those being: interaction with content, professor and other students. eCampus offers various features (e-classrooms, e-materials, personal messages, forums, chat rooms, online tests, etc.) via which the mentioned interactions can be realised. However, the technologies which ensure real-time interaction yield best results, motivation and experiences for students, which is why integration of a web conference into teaching is of great importance for blended learning students. Therefore, the application of a web conferencing tool aims to enable for blended learning students a real-time interaction with professors and their peers, which would enhance socialisation and their active participation in the educational process, which in turn should result in better exam results. With web conference, online students can give live
presentations to either the professor or fellow classmates, and the presentations can be recorded and archived so that students can review their presentations and learn ways to improve their performance [4].

Web conferencing lectures at eMPIRICA College were conducted according to a weekly class schedule, simultaneously for F2F and blended learning students, at the following 3rd semester courses: Web Technologies, Software Engineering; and 4th semester courses: Development of Web Applications, Object-oriented Programming. Two scenarios were used: F2F students were in classrooms and blended learning students in their respective locations; all students accessed the conference from their locations. Web conferencing participants can have different roles: host, alternate host, presenter and participants. A conventional scenario for conducting web conferencing lectures at eMPIRICA College was that the professor was assigned the host role which enables him access to different features such as control over video, desktop, documents and presentations sharing as well as other computer applications which he uses while he leads the class. Furthermore, professor as a host has a complete control over his students, collaboration and interaction activities. WebEx Meeting enables that along the host, students can take control over a web conferencing session so as to present their content or solve specific tasks - those students are called presenters. In such case, presenters have control over the running applications on the professor’s computer as well, which enables them to perform different actions. This feature gives the professor the opportunity to check at any given moment the level of understanding and knowledge acquired by the students and discover the problems and unclear issues that students encounter, which proved to be extremely useful in teaching programming. However, in general, students were assigned the role of regular participants. Even though a web conference was primarily intended for visiting professors’ lectures, some eMPIRICA professors, upon noting the interest of blended learning students for this technology, have decided to use its advantages in realising a part of practical classes and consultations. Finally the web conference was used for oral exams in some visiting professors’ courses. F2F students have shown a considerable interest for web conference lectures when they occurred in the afternoon hours, when they accessed the session from their own locations, which was more comfortable and less tiring so that they were able to gain knowledge more efficiently.

A. Summative Analysis

To evaluate the effectiveness of using web conferencing lectures in teaching at Engineering Informatics study programme the analysis of pass rate and average grade was carried out for two test groups: F2F students (group A) and blended learning students (group B), as well as the summative pass rate and average grade on each course in the second year of the studies. Web conferencing lectures were applied in class on four out of ten courses in total, in the second year of the studies, for both groups of students at the same time.

A summative analysis is based on the following data:

- Students' achievements during the first test,
- Students' achievements during the second test,
- Students' achievements at final written exams,
- Students' achievements at final oral exams,
- Percentage of students who took part at final oral exam terms.

In each 2nd year course two tests are organised, one in the middle and the other at the end of the semester. If students achieve 50% minimum in both tests, they are not obliged to take the final oral exam, but in that case they can’t accrue enough points for a high grade. At the end of the semester final written exams are organised for students, which did not take or pass the tests. One passes the exam if a student gains at least 50% of the points. After they pass the written exam the students need to pass the oral exam as well. Due to the nature of the examination process, which has been explained, pass rate has been analysed for tests and final written and oral exams and the overall pass rate after the examination period is over. Table II shows pass rate for 3rd semester courses while Table III shows pass rate for the 4th semester courses separated by test groups. Courses are grouped into two main columns based on the fact whether a web conference was used for leading classes or not.

Based on the results, it can be concluded that F2F students achieved almost identical pass rate for both modes of conducting classes: in-class and web conference. This data is of great importance for the future use of web conference with F2F students since it implies that the new way of leading classes does not cause pass rate lowering.

Also, it is evident that the results of F2F students are better than the results of the blended learning students regardless of the modes in which lectures are held. There are several reasons that influenced better results of F2F students than blended learning students, some of the most prominent one being: age, free time, employment, etc. Regular F2F students at Engineering Informatics study programme are young individuals who enrolled at the college upon finishing high school and have more free time at disposal unlike blended learning students who are older, usually employed and residing outside of the school headquarters. The need for a longer travel to the school and lack of free time are a significant cause for a low exam turnout as well as lower results of blended learning students in the exams.

Analysis of pass rate of blended learning students has been carried out for two modes of conducting distance learning lectures: via usage of a web conference and absence thereof.
TABLE II. PASS RATE ANALYSIS FOR 3rd SEMESTER COURSES

<table>
<thead>
<tr>
<th>Analysis of pass rate of tests and two final exams</th>
<th>Pass rate for 3rd semester courses</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Courses with use of web conference</td>
</tr>
<tr>
<td></td>
<td>WBT</td>
</tr>
<tr>
<td></td>
<td>Group A</td>
</tr>
<tr>
<td>First Test</td>
<td>100</td>
</tr>
<tr>
<td>Second Test</td>
<td>100</td>
</tr>
<tr>
<td>First final written exam</td>
<td>N/A</td>
</tr>
<tr>
<td>Second final written exam</td>
<td>PSE</td>
</tr>
<tr>
<td>Second final oral exam</td>
<td>PSE</td>
</tr>
</tbody>
</table>

TABLE III. PASS RATE ANALYSIS FOR 4TH SEMESTER COURSES

<table>
<thead>
<tr>
<th>Analysis of pass rate of tests and two final exams</th>
<th>Pass rate for 4th semester courses</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Courses with use of web conference</td>
</tr>
<tr>
<td></td>
<td>WAD</td>
</tr>
<tr>
<td></td>
<td>Group A</td>
</tr>
<tr>
<td>First Test</td>
<td>50</td>
</tr>
<tr>
<td>Second Test</td>
<td>100</td>
</tr>
<tr>
<td>First final written exam</td>
<td>PSE</td>
</tr>
<tr>
<td>First final oral exam</td>
<td>PSE</td>
</tr>
<tr>
<td>Pass rate</td>
<td>100</td>
</tr>
</tbody>
</table>

**Description:**
- WBT - Web technologies
- SWE - Software Engineering
- OPS - Operating Systems
- EBS - e-Business
- CMN - Communications and Networks
- WAD - Web Application Development
- OOP - Object-oriented Programming
- IDB - Introduction to Database
- INS - Information Security
- NAD - Network Administration and Design
- PSE - Percentage of students who passed final written exam and took part in final oral exam
- Pass rate = students who pass test / students who took test

Blended learning students have achieved high pass rate at tests, especially the second one, in all courses except Object-oriented Programming where there is a decrease from 33% at the first test to 0% at the second one. It can be deduced that a considerable number of blended learning students carried out the course assignments in continuity and accessed the assessments also continually.

Analysis of pass rate at the 1st written exam from the 3rd semester corroborates that blended learning students have achieved the highest pass rate for the courses that incorporated web conference (SWE and WBT) as well as on EBO course (a non-IT course) while on other two courses where web conference lectures were not held - OPS and CMN - pass rate is considerably lower, 50% and 70%, respectively. At the second exam term 3rd semester courses saw the reverse situation where WBT got 0% pass rate while exam turnout was also extremely low.

Web conference was not used in conducting classes on INS and NAD courses, but in these courses blended learning students had a considerable number of in-class hours that had to be spent in a real laboratory, which all in all resulted in a better pass rate on these courses in comparison to other 4th semester courses.

Having analysed the overall pass rate after all 3rd semester courses have been finalised it can be deduced that the application of a web conference contributed to better results of blended learning students as SWT and WBT courses saw higher pass rate in relation to F2F students, and the overall pass rate on these courses is higher or on a par with the pass rate on other courses. However, by assessing the overall pass rate on 4th semester courses it is evident that pass rate is lower on courses where a web conference was applied. One of the important reasons for this is the fact that a large number of 2nd year students have not passed 2nd semester exams from the 1st year of studies, so they tried to pass 2nd semester exams whilst
4th semester was still on or they gave a priority to the 2nd semester exams as it is obligatory to pass them for enrolment for the forthcoming study year.

Apart from the pass rate analysis, the paper also analyses the average grade for all 2nd year courses, separately for the assessed groups of students as well as the overall average grade on the course. Average grades for the 3rd semester courses are shown in Table IV while 4th semester course average grades are shown in Table V.

<table>
<thead>
<tr>
<th>Mode of conducting class</th>
<th>Analysis of average grades for 3rd semester courses</th>
<th>Average grade for courses</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Course</td>
<td>Group A</td>
</tr>
<tr>
<td>Traditional or blended</td>
<td>Communications and Networks</td>
<td>9.00</td>
</tr>
<tr>
<td>learning, without web</td>
<td>e-Business</td>
<td>8.33</td>
</tr>
<tr>
<td>conference usage</td>
<td>Operating Systems</td>
<td>8.50</td>
</tr>
<tr>
<td>Web conference lectures</td>
<td>Software Engineering</td>
<td>8.00</td>
</tr>
<tr>
<td></td>
<td>Web Technologies</td>
<td>8.50</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Mode of conducting class</th>
<th>Analysis of average grades for 4th semester courses</th>
<th>Average grade for courses</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Course</td>
<td>Group A</td>
</tr>
<tr>
<td>Traditional or blended</td>
<td>Network Administration and Design</td>
<td>10.00</td>
</tr>
<tr>
<td>learning, without web</td>
<td>Information Security</td>
<td>N/A</td>
</tr>
<tr>
<td>conference usage</td>
<td>Introduction to Database</td>
<td>10.00</td>
</tr>
<tr>
<td>Web conference lectures</td>
<td>Object-oriented Programming</td>
<td>10.00</td>
</tr>
<tr>
<td></td>
<td>Web Application Development</td>
<td>8.00</td>
</tr>
</tbody>
</table>

Analysing the average grade, conclusions which are reached are similar to those regarding pass rates. Regular F2F students achieved higher average grade in all courses in comparison to blended learning students. This is particularly the case in the courses where the lectures were held in-class for the F2F students. Blended learning students achieved approximately the identical average grades for both modes of conducting classes, apart from Object-oriented Programming where the lectures were organised via a web conference. On the Communications and Networks course the blended learning students received the highest average grade which is higher than F2F students’ average grades.

B. Formative analysis

Formative analysis was carried out based on the results of an anonymous survey for both groups of students regarding the students’ satisfaction with the use of web conference in classes. Questions sought to find out students’ opinion and impressions regarding the usage of web conferencing lectures, organisation and willingness of professors to use various web conferencing tools features at their disposal, the degree to which interactivity was achieved, and the way of acquiring knowledge by using web conference features. The survey comprised 30 questions of different type. Ninety-five percent of 2nd year students in total took part in the survey, which implies that the students wanted to express their opinion on the usage of the web conference and provide suggestions for its improving in the future. The survey was anonymous and carried out electronically and available for F2F and blended learning students. General satisfaction with web conferencing lectures and the tool used rated as satisfactory by 56% of the students, 17% deemed it highly satisfactory, 11% rated it as unsatisfactory and very unsatisfactory while 6% had no opinion on the matter. Fifty percent of the surveyed students expressed interest in continuation of web conference usage, 39% want it to be used occasionally, while 11% do not want to use it at all. As assessed by the students, 61% of them believe they have achieved the same results on courses where the web conference was used and courses where it was not, 33% believe that they achieved better results where the web conference was applied, while 6% believes those results are lower. When asked whether they would recommend the usage of a web conference to their friends and peers, 50% gave an affirmative answer, 28% said they probably would, only 6% stated they would not, while 17% did not answer. When asked about the quality of lectures delivered via web conference, 50% of the students believe that with the aid of that tool a higher quality teaching is ensured. When asked whether following the web conferencing lectures as time progressed was aggravated, only 22% said ‘yes’, while the rest said it stayed unchanged or it was easier. When asked to rate web conferencing lecture on whether it was interesting, using 1-7 scale, where 7 is the highest mark and 1 the lowest, 39% of the students rated lectures with a 7, 22% gave a 6 and only 11% rated it with 1.

To analyse which web conferencing features provide the best support for achieving interaction, students were requested to rank 8 web conferencing features using 1-7 scale. The results of the average grade for web conferencing tool interactive features are shown on Fig. 1 where it is evident that the highest mark went to the usage of private and public chat, which are followed immediately by desktop, documents and application sharing, raise hand and pass the ball features, which received the same average grade.

Students have rated the most important web conferencing features according to their usefulness, as well. The results show that the chat room is rated with a 7 by a large number of students, 53% of them, while 50% of the students deemed the recording session feature as most useful.
Other features were also largely rated with marks such as 6 and 7, which contributed to a higher average grade, which is evident on Fig. 2.

![Fig. 1. Average grade of web conferencing tool interactive features](image)

![Fig. 2. Average grade of web conferencing tool features according to its usefulness](image)

Based on students’ acclaims, suggestions and criticisms that were entered in the survey, it can be generally concluded that the students were very satisfied with web conferencing lectures and features of the tool, as well as with the results achieved in those courses. As web conferencing best asset in class the students highlighted session recording, holding lectures in the afternoon hours, inclusion of students from different locations and different devices, and emphasized the interaction along the lines student-professor and student-content. Some students voiced their criticism regarding occasional audio problems which were present when an older version of WebEx Meeting was used. This problem was solved when the new version was installed, which was used from 4th semester onwards.

IV. CONCLUSION

Based on the analysis of pass rate and average grade results for F2F and blended learning students, and for different modes of conducting lectures (in-class/eCampus or web conference) it can be concluded that on a large number of courses F2F students achieved better pass rates and average grades than blended learning students, regardless of the mode of leading the lectures. On the other hand, introduction of a web conference into the teaching process contributed to enhancement of the pass rate for blended learning students. This is especially evident in the 3rd semester, while the use of a web conference in 4th semester did not result in higher pass rates. Quite on the contrary, lower pass rate is achieved in relation to courses where this technology was not used. Based on the summative analysis it can be generally concluded that the inclusion of a web conference in classes can contribute to better pass rates especially with blended learning students, but the same cannot be concluded for an average grade. Regular F2F students achieved a higher average grade on the courses where lectures were held in a traditional manner, while blended learning students achieved an approximate average grade for both modes of conducting class, but received the lowest average grade on the course where a web conference was used and the highest on the course where a web conference was not used.

Achieving a high quality web conferencing lecture is heavily reliant on preparation of the professor, his familiarity with the technology and his ability to create an interesting and interactive educational environment. All professors hired by eMPIRICA College to conduct web conferencing lectures, save one, had not been acquainted with a web conference thus far. However, as the semester progressed, those professors also started using different features of the web conferencing tool more intensively. The results of the conducted survey have shown that students were very satisfied with the quality of the web conferencing lectures and the way in which professors achieved interaction during the lectures. The highest number of students pointed out as one of the main disadvantages the occasional audio and connectivity problems when the older tool version was used, while the largest number of suggestions referred to the usage of a web conference to conduct practical parts for blended learning students, and scheduling students-only sessions so they can exchange knowledge and experience without the presence of a professor. Furthermore, a large number of students have stated that organising web conferencing lectures in the afternoon hours would significantly influence the greater involvement of the blended learning students, as they pointed out that interaction during web conferencing lectures enables them more efficient studying and understanding of the lesson in comparison to watching the recorded session. The suggestions for enhancements that students pointed out in the survey are one of the ways to act so as to attain better effectiveness of learning with use of web conference.

Conducting programming classes exacts solving problem assignments and a larger number of students getting involved
more actively, which is enabled using different web conferencing features not only for F2F students but for blended learning students as well. Optimal usage of features such as chat, raise hand, resource sharing and pass the ball during the programming lectures ensures better interaction and active involvement and participation of the students in conducting classes and solving problems. On the other hand, since this approach is used by most of the professors, it is noted that some students, mostly the less successful ones, cannot keep up with this manner of leading class. As the semester progressed these students avoided to participate in web conferencing lectures and preferred to watch the recorded lectures. Students who actively followed and participated regularly in web conferencing lectures have shown the best results in the exams and other continual forms of knowledge assessment. With the right selection and usage of various web conferencing tool features, such as passing the ball to students, the professor creates a student-centred educational environment, and receives better feedback on the dynamics of knowledge acquiring during the lecture. This approach enhances students’ focus during the educational process and enables them not only to learn through concrete tasks but from their peers as well. In this way the professor can contribute to the exchange of opinions and ideas, encourage initiatives and enable more intensive collaboration than it is the case in the traditional classroom.

The analysis conducted in this paper has shown that the use of web conference in classes with F2F students generally does not cause the decrease of pass rate, but those students still prefer to combine web conferencing lectures with in-class lectures. The use of web conference significantly influences the increase of satisfaction and interest with the blended learning students for a more active way of learning.

REFERENCES