



Research Paper  
SBWL Business Information Systems  
Course V

Critical Evaluation and Comparison  
of MS-Teams and BigBlueButton  
for University Teaching

Course BIS 0100

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## Abstract

Over the last years online teaching experienced an upward trend. This is due to the constant availability of mobile and other devices. Yet, Distance Learning never witnessed a breakthrough in University Teaching. Due to current events around the Covid-19 Pandemic, however, there is a great need for conferencing tools in order to be able to carry out Distance Learning efficiently in the context of University Teaching. This paper aims to show what these Conferencing Systems are and what advantages and disadvantages arise in the context of their use. Furthermore, two selected conferencing systems, Microsoft Teams and BigBlueButton, will be described and compared. This will show which of the two tools is more suitable for use in University Teaching and should provide a guide for universities wishing to adopt one of these Conferencing Systems.

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# 1. Introduction

The following introduction is supposed to give an overview about the covered topic and wants to explain the motivation behind this choice.

## 1.1. Context

Iniobong Fred Akpan and Atim Edet Itighise (2019) assessed the usage of ICT-Tools for Communication at university level. They came to the clear conclusion that of 138 students surveyed, 100 percent felt that the use of Conferencing Tools for University Teaching was insufficient. They justify this result by pointing out that many lecturers do not accept these ICT means, or accept them only insufficiently, in order to realize their teaching objectives. In some cases, this could also be interpreted as a lack of competence in IT (Akpan & Itighise, 2019).

Finally, the current situation, relating to the Covid-19 Pandemic, leverages the use of digital Conferencing Tools especially in the context of University Teaching.

Due to the fact, that highspeed internet and cloud-infrastructure were already in place, it was not necessary to invent something new. Nevertheless, the disruptive nature of the COVID-crisis poses a big challenge to the responsible authorities of the Universities. Decisions had to be made very fast and nearly without any planning or testing phase. Part of the decision was to choose an applicable software-tool, that would suit the principles of the respective educational institution. Therefore, it was necessary to consider different perceptions, for instance towards the relevance of Data Security.

## 1.2. Motivation

My motivation for this topic results from the fact, that IT-Conferencing Tools cannot be neglected anymore, independent of the area of interest. Neither in the Teaching, nor in the private-sector context. Due to the practical experiences that I gathered over the last months at University and the company I am working in, my interest in this topic was further raised and therefore I am keen to gain additional insights about it, with a focus on University Teaching.

## 1.3. Problems, Challenges, Questions

The aim of research is to critically evaluate the usage of digital Conferencing Tools for University Teaching, spotlighting Microsoft-Teams and BigBlueButton. In this regard this paper seeks to provide profound answers to the following research questions:

- What are Conferencing Systems and what technologies are they composed of?
- What are the general advantages and disadvantages of Distance Learning, with means of digital Conferencing Tools, compared to in-class learning?
- How does MS-Teams and BigBlueButton work, what are each`s advantages and disadvantages and what is more suitable for University Teaching and why?

What might be challenging in the research process is the fact, that both applications are quite similar and figuring out proper indicators, for an objective comparison is therefore complicated.

#### 1.4. Methodology

For my research paper I will pursue a descriptive research approach, to describe both software applications in detail, especially towards their usability and utility in the context of University Teaching. My thesis will be mainly based on academic literature, therefore implementing a systematic literature review.

To add a practical perspective as well, I will go into detail about two selected Conferencing Software Tools that I have a personal experience with. These two are Microsoft-Teams and BigBlueButton, which already were used in different courses over my last semester.

The aim is to generate added value by showing which advantages and disadvantages come with Microsoft Teams and BigBlueButton in the context of University Teaching. Subsequently, these tools will be compared and evaluated. This paper is supposed to determine which Conferencing Tool is more suitable for universities to respond as efficiently as possible to changes in teaching conditions at short notice.

## 2. Conferencing Tools for University Teaching

### 2.1. Video Conferencing Tools

Video Conferencing Systems belong to the category of synchronous communication tools. This means that despite the distance between two users, simultaneous communication is possible, just like in a real conversation (Leimeister, 2014). Due to this fact, video Conferencing Systems are probably the most popular means for efficient Distance Learning at Universities.

### 2.2. Cloud Technologies

*“Cloud computing, as it is stated, is the delivery of applications, platforms, data storage, operating systems, and other computing resources over the Internet instead of over on-premises infrastructure.” (Symonenko et al., 2020).*

Over the last years cloud-based software tools increased in popularity, due to the way they facilitate remote collaborations. Experts therefore believe that different positive effects will result by means of cloud-based services, not only in companies but also in the educational context (Symonenko et al., 2020).

### 2.3. Voice Over IP

In parallel to the above-mentioned developments, a positive trend in the use of network-based communication can also be seen. This is very efficient in two respects, since existing network infrastructure can be used for this purpose and makes it much easier for users to work from any location (Klaffke, 2019).

### 2.4. Specific Conferencing Tools for University Teaching

There are many different cloud-based Conferencing Tools that are used for University Teaching. I will go into detail about Microsoft Teams. In addition, also the web-based Conferencing System BigBlueButton will be examined. Both of those tools enable flawless communication over the network, utilizing Voice Over IP technology.



The main difference between those two types is, that cloud-based solutions do not require a web browser to be accessible (Fitzgerald, 2019).

## 2.5. Deployment of Conferencing Tools

There are different models to deploy a Conferencing Tool like Microsoft Teams or BigBlueButton, independent of the proprietary or open-source context. The first decision to take is, whether the respective university intends to host the software locally on their servers, making use of already existing infrastructure, then they pursue an on-premises approach. Secondly, due to the increased spread of cloud solutions, there is an increasing shift also to off-premises alternatives, which provide for the management of data externally by the respective software vendor (Clement, 2017).

Within the cloud solutions, three different service levels are differentiated, according to the way the provider offers his services to the consumer. These are Software as a Service (SaaS), Platform as a Service (PaaS) and Infrastructure as a Service (IaaS) (Mell & Grance, 2011).

Nevertheless, in the context of this paper the concept of Software as a Service (SaaS) is considered as most important to conduct the comparison of Microsoft Teams and BigBlueButton.

Software as a Service (SaaS) is characterized by the remote provision of applications via the vendor's own infrastructure. This is independent of the actual devices that the respective customer uses to get access to the provider's applications. The management of the infrastructure, such as servers and the operating system, is carried out exclusively by the provider offering Software as a Service (Mell & Grance, 2011).

Since the configuration and operation of Information and Communication Technology Tools is very complex and the flexibility of organizations plays a decisive role in today's world, it should be carefully evaluated, whether external providers specialized in this field should be used or not (Birudavolu & Nag, 2019).

A detailed cost evaluation and comparison will be discussed later.

## 2.6. Advantages of Conferencing Tools

The independence of physical hardware allows highly efficient remote working. This means that you can access the respective cloud solution with every device, that is connected to the internet. This is especially important in the context of University Teaching, since students use a variety of different

devices and make use of different operating systems accordingly. Furthermore, not having to be physically present, boosts flexibility of the participants and therefore enhances the outcome of collaborating (Symonenko et al., 2020).

## 2.7. Disadvantages of Conferencing Tools

Human communication is coined by interaction, thus the voice is not the only important factor. By means of digital Conferencing Tools, body language and expressions are not fully recognizable by the opposite. Consequently, communication is more complicated than it is with face-to-face learning. Another critical aspect of Conferencing Tools for University Teaching is that the observation of the students learning effort is complicated by the fact, that they are not physically present.

Therefore, the self-commitment and motivation of the students is the central factor towards successful learning by means of cloud-based Conferencing Tools. In addition to the stated disadvantages, implementing a Conference System at University induces additional costs. Not only relating to the investment necessary to host servers on the respective premise, but also relating to the maintenance and constant support. Considering this fact thus is not only necessary on a financial basis, but also on an organisational one (Sudhakar & Nalini, 2020).

### 3. Microsoft-Teams

#### 3.1. General Information

*“Microsoft Teams is a cloud app digital hub that brings conversations, meetings, files and apps together in a single Learning Management System (LMS)” (Martin & Tapp, 2019).*

It constitutes an aggregation of Microsoft technology that already has been in place. For instance, there will be created a unique SharePoint-Space for each team, that every member can access freely. Furthermore, an exchange mailbox is established for every new team. Teams is accessible via the stand-alone application on a mobile or desktop device, as well as different browsers. (Hubbard & Bailey, 2018, S.4-5). For file storage, OneDrive is used, which also manages access rights of the different members of a team (Hubbard & Bailey, 2018, S.9).

Teams is often the first choice for Universities since Microsoft Office 365 already held a very dominant position here due to its universal application possibilities and compatibility. Teams can be used as a simple extension (Kasahara et al., 2017).

Figure 1 shows the graphical user interface of Microsoft Teams.

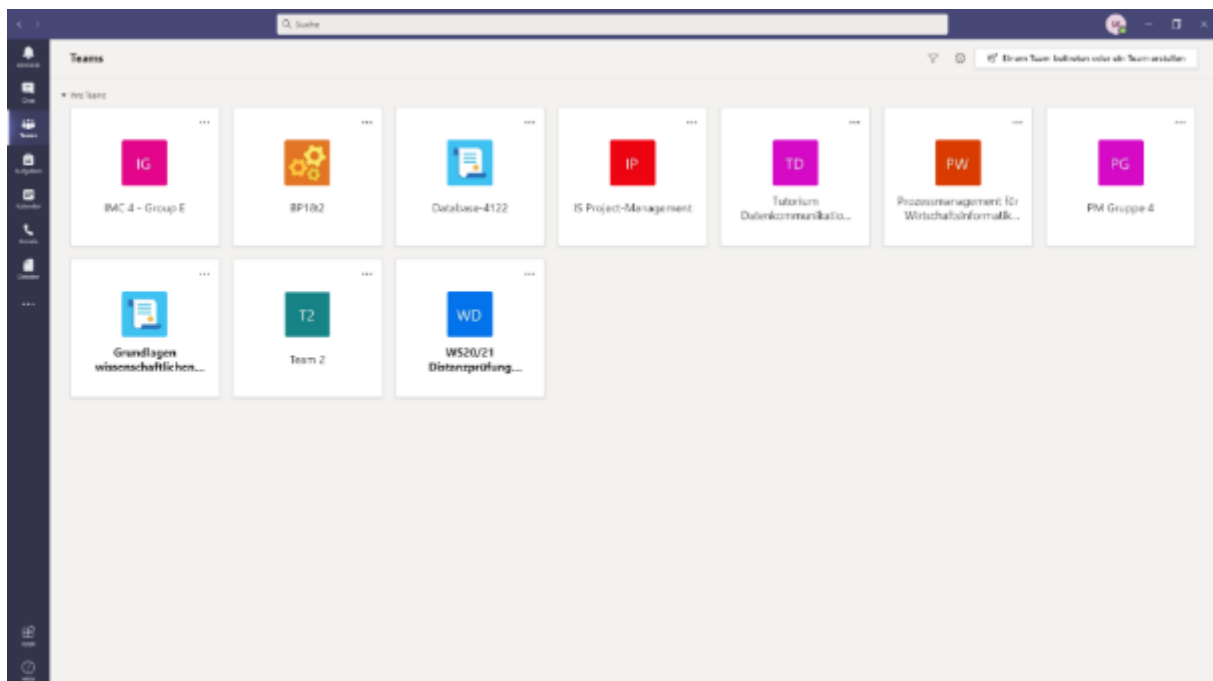


Figure 1: Microsoft Teams User Interface  
Source: Screenshot from Microsoft Teams User Interface, 2020

Users can create up to 250 teams and have a membership in a maximum of 1,000 teams. Meetings with up to 300 simultaneous users are possible and recordings of past meetings are available for all the members of a team for up to 20 days (Microsoft, 2020a).

Universities have a variety of options when it comes to using Microsoft Teams commercially as Software as a Service. There are several licenses of the Office 365 suite that include Microsoft Teams and all its functionalities. Office 365 A1, A2 and A3 are recommended for educational institutions. (Microsoft, 2020f).

Below is a short list of the different license plans, each for students/pupils and teaching staff and employees (Figure 2).

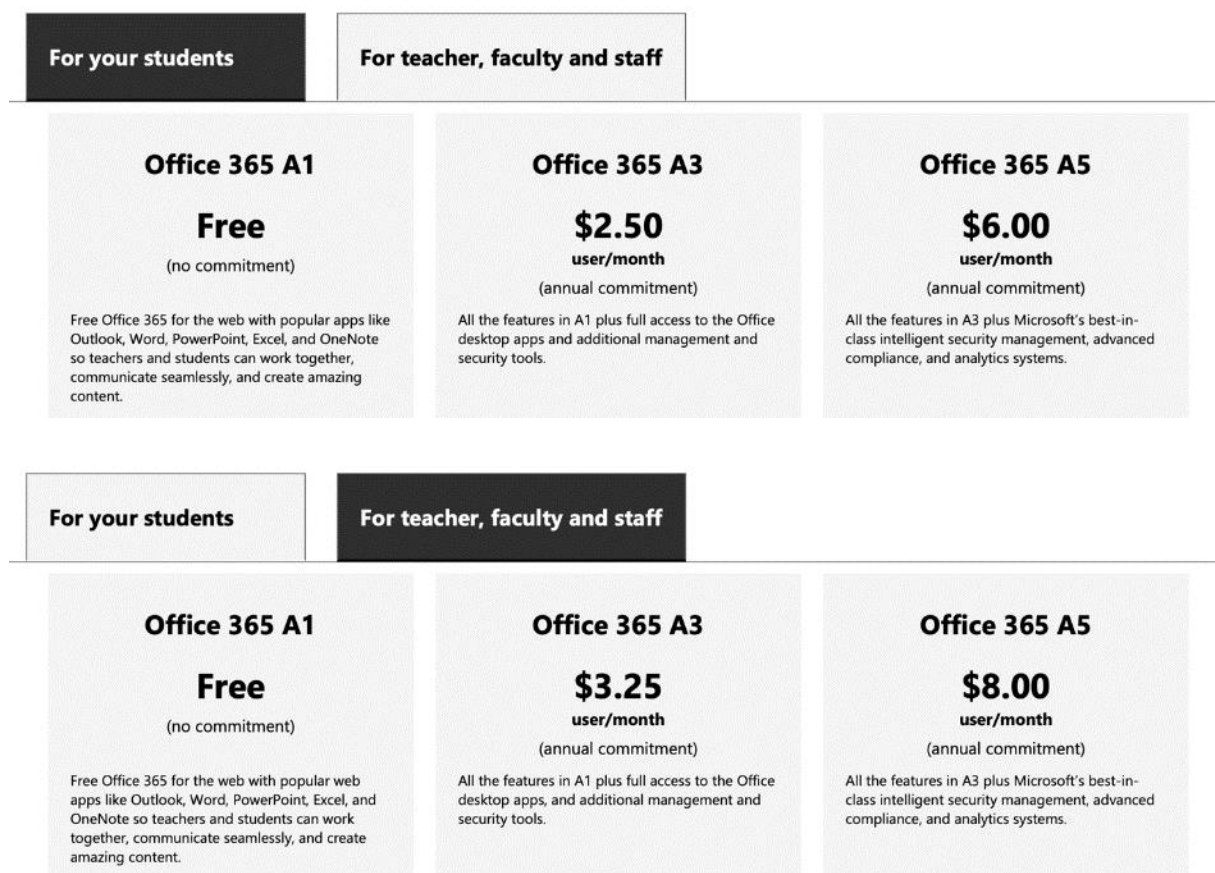


Figure 2: Microsoft Teams Education Plans  
Source: Microsoft, 16<sup>th</sup> December 2020f

Such pay-per-user offers are more likely to be taken up by small educational institutions and schools. In practice, however, universities and other educational institutions conclude individual contracts with Microsoft. In this context, there is the possibility of concluding an “Enterprise Agreement” with Microsoft, which offers a variety of advantages. For example, the total costs can be reduced by up to

45 percent compared to a normal license agreement. These agreements are concluded for a period of at least three years and are aimed at organizations with more than 500 users who want to have permanent access to various cloud infrastructure and software applications from Microsoft (Microsoft, 2020d).

For a more detailed cost evaluation see the discussion section.

As part of the 365-office suite, Teams has access to the universal security features Microsoft offers for all their products. In addition, Teams is based on two-factor authentication, which affects the entire organization or the organizational environment (Microsoft, 2020b).

Two-factor authentication can be considered as an advanced security feature and means, that in addition to a password user require something they personally possess, for example a smartphone, or something they are, for example their fingerprint or other biometrical attributes. There are different methods of two-factor authentication available. One simple form is the SMS, in this case the user enters a password and additionally requires a one-time code, that the user receives per SMS. For security measures this code is only available for a short period of time (Ken et al., 2019).

Furthermore, Advanced Threat Protection (ATP) is available for Teams, which scans all data related to Teams for malware and blocks it if necessary (Microsoft, 2020b). The Microsoft Azure Active Directory should be highlighted in terms of Microsoft's security features as well. It is designed for Web applications and is intended to regulate the access rights and identities of Office 365 users (Karlstetter, 2020).

### 3.2. Important Features

Now, some selected features will be spotlighted that go beyond the basic Microsoft Teams functionality but are freely available for all users. Some might even have a big impact on how future conferencing is executed.

#### 3.2.1. Apps

Microsoft Teams comprises a high number of integrable third-party applications that can easily be attached as an additional tab to a team. This gives the possibility to access other used programs and their data with little effort.

For example, an instance of OneNote can be used as a team, as you can see in figure 3.

This also applies to many applications that are not from Microsoft.

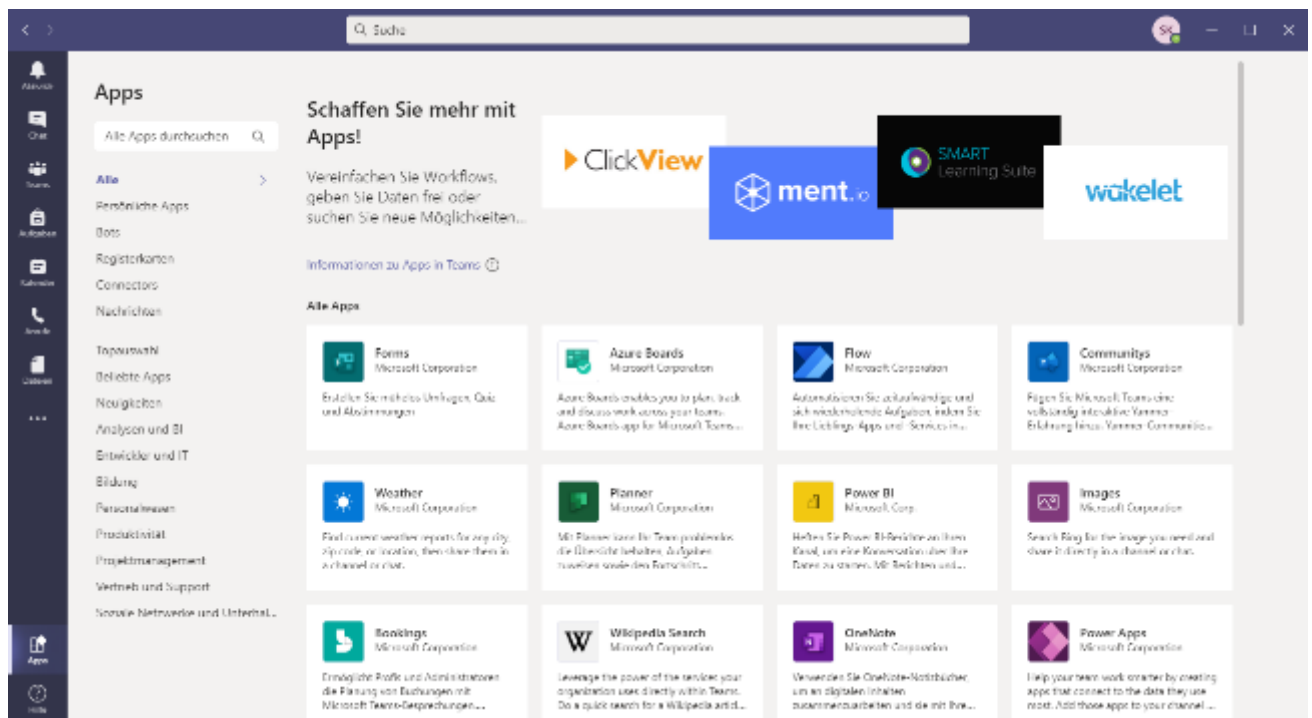


Figure 3: Microsoft Teams App Integration  
Source: Screenshot from Microsoft Teams Apps, 2020

### 3.2.2. Together Mode

As one of the latest innovations, Microsoft announced the "Together Mode" in 2020. Especially under the current conditions around the Covid-19 Pandemic, this innovation gains further importance.

It offers a simultaneous virtual presentation of all participants against a specific background. This should make it possible, for example, to virtually recreate an auditorium, a coffee shop, or a conference room. This feature is designed to transform online conferencing from the ground up by encouraging group membership and social interaction within the group. It creates a feeling of being physically close to the other participants (Ray, 2020).

Currently, only the auditorium background can be selected, but work is already underway on other backgrounds. Nevertheless, only a maximum of 49 participants can take part in such a meeting so far (Der Standard, 2020).

Figure 4 illustrates how the new mode works in practice.



*Figure 4: Together Mode Microsoft Teams*  
*Source: Der Standard, 2020*

### 3.2.3. Productivity Score (Microsoft Office 365)

The Productivity Score feature allows system administrators (Team Admins) to easily retrieve detailed evaluations of the intensity, duration, and quality of the use of Microsoft Office 365 services, such as Microsoft Teams. Microsoft even specifies target values that companies can then use as a basis for their own evaluations (Hurtz, 2020).

The rating is composed of various sub-categories, each of which is evaluated separately and ultimately forms a total score. The most important of these categories for working with teams is certainly the communication, meeting, and teamwork score. In addition, many other factors can be evaluated, such as the total network connection time of a user. In addition, Microsoft provides special reports, based on key performance indicators, that tell organizations whether the migration to digital collaboration has been successful or not. Microsoft therefore wants to address the need to measure the impact of the current lockdown on business operations (Microsoft, 2020e).

Figure 5 shows how the graphical user interface of the productivity score component looks like.

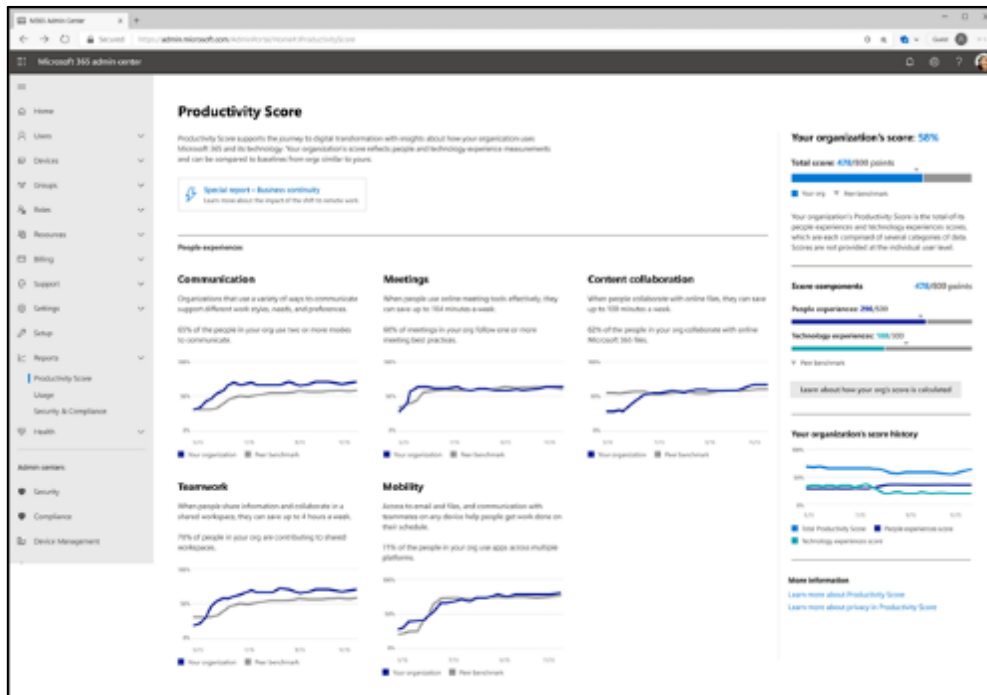


Figure 5: Productivity Score Interface  
Source: Microsoft, 12<sup>th</sup> December 2020e

### 3.2.4. Conversational Bots

Microsoft enables the creation of conversational bots based on artificial intelligence that can be integrated into teams to perform useful tasks. For this purpose, Microsoft offers its own bot framework that allows developers to create bots in Java, C# or Python using the Microsoft Software Development Kit. Once the bot is created, it can be integrated into teams as an individual app, which can then be accessed as explained in 3.2.2. Subsequently, the bot can be added to either a team or a simple chat. Depending on what is intended, the bot will react to different desired events, such as adding or deleting a member to or from a team. But it is also possible to let it proactively start conversations in channels, such as a welcome message. (Microsoft 365 Developer, 2020).



The figure 6 shows how the bot can be used. The user on the right enters a question into the chat and this triggers a specific event, which the bot on the left responds to with a detailed answer.

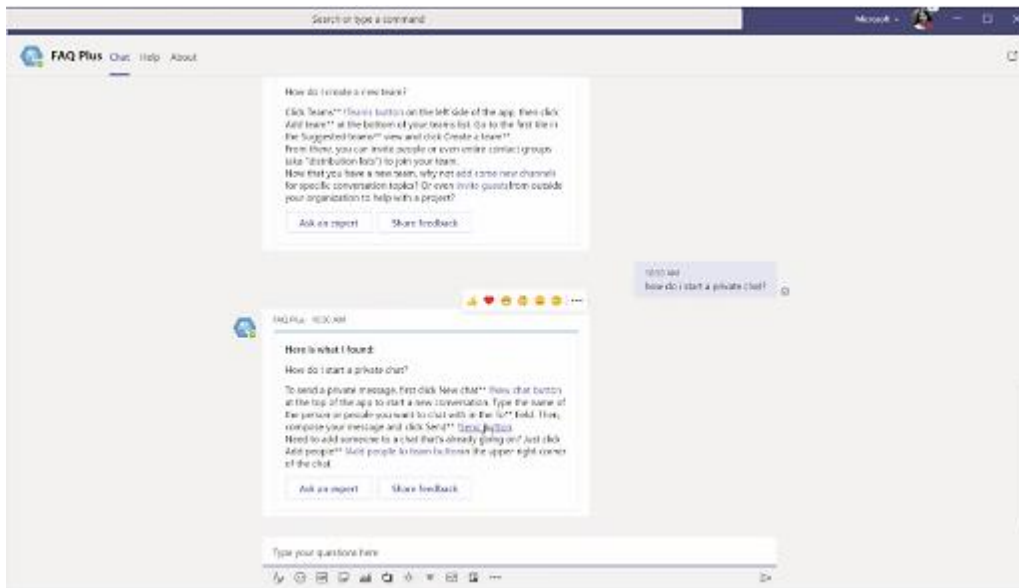


Figure 6: Conversational Bots  
Source: Microsoft 365 Developer, 12<sup>th</sup> December 2020

### 3.3. Experiences in University Teaching

Microsoft Office is widely used in educational institutions around the globe. As a result, Teams is also the desired tool for different Universities. Apart from this, it provides all the necessary infrastructure for qualitative Distance Learning.

In the context of usability-based survey Microsoft Teams was tested. The survey with over 1600 participants resulted in a mean SUS (System Usability Scale) of 77,20 %.The following graphical illustration (Figure 7) is supposed to create a reference on how to evaluate the SUS among other applications or devices usability (Pal & Vanijja, 2020).

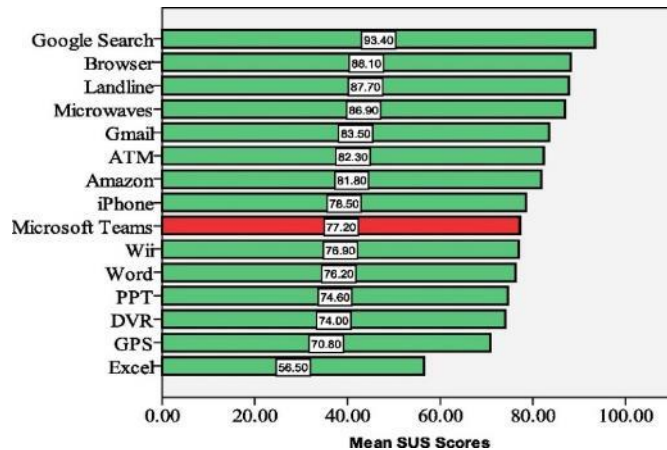


Figure 7: System Usability Scale  
Source: Pal & Vanijja, 2020

In addition, Microsoft Teams were also used for a physician training program launched in London in March 2020 to counteract the rising incidence of corona disease. In this context, physicians from a wide range of disciplines and seniorities, including several volunteer medical students, were consulted as emergency teams to provide frontline assistance.

However, it was quickly recognized that this mix would require a great deal of coordination and training, so Microsoft Teams helped to create such a program.

Microsoft Teams was recognized as a suitable Conferencing System because of its ease of use and rich functionality.

Nearly all participants (97%) evaluated the use of Teams as very helpful and suitable to complement the practice. In addition, it became apparent that the participants also want to access the recorded conferences and documents in their spare time (Henderson et al., 2020).

### 3.4. Advantages in the Context of University Teaching

Now some advantages of Microsoft Teams that occur in the University Teaching context will be described, especially in connection with the already stated features above.

Students and lecturers have the option of linking their personal appointments, which are recorded in their Microsoft Outlook application, with Microsoft Teams. This has the advantage that subsequently also current status messages, such as temporary absence, are taken over by Teams and made available to other users as information. As an additional feature, there is a private activity channel that shows users which tasks they still must complete (Wolverton & Davidson, 2020).

Furthermore, Teams offers the possibility to conduct polls and votes. By that, University conferences are made more interactive. The possibility to work on documents together with peers also has a positive effect on the interaction capability of online conferences. This creates a certain similarity to physical courses (Symonenko et al., 2020, S.234)

The existing three different Office 365 licensing plans for education allow high flexibility for universities, as the most suitable package can be chosen. Furthermore, Universities with over 500 required licenses can also benefit greatly from the Enterprise Agreements, which are intended for long-term partnerships with Microsoft (Microsoft, 2020d).

The cost evaluations will be discussed later in more detail.

By using the “Together Mode” it is possible to have a much more realistic teaching experience at universities. First and foremost, the lecturer can check much better if he or she is really being paid attention to and at the same time it makes the lectures much more varied, as students can interact much better (Ray, 2020).

With the Conversational Bots of the Microsoft Teams application, it is possible for students to delegate simple tasks without having to open another application (Rathnam, 2020).

### 3.5. Disadvantages in the Context of University Teaching

On the other hand, several disadvantages occurred in the context of University Teaching.

In connection with uploading documents to channels or chats, there is no possibility to create an ordered structure of the documents. Uploaded documents are automatically stored in a common collection folder. When trying to restructure them, errors often occur which can have a negative impact on the user experience. Especially for University Teaching, many different documents are needed, which often should and will be edited by different people (Abramson, 2019).

When purchasing Microsoft Office Security licenses, it often happens that organizations do not have a clear overview of all the features included. The wide variety of Microsoft features can overwhelm users (Lawson & Riley, 2020).

In connection with the management of this user data, major data protection complications have arisen in recent years, primarily because there are divergent data protection laws in the USA and the EU (Al-Youssef, 2020).

An initiative of the European Data Protection Supervisors (EDPS) to investigate the use of data of European institutions by Microsoft, has shown that: *„EU institutions were unable to control the location of a large portion of the data processed by Microsoft. Nor did they have full control over what was transferred out of the EU/EEA and how. There was also a lack of proper safeguards to protect data that left the EU/EEA. This had a negative practical impact on EU institutions’ ability to hold Microsoft accountable” (EDPS, 2020).*

In response to this investigation, the federal government of Germany announced that Microsoft Office 365 violates the Basic Data Protection Regulation (DSGVO) (Al-Youssef, 2020). This is particularly critical in the context of University Teaching, where Microsoft gains access to very sensitive user-specific data, such as demographic or performance-related data on students or employees.

## 4. BigBlueButton

### 4.1. General Information

The BigBlueButton system was purposely created to facilitate teaching and learning remotely. It is an open-source Conferencing Tool, that is designed for web-based interactions with peers. The application allows users to participate in virtual real-time meetings and have access to relevant materials. Due to the learning-friendly environment, relating to the graphical user interface, different Universities around the world already implemented the system in their teaching portfolio (BigBlueButton, 2020a).

The concept is based on the web real-time communication libraries (webRTC). WebRTC is an open standard, which is available as Java-Script-API in all browsers (WebRTC, 2020).

Therefore, BigBlueButton keeps its distance from a standalone version since the software is already running on all common browsers. However, Chrome or Firefox is recommended for optimal performance. Recent versions are based on HTML5, which emphasises that Big Blue Button wants to distance itself from proprietary software (BigBlueButton, 2020b).

The operator is responsible for the security of the BigBlueButton server.

In this context it is possible to use the Secure Socket Layer Protocol (SSL). This enables a secure connection between server (e.g. BigBlueButton university server) and client (e.g. student's PC) by performing an authentication test in the form of an SSL handshake. Based on this, various cryptographic methods can be used to encrypt data transmission (Bhiogade, 2002).

BigBlueButton is suitable for small to medium numbers of participants, up to 100 participants per conference are possible (Charidimou et al., 2020).

### 4.2. Important Features

In this part of the research paper, there will be spotlighted some selected features that are relevant in the context of University Teaching or teaching in general.

#### 4.2.1. Greenlight

With the 2018 announced version 2.0. of Greenlight, a backend-interface was created, which provides the user with a clear graphical interface to manage his meetings and enable him to efficiently communicate with peers (BigBlueButton, 2020e).

Figure 8 shows the backend interface. (BigBlueButton, 2020g)

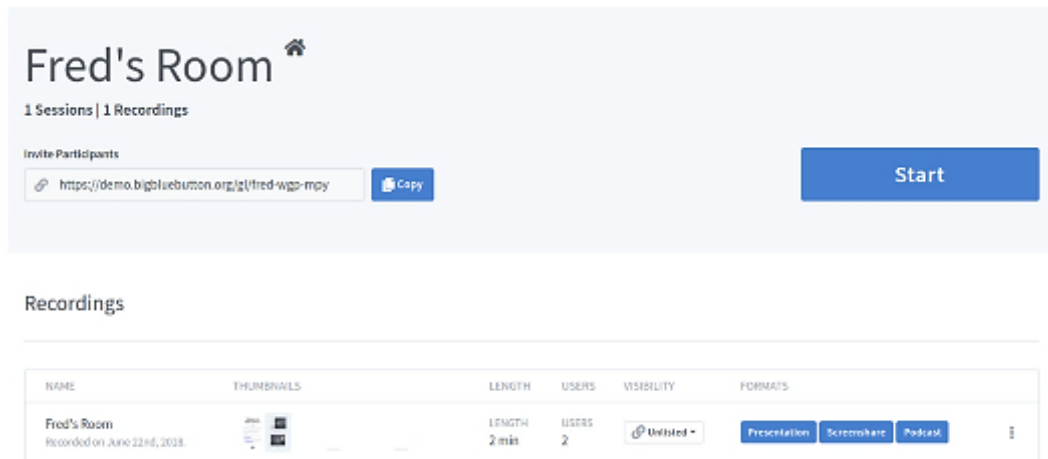


Figure 8: BigBlueButton Rooms  
Source: BigBlueButton, 16<sup>th</sup> December 2020g

#### 4.2.2. Breakout Rooms

In order to conduct more efficient group work, BigBlueButton has created the Breakout Rooms. By establishing different separate rooms next to the main conference, the conference leader can distribute tasks which can then be worked out by the individual groups. The lecturer can then decide whether to join a room directly or just enable the audio of that respective room, to actively listen to the progress of that room. Students can switch their chat to public in order to communicate with the teacher, for instance to ask for advice (BigBlueButton, 2020d).

#### 4.2.3. Interactive Whiteboard

BigBlueButton offers a multi-user whiteboard as part of each conference. The conference leader can determine who has access to this feature at what time by assigning access rights, like with the screen sharing feature. Notes can be written or drawn on the whiteboard (BigBlueButton, 2020a).

#### 4.2.4. Integration of Learning Platforms

Due to its focus on the education sector, BigBlueButton has a wide variety of cooperation with various learning platforms. The most important representative in this context is the learning platform Moodle. Moodle is the world's most popular learning portal, with over 245 million users, 32 million courses and is used in schools and universities (Moodle, 2020).

BigBlueButton can be installed as a simple plugin in Moodle and provides its full functionality.

#### 4.3. Advantages of BigBlueButton in the Context of University Teaching

The following advantages can be identified, when studying related literature:

By using HTML5, configuration problems with browsers that do not allow Flash Player, for example, can be bypassed and a user-friendly, device-independent experience is guaranteed. The open standard also allows software developers to contribute to the improvement of the system, so user interests flow directly into the development. Participation to the coding is possible with a free of charge subscription to GitHub (Charidimou et al., 2020).

Since HTML5 does not require any further plugins, but is already embedded in the web pages, there is hardly any room for attacks from the web (IONOS SE, 2016).

BigBlueButton is a free of charge open-source system and therefore no license needs to be purchased for use. By deploying an own BigBlueButton server, access to all the contained features is granted. According to the BigBlueButton project it is possible to set up a BigBlueButton server via the command line in less than half an hour, this makes it attractive for different educational institutions especially in a disruptive situation like the Covid-19 Pandemic (BigBlueButton, 2020b).

A detailed description on how to install BigBlueButton can be found on GitHub (GitHub, 2020).

On utilization of BigBlueButton Greenlight, users can access their personal space via a unique link that is assigned to every user after registration (see *Figure 8*). This allows efficient administration of meetings, since users can simply invite friends to their room, by supplying them with a specific link. Greenlight makes it very easy to create rooms and to switch between them. With one click the URL of the room can be copied and sent to peers. In addition, each of the rooms clearly lists recordings of past meetings, which the administrator of that room can make publicly available or send via e-mail using a predefined function. As soon as a meeting is started by the administrator, the entire functionality of the BigBlueButton system can be accessed. The interactive board, which is available to all users, is particularly noteworthy here. The administrator also has the possibility to grant

different rights to the different users, for example in terms of screen sharing. This allows performing well organised meetings (BigBlueButton, 2020a).

#### 4.4. Disadvantages of BigBlueButton in the Context of University Teaching

On the other hand, several disadvantages occurred in the context of University Teaching.

Regarding the handling, one can criticise, that sharing your own screen is not possible when BigBlueButton is used on a mobile device (BigBlueButton, 2020a).

On using BigBlueButton as a Moodle integration, recordings of meetings cannot be downloaded by students locally, but only be reviewed in the respective Moodle space. (Bhartu & Yusuf, 2016)

Another downside in this context is the fact, that recorded meetings require 24 hours processing time, before the document is available to use by the respective student or professor (Akiwenzie, 2020).

To host the BigBlueButton system on university`s server the operating system Linux Ubuntu is required, which restricts individuality in terms of software (BigBlueButton, 2020b).

Although BigBlueButton is one of the most popular Conferencing Systems, there are some vulnerabilities, especially regarding security.

Golem.de has highlighted a critical aspect in this regard. Because files uploaded to the system are converted with LibreOffice, it is possible to read local files, which contain information about API keys, for example. With this information it would then be possible to establish unauthorized access to foreign conference rooms. Even after the announcement of the security bottleneck, the developer did not initiate a correction (Böck, 2020). This would be particularly problematic in the context of University Teaching, as external parties could then gain unauthorized access to user-specific data. This includes, for example, recordings of past conferences, but also sensitive documents archived in the private user area.

#### 4.5. Experiences in University Teaching

Among the most popular online Conferencing Tools, BigBlueButton has gained great reputation and is widely used, especially for remote teaching and learning.

The university of Zagreb conducted a survey to evaluate different online Conferencing Tools, since they were desperately looking for a proper tool to facilitate Distance Learning, due to the Covid-19

Pandemic. They decided to reduce their study to one applicable tool and therefore chose the BigBlueButton. The BigBlueButton system was both tested on the utility in online University Teaching and on the respective experiences of the students, therefore measuring the usability and likeability of the Conferencing Tool. Examining the achieved results, one can say that the BigBlueButton led to great satisfaction among the participating students. Nearly 90 percent out of the participating 140 students described their experience with the BigBlueButton system as satisfying and witnessed it as a great tool to perform distant learning effectively (Čižmešija & Bubaš, 2020).

The circumstances regarding the Corona-lockdown also caused a case study to be conducted at Valley View university in Ghana, where the BigBlueButton system was therefore implemented. The research shows that the way how the students are guided and assisted decides, whether the tool will positively impact the learning quality or not. Thus, it is important to develop strategies that draw on the disadvantages of Cloud-based Conferencing Tools, which were already outlined in Chapter 2 of this seminar paper (Chidambaram, 2020).



## 5. Critical Comparison and Discussion

### 5.1. Checklist

<b>Microsoft Teams</b>	<b>BigBlueButton</b>	<b>General Facts</b>
➤ Up to 300	➤ Up to 100	Simultaneous Participants/Meeting
➤ Up to 20	➤ Unlimited	Recordings Availability (days)
➤ Up to 1000	➤ Unlimited	Different Channels/Rooms
➤ Yes	➤ Yes	Breakout Rooms
➤ No	➤ Yes	Interactive Whiteboard
➤ Yes	➤ No	Custom Backgrounds
➤ 500kbps/1Mbps (Upload/Download)	➤ 500kbps/1Mbps (Upload/Download)	Bandwidth requirements (of a Group Video Call)
➤ Different 365 Licenses	➤ Free of Charge	Licensing Cost
➤ 24/7 Commercial Support	➤ GitHub	Customer Service
➤ Yes	➤ Yes	Mobile Support
➤ No	➤ Yes	Learning Platform Integration
➤ Yes	➤ No	Application Share
➤ Yes	➤ No	File Transfer
➤ Yes	➤ No	Integrated Calendar
➤ Every member by default	➤ Room Owner by default	Start Meeting
➤ Yes	➤ No	Reactions (Emotes)
➤ No	➤ No	End-to-end Encryption
➤ Yes	➤ No	Two-Factor Authentication
➤ Yes	➤ Yes	Polls

Figure 9: Checklist MS-Teams vs. BigBlueButton  
Source: Own figure

## 5.2. Discussion

The use of conference systems such as Microsoft Teams or BigBlueButton is becoming increasingly important due to current circumstances in connection with restrictive exit restrictions in many countries. Especially the introduction of Distance Learning has an enormous influence on the way of teaching. It is therefore even more important to show which ICT software tools are most suitable for conducting efficient online conferences and how they differ.

This thesis addresses this important topic and aims to give answers to what exactly Conference Systems are, what Microsoft Teams and BigBlueButton are exactly, what advantages and disadvantages they have in the use of University Teaching and which one is more suitable for this purpose.

First, it can be said that there are several advantages and disadvantages of both Conferencing Systems in the context of University Teaching, which are presented at a granular level in this paper.

Microsoft Teams is suitable for small to medium-sized courses at universities. There is an upper limit of 300 participants per video conference and users can be member of up to 1000 channels or (Microsoft, 2020a). BigBlueButton, in comparison, only enables video conferencing with up to 100 participants (Charidimou et al., 2020).

BigBlueButton was developed specifically for Distance Learning and thus provides only a small selection of functions. However, this Conferencing System can be integrated with various learning platforms, such as Moodle, which constitutes the biggest advantages for University Teaching. The focus on education is also reflected in features such as the interactive whiteboard and breakout rooms (BigBlueButton, 2020f).

The advantage of Microsoft Teams is that there is a tremendous amount of functionality available for use. As we have seen in connection with the "Together Mode", Microsoft is also a pioneer in terms of innovations in digital Conferencing Systems (Ray, 2020). In addition, the Productivity Score offers the possibility to evaluate activities in connection with Teams (Microsoft, 2020e).

However, this surveillance function can also lead to problems, especially in connection with the productivity and motivation of students (Ball, 2010).

The Chatbot feature of Microsoft could make life easier for students and lecturers by taking over simple repetitive tasks (Microsoft 365 Developer, 2020).

However, certain disadvantages in dealing with bots can also be recognized. On the one hand, it can happen that many different messages are sent by the bot, so that it is no longer clear how to respond to individual messages. Furthermore, the frequency of reminder or alert messages could disturb the participant's attention and therefore be inappropriate for University Teaching (Toxtli et al., 2018). In summary, it can be said that this form of automation can have great advances for Distance Learning if it does not lead to excessive overuse.

Nevertheless, this variety of different features can also overwhelm customers, as they are not always aware of the full functionality of their license (Lawson & Riley, 2020).

Regarding usability in the context of University Teaching, an important advantage of Microsoft Teams can be pointed out. By linking Outlook appointments with Microsoft Teams, other users can see whether the desired user is currently available or not (Wolverton & Davidson, 2020). In addition, documents can be edited together with other participants at the same time, and interactive elements can be included in the lessons, such as voting or surveys (Symonenko et al., 2020).

The missing possibility for the structuring of documents can be stated as disadvantage regarding usability of teams (Abramson, 2019).

BigBlueButton Greenlight makes it very easy to create rooms and to switch between them. With one click to the URL of the room can be copied and sent to peers. In addition, each of the rooms clearly lists recordings of past meetings, which the administrator of that room can make publicly available or send via e-mail using a predefined function (BigBlueButton, 2020e).

The biggest issue in this context, is that processing of recorded meetings takes 24 hours (Akiwenzie, 2020).

In terms of security, it can be said that the proprietary Microsoft Teams software brings great services to university operations. Microsoft guarantees, within the framework of the use of Teams, encryption of all data on the network and during transmission (Microsoft, 2020b).

In addition, secure identity management takes place using Microsoft Azure Active Directory (AD). Furthermore, AD offers the administration of user access rights (Karlstetter, 2020).

This function can be used in the context of University Teaching to ensure secure access distribution between professors, students, and other staff.

In addition to security aspects, the handling of private user data must also be examined.

In this context, as mentioned above, there are investigations by the European Data Protection Supervisor (EDPS), which accuse Microsoft of not being able to specify the location where a large

part of user-specific data from organizations in the EU is stored (EDPS, 2020). This is particularly critical in the context of University Teaching, where Microsoft gains access to very sensitive user-specific data, such as demographic or performance-related data on students or employees.

In contrast, BigBlueButton's on-premises infrastructure allows Universities to determine which security measures they want to implement to make their servers more secure, and thus the Conferencing System as well (BigBlueButton, 2020c). In this context, the Secure Socket Protocol (SSL) can be used to ensure several security-related aspects for web services (Bhiogade, 2002).

In the following part of the discussion a detailed cost comparison is conducted.

### 5.2.1. Cost Comparison Microsoft Teams and BigBlueButton

First, it must be clarified that a direct cost comparison between the two systems is hardly feasible, as Microsoft Teams can only be acquired to the extent of an Office 365 version.

Nevertheless, to find a proper cost comparison between Microsoft Teams and BigBlueButton, the Total Costs of Ownership (TCO) of software must be considered, as the stand-alone licensing costs are far from being a basis for a decision.

For this purpose, we assume that Microsoft Teams is used by universities as Software as a Service, as this is the way Microsoft offers their applications to organisations. Here, the respective university accesses office software provided by Microsoft via the cloud. In this case the Office 365 suite, which comprises the Teams application (Microsoft, 2020c).

In contrast, BigBlueButton requires an on-premises installation of its web-based Conferencing Software, which requires the presence of physical servers and operating system. In this context, BigBlueButton recommends Linux Ubuntu to run the BigBlueButton system on (BigBlueButton, 2020a).

McKinsey (2007) states in its monthly report that for the cost comparison of a on-premises software and a software as a service, the installation cost must first be considered. This includes the design, as well as the testing of the required resources, such as the infrastructure. The second cost factor is the operation of the software. In addition to the activities to ensure ongoing operation, this includes activities related to training, but also the costs for adapting the entire business processes due to the new software to be introduced and finally the cost for running the respective infrastructure, for instance servers and other hardware. The most significant source of costs are the licenses for using the respective software. Finally, costs can be mentioned, that occur in connection with errors and

problem removal (Dubey & Wagle, 2007).

Only by taking all these factors into account it is possible to make a well-founded comparison.

<b>Costs</b>	<b>Initial</b>	<b>Year1</b>	<b>Year2</b>	<b>Year3</b>	<b>Total</b>
<b>Initial Planning and Implementation</b>	\$16,833				\$16,833
<b>Hardware</b>	\$ 7,000	\$ 900	\$ 900	\$ 900	\$ 9,700
<b>Microsoft Subscription and Licenses</b>		\$ 44,400	\$ 44,400	\$ 44,400	\$ 133,200
<b>Training</b>	\$ 12,500				\$ 12,500
<b>Administration</b>		\$ 48,750	\$ 48,750	\$ 48,750	\$ 146,250
<b>Additional Bandwidth</b>		\$ 5,000	\$ 5,000	\$ 5,000	\$ 15,000
<b>Total</b>	<b>\$ 36,333</b>	<b>\$ 99,050</b>	<b>\$ 99,050</b>	<b>\$ 99,050</b>	<b>\$ 333,483</b>

Figure 10: Total Cost of Ownership (TCO) Microsoft Office 365  
 Source: Own figure based on Forrester, 2015

The figure above shows the Total Cost of Ownership (TCO) of the Microsoft Office 365 Suite based on a study by Forrester Research of 7 midsize organizations surveyed (Forrester, 2015). According to Gartner (2020) a midsize company comprises 100 to 999 employees. (Gartner, 2020)

It is shown that administration incurs more costs than the actual license payments. Although Software as a Service is being evaluated here, there are costs in terms of hardware. These result from the need for a server to manage identities. In terms of subscription costs, Forrester calculated 24\$ per user for each month. However, if Microsoft Office licenses for education are considered, there are still significant savings to be made in this area compared with the study (Forrester, 2015).

Based on this, we can now evaluate in what aspects the cost breakdown of the BigBlueButton would differ from the one of Microsoft Teams.

First, the BigBlueButton open-source software eliminates any licensing costs, since BigBlueButton allows free installation via the command line (BigBlueButton, 2020a). However, this in turn results in costs, especially for hardware, since on-premises software must be hosted on local servers.

In addition, there are costs for performing various tests as part of the implementation, as well as costs for adapting the business processes to the software. Finally, the use of the BigBlueButton system does not include any mutual service level agreements that safeguard against interruptions in the ongoing operation and other problems of the conference system. Therefore, additional costs may occur that were not considered during planning (Dubey & Wagle, 2007).

The considerations listed must be individually adapted in the specific case of universities to evaluate which variant would be preferred by the respective university.

In summary, it can be stated that a cost assessment is very essential for universities to select the most suitable Conferencing Tool. In this context, the total cost of ownership is an adequate means to generate a profound basis for decision-making. However, universities must not make the mistake of assuming from the outset that open-source software generates lower costs overall.

It must also be considered that such software requires a longer planning phase, as well as more time-consuming training, since fewer resources and less information are available than with commercial products (Giera & Brown, 2004).

## 6. Conclusion and Outlook

This paper describes Conferencing Systems in general and compares the advantages and disadvantages of Microsoft Teams and BigBlueButton. Based on the knowledge gained, answers can now be given to the defined research questions. In particular, to the question of which Conferencing System is more suitable for University Teaching.

On the one hand, there is the proprietary software tool Microsoft Teams, which stands out with its functional diversity. On the other hand, there is the open-source Conferencing System BigBlueButton, which is specialized for the use in teaching.

First, it can be said that a decision in favour of a Conference System cannot be made based on a general cost comparison, as was carried out in section 5.2.1. Rather, an individual cost comparison must be carried out by each university, which is meaningful for the respective case. It is important to compare not only the pure license costs, but the Total Cost of Ownership (TCO). Contrary to expectations, the TCO of on-premises software can exceed the TCO of Software as a Service (Dubey & Wagle, 2007).

The integration with various learning platforms, primarily Moodle, makes BigBlueButton a very viable tool for University Teaching, even though small problems can arise in this context, which have been outlined earlier in this paper. In addition, the Interactive Whiteboard and Breakout Rooms are suitable for providing good substitutes for physical classes. However, the capacity for conferences with larger numbers of participants is lacking, thus reducing the applicability of BigBlueButton to smaller courses. This is especially critical for introductory phases, where large numbers of participants are expected for each course.

In this respect, Microsoft Teams should clearly be given priority, as it also allows larger courses to be held in digital form. Microsoft Teams also offers considerably more features than BigBlueButton in terms of functionality. Especially the integration of Outlook, as well as the activity channel and the joint editing of Office documents with peers, enable a structured way of working and efficient time management. By using selected features such as Together Mode or Conversational Bots, disadvantages of Distance Learning can be compensated.

As already outlined, Microsoft guarantees the encryption of data, as well as selected authentication measures and identity management for the use of Teams, thus enabling universities to focus on their own core areas and to receive a guarantee of a certain quality of service through service level

agreements from Microsoft. In contrast, BigBlueButton leaves universities free to decide how to handle these aspects, although there are certain specifications in this regard.

It should also be remembered that Microsoft raises ambiguities regarding the processing of user-specific data, which must be considered when choosing the most appropriate Conferencing System.

After evaluating both Conferencing Systems and comparing their advantages and disadvantages, it can be summarized that Microsoft Teams offers more useful functionality for use in universities and is therefore the more suitable Conferencing System for University Teaching. However, if a university attaches more importance to independence in terms of data storage and data management, selection of hardware and software, and selection of security measures, the use of the BigBlueButton system is recommended.

The comparison of the Conferencing Systems Microsoft Teams and BigBlueButton has shown that many different aspects are of importance here, which, however, can only be partially dealt with in the context of a single paper. In addition, the focus of this work was primarily on University Teaching. Therefore, there is potential for further scientific research that can investigate the use of selected Conferencing Systems in companies. Based on the findings of this thesis, it is also possible to go into more detail on individual sub-areas, such as Data Privacy in connection with Conferencing Systems.



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