Systematic Review of Virtual Classroom Software Tools used in higher education - MSc Dissertation

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Abstract

Vitrual Classroom Software Tools (VCSTs)[1] are software tools that allow students and teachers to use their functions to communicate synchronously. It is important to select VCSTs with the right functionality for different requirements. Because of COVID-19[2], many universities have been forced to use VCSTs instead of face-to-face teaching. This makes us rely more on VCSTs than ever before. But because there are many kinds of software, it can be difficult to choose properly. So far, there has been no systematic review of VCSTs used in higher education. Therefore, this timely project will conduct a systematic review of VCSTs used in higher education, reading and summarizing the relevant literature, evaluating relevant VCSTs, and reporting the results. My project not only can help users to select the right software, but also help software designers to improve the existing software, help other students and researchers in the field of using my study or in their research, or on the basis of my project to do their investigation, it can also help some of the underlying software designers and developers to design their own products better.

This project did a literature review of related papers about VCSTs to acquire basic knowledge of VCSTs, including difinitions, pros and cons, and all the features of VCSTs. Then the features were matched with those pros and cons, only those features which help to promote pros or avoid cons can be kept, to filter useless ones. This list of useful features is my evaluation criteria. Then a systematic review of VCSTs was conducted to identify and evaluate them based on the evaluation criteria. This project mainly focused on VCSTs used in higher education, which are in English and are free or have free trials. These restrictions formed my eligibility criteria. A total score for each VCST is calculated during the evaluation, and each point indicates that the software meets a certain evaluation criterion. The best performing VCSTs in different features are ranked by functional scores and overall scores. According to findings above, a list of recommendation for current tools was made to provide improvment guidelines for their current VCSTs.

Acknowledgements

First, I want to thank my supervisor, Alexandru Cristina. She has been providing great helps and support to me in this project. From weekly meetings to timely answers whenever I was confused, it was her constant participation that made me more motivated to complete my projects.

I also want to thank my second supervisor, Constantin Aurora. Thanks for her many valuable suggestions and the amount of time she spent on my project.

The success of my project is inseparable from the support and help of my two supervisors. It was their enthusiasm and expertise that made my project went smoothly. I also want to thank them for their precious time and dedication, which made my project results very good.

I would also like to thank my family and friends for their support and encouragement during my project. They gave me strength when I was lost and weak.

Declaration

I declare that this thesis was composed by myself, that the work contained herein is my own except where explicitly stated otherwise in the text, and that this work has not been submitted for any other degree or professional qualification except as specified.

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Chapter 1

Introduction

1.1 Rationale

COVID-19[4] has seriously changed our lives since early 2020. Because of the outbreak, people need to maintain some social distance[5], so many offline activities have been banned. Similarly, teaching at universities has been affected. At the behest of the government[2], universities are abandoning offline teaching and using Virtual Classroom Software Tools to teach online. This makes Virtual Classroom Software Tools more popular than ever before.

Virtual Classroom Software Tools (VCSTs)[1] are software tools which "allow students and instructors to communicate synchronously using features such as audio, video, text chat, interactive whiteboard, and application sharing". Microsoft Teams[6], Zoom[7], or Blackboard Collaborate[8] are typical examples. By using these tools to hold online classes, most of the traditional classroom activities can be kept[9]. Because of their convenience, many universities are using VCSTs to host classes, and these tools are becoming a trend of online teaching. However, there are too many VCSTs on the market now, and all of them have different features. As a result, it is hard for people to choose which tool is the most suitable one.

A systematic review[10] is a good way to understand VCSTs. A systematic review is a comprehensive, unbiased review of all related studies, to address a well-described problem. However, there has not been a systematic review of all VCSTs in higher education, which is quite useful for educators to choose suitable VCSTs and for designers to design better VCSTs. Up to now, most of the existing papers are evaluations and critiques of few VCSTs (e.g.[11]), or investigate the impact of VCSTs on a particular community (e.g.[12]). As a result, my project is timely and useful, and can fill this

gap.

1.2 Objectives

This project aims to conduct a systematic review of Virtual Classroom Software Tools. It will involve identifying all Virtual Classroom Software Tools from related papers, articles, and evaluating all those which meet certain eligibility criteria. Since this project doesn't have funding, I only consider open source VCSTs, free VCSTs, VCSTs with free trials, and VCSTs available under university licences. I will use my computer and tablet as my main evaluation devices. I would use my computer to register a teacher account to conduct the evaluation, and share the link to the tablet as a participating student to enter the meeting. A list of recommendations or guidelines for improvement of VCSTs for VCST designers is made after doing the systematic review.
Here are my hypotheses of my project, which are modified from my IPP coursework[13]:

- H1 None of the VCST available nowadays can meet all the educational aims of higher education classes.
- H2 No single VCST can contain all of these advantages that would enable them to meet teachers' and students' educational goals.
- H3 The existing VCST can be modified in design to meet the educational aims of higher education classes.

Based on the hypotheses, my research questions are as follows:

- RQ1 What are the evaluation criteria of VCSTs?
  - RQ1.1 What are their educational pros?
  - RQ1.2 What are their educational cons?
  - RQ1.3 What are the features or design guidelines they should follow to achieve the educational aims by meeting their pros or avoiding their cons?
- RQ2 How do current VCSTs compare in terms of these features and design guidelines?
  - RQ2.1 What is a good framework to evaluate VCSTs?
    - RQ2.1.1 Eligibility criteria

    - RQ2.1.2 Entire protocol
  - RQ2.2 What are the best VCSTs resulting from the systematic review?
  - RQ2.3 What design elements can be added onto the best VCST to improve their functionality and usability?

1.3 Summary of project

Each step of my project is introduced in chapter 2. There is a figure to show all the steps and methods I used to finish my literature review, plan and finish my systematic review, do the evaluation and conclude lists of recommendation of improvements.
Chapter 3 gives a detailed introduction of this project's background: the definitions of important terms, project aims and reasons, introductions and reasons of the methods I use, and introduction of related works. Also, the educational pros and cons and features of VCSTs are introduced here.
My detailed plan for the most important part of my project is shown in chapter 4. The plan is specific to how each step will be done and what results will be obtained, which includes an introduction to the systematic review, aims and objectives, methods I use, my eligibility criteria and information sources, searching strategy, study selection process, data collection process, data items, effect measures and possible risks, and the final synthesis of results.
Chapter 5 shows the whole process and results of systematic review by following the plan in chapter 4. It shows how the VCSTs were selected, and the evaluation process and results, and lists of recommendations for top 3 VCSTs, the VCST which got the best results for top evaluation criteria and for general VCSTs are provided here.
Chapter 6 concludes the dissertation by summarizing the process, and referring and answering the research questions. There is also a discussion of the overall achievements of the project, the experience with methodology, the problems encountered and solutions, and the project's limitations. This chapter also provides some possible future work that can be done based on what I've learned in this project.

Chapter 2

Methodology

This chapter describes the steps of the project and justifies the methods I use. The whole project is divided into 5 steps. This chapter describes in detail the practice of each step, the methods and reasons used, the possible outcomes, and the corresponding research questions that can be solved.

2.1 Steps of project

Figure 2.1 is a flowchart showing the steps of this project in a more institutive way.

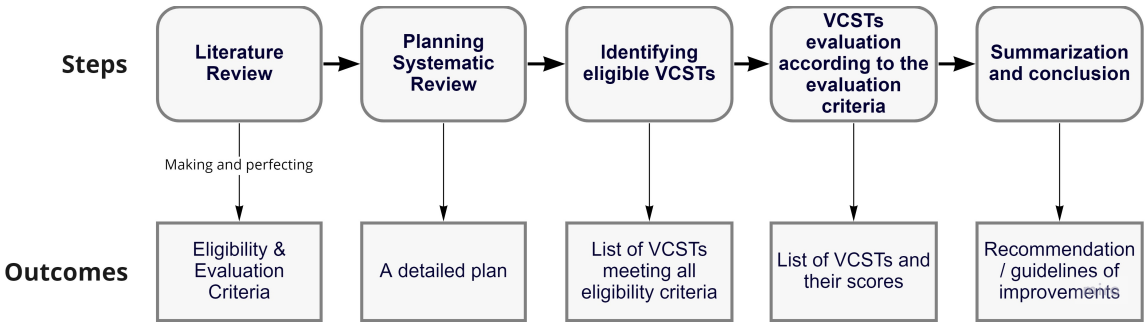

Figure 2.1: Flow chart of main steps of this project

Here is a list of each step of my project, and the methods I used:

1. The first stage of my project is doing a literature review[14] of current situation and related researches of VCSTs, pros and cons and the educational outcomes of VCSTs. A literature review[14] addresses a particular research problem through investigation of any published material that relevant to a particular problem, research field, or theory, including a description, summary, and critical evaluation

of relevant material. This helps me to make and perfect my eligibility and evaluation criteria, which I will use in the next stage.(See chapter 4) I can conclude the evaluation criteria of VCSTs by finding educational pros and cons and the related features of VCSTs when doing literature review. All these can answer RQ1 well.

2. The next step is to plan and structure my project using Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA)[3]. PRISMA is a statement intended to ensure that the systematic review plan is adequately, clearly documented, and consistently conducted. It contains a list of 27 steps and four phases to guide a high-quality approach to make a good systematic review. Need to mention that, PRISMA is used for investigating papers, but I'm going to modify it to investigate tools. Its modified sections are shown in section 4.3 chapter 4.

3. After well planing my research through PRISMA and getting my eligibility criteria, I can start searching related papers on Google[15] and Google Scholar[16]. I use these two search engines because they are well-known and reliable search engines, which can provide almost all the information I want. I use eligibility criteria to filter found papers and articles first to find reliable ones to find VCSTs. All the names of found VCSTs are recorded, and then check whether they meet my eligibility criteria. If so, they can be used for further evaluation. If not, they are dismissed.

4. Then use my evaluation criteria to evaluate the remaining VCSTs. Then they are ranked by their score, and the best few VCSTs for different functions are recorded and reported. After this evaluation, my findings, evidences of research, limitations of my study and a general conclusion are provided.

5. Based on what I have now, I can provide lists recommendations or guidelines of improvement of VCSTs for designers to improve their products. They can use my guidelines to improve by adding important features and deleting unnecessary features.

Chapter 3

Background

This chapter shows some basic information of this project. Including definitions of terms, project aims and reasons, and methods I use. The results of literature review (i.e. educational pros and cons, and related features) are shown here. This chapter answers RQ1: "What are the evaluation criteria of VCSTs?", which is mentioned in section 1.2.

3.1 Introduction of VCSTs

As introduced in chapter 1, Virtual Classroom Software Tools (VCSTs)[1] are those software tools which can help teachers and students to work together online as they are in a physical classroom. There are some typical features of these tools, such as audio and video streaming, text chat, interactive whiteboard and application sharing. There are many synonyms of them. They can be called as "virtual classroom software tools"[17][18], or just "virtual classroom software"[19][20], or "remote learning platforms"[21][22] and many other names. Because of these tools' convenience, many schools started to use them as tools to boost education, such as providing flexibility into classes for students[23] and aiding communication between students and teachers[24]. What's more, COVID-19[4] has accelerated the trend towards the use of VCSTs in higher education, as universities have been asked to use VCSTs to replace traditional offline courses[2]. As a result, more schools are using VCSTs, which makes them more popular. There are too many kinds of VCSTs in the market so far, but there is no detailed systematic review to investigate this kind of software used in higher education, which can be used for guiding people how to choose the most suitable tools.

3.2 Results of literature review

After doing the literature review, I have a certain understanding of VCST and research in related fields. I concluded the answers of RQ1: what are the educational pros and cons of the VCSTs, and what features facilitate these benefits or reduce the effects of the disadvantages. By keeping or adding these useful features as many as possible, the resulting VCSTs can better help remote studying to achieve people's educational aims for real. I summarize the current features of VCSTs from a number of well-established papers and match them to the pros and cons of the VCST that are also summarized in the paper. Only features that actually promote benefits or avoid drawbacks are retained and documented. I recorded these relevant information in a spreadsheet. These can answer the questions in RQ1.
The following lists are showing some concluded high-level educational pros and cons, and some high-level features. For space reasons, the full list of all pros, cons and features, and the results of matching them with related features, are shown in the appendix. The final table showing the features which help achieve pros and avoid cons will be my evaluation criteria.

3.2.1 Advantages of VCSTs

Advantages of VCSTs are well documented in related papers. The most frequently mentioned advantage is that VCSTs can make traditional classes possible online. They can support virtual meetings[11][25][1], support interactions between participants and instructors[26], and engage students while they are studying[11] [25][1][27][28]. The next popular advantage is that VCSTs can better promote classrooms' functions than traditional classrooms. By using them, it is easy to get students' immediate feedbacks [26][25], and it is faster to assign students to small groups (breakout rooms) than traditional classes[29]. VCSTs can also reduce travel time and cost than traditional classes, since teachers and students can take classes online, without actually going to school. This advantage brings together participants from different geographical locations[26], saves the possible expense for travel, accommodation and training facilities[26], which reduces the time for teachers to be away from their jobs[23]. VCSTs also provide more flexibility. For example, varied tools can be used in VCSTs without buying or installing physical facilities, and people can have different control roles in a session easily for better control[11]. Besides, students can have better learning experiences. VCSTs make students more involved and interact with lectures[23], and guarantee continuity

of instruction and promotes students' information retention[23].

3.2.2 Disadvantages of VCSTs

There are also some disadvantages. For teachers, they may be hard to operate. For example, it is not easy for teachers to follow every instant message[25], and the radical shifts in the teachers' pedagogical methods to accommodate to the new technology [23]. Students also face some challenges, for example, it is hard for students to concentrate. Sometimes, VCSTs make it difficult for students to concentrate in course contents[28], and they are more passive and often behave like they are watching TV but not attending a lesson[23].

3.2.3 Features of VCSTs that help them achieve advantages and avoid disadvantages

I did a lot of research to find and summarize the common features of VCSTs, and divided them into several categories. They are: scalability[23][11], audio conferencing [26][11][1], video conferencing[26][23][11][25][1], synchronous reactions in meeting[23][25], alerts for joining meeting[23], chat[30][26][23][11][25][1], application/ screen sharing[30][26][11], meeting scheduling(calendar)[23][11], teams[30], breakout rooms[11][25][29], file sharing[26][23][11], capture/ record/ playback[26][23] [11], subtitles[31], integrated with internal/ external tools and services[30][26][11], platform accessibility[23][31], multimedia [11][32][33], polling & quizzes[30][26][23] [11][25], whiteboard[26][27][28], participant list right management in meeting[23][11] [25], and ways to access live meeting[11]. There are also many sub-features in each function, and the full list of features is shown in Appendix A.2.

From the definition of VCSTs in section 3.1 chapter 3, there are some typical features of VCSTs, which are audio and video streaming, text chat, interactive whiteboard and application sharing[1]. Take these features for example, they promote advantages or avoid disadvantages of VCSTs. Audio and video conferencing support virtual meetings, and support interaction and engage users as well by allowing users and tutors to turn microphones on/ off[11]. Text chat can ensure collaboration between users through public and private chat, the emojis in chat and the alert for new chat messages[30]. Whiteboard helps to simulate the real-world classrooms well and helps to preserve some usual conditions and class dynamics [28], since a key feature of the whiteboards is that multiple participants can use it simultaneously, which is the same

as real life whiteboards. Application and screen sharing helps computer application demonstrations and practising and offers more flexibility by giving multiple levels of controls[30][23], since presentors can choose which part to share to the meeting.
There are other non-basic functions that also help VCSTs to promote pros or avoid cons. “Scalability” allows a great number of participants to supporting virtual meetings [23][11]. “Synchronous reactions in meetings” such as “clap”, “raise hand” and “thumbs up” can support interaction and engage users[25], and help to make the teachers aware of students’ reactions[23]. “Meeting scheduling” offers more flexibility to both teachers and students[23], as people can choose who they want to invite into the meeting and check invitee availability status. “Teams” can promote collaboration between participants[30]. “Breakout Rooms” support online training and tutoring[11], and keeps features of traditional classes[29], and even can do better and faster when assigning breakout rooms automatically. “File sharing” is good for synchronous instructional content presentation[26] by allowing users to upload and download files. Subtitles can help to strength students’ interests and motivate them. “Integrated with internal/ external tools and services” makes VCSTs can be used for specific topics or specific needs of learners[11], and participants can use software that does not exist locally[26]. “Platform Accessibility” provides more flexibility and people can respond more actively[31]. “Multimedia” can add interactivity and provide more real class experience [32][33]. “Polling Quizzes” with display of the synchronization result data allow users to get immediate feedbacks[25] and to track and analyse their learning outcomes[11]. “Participant list & right management in meeting” allow users to have different level of controls in the meeting[11], and the notification of microphone status and reactions shown in the list can let teachers find students’ requirements/ status easier[25]. “Access live meeting” makes accessing meetings easier, which reduces the time for users to be away from their home.
The full list matching each feature with related pros and cons is shown in Appendix A.2.

3.3 Introduction to PRISMA[3]

After finishing the preparation, the next stage is to do the systematic review. Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA)[3], as the name implies, represents content that needs to be emphasized or presented in pri-

ority during the submission of systematic reviews and meta-analyses, so that reviewers can tell whether the research is scientific and rigorous or not.
It is a writing guide and reporting standard for systematic reviews and meta-analyses[34], which contains 7 stages and 27 items in total. The 7 stages are "Title, Abstract, Introduction, Methods, Results, Discussion, and Funding". "Title" identifies the work as a systematic review; "Abstract" gives a rough conclusion of the whole report; "Instruction" introduces the rationale and objectives; "Methods" explains the eligibility criteria, information sources, search strategy, data collection, possible risks of this study and so on; "Results" shows and explains all the results; and "Discussion" provides a general interpretation of the results based on the evidence and analyses possible deficiencies and limitations.
Therefore, using PRISMA as a guideline for planning the system review is a very scientific and rigorous approach. However, PRISMA is for reviewing papers, but in this project it's the software tools that are being reviewed, so the PRISMA principle should be modified for reviewing tools. The modified results are shown in section 4.3 of chapter 4, in which each of the sections follows PRISMA principle with different degrees of renaming to better describe the main ideas of each subsection.

3.4 Related Work

As mentioned in section 1.1 chapter 1, there is no systematic reviews of all VCSTs used in higher education. After doing the literature review, I conclude those related works as several types.
There are some works about evaluating VCSTs, but they only talked about particular tools used in particular places. For example, The University of Lima North[35] tested and evaluated the performance of different VCSTs used in their university for teaching, and summarized possible improvements to the existing system of the university. Finally, they used what they've learned to choose a suitable VCST for their university.
Some related works are about investigating and testing functions of VCSTs and the related advantages. For example, Raes, Annelies, et al.[23] match VCSTs' functions with different types of students' engagements: behavioural, emotional or affective, and cognitive engagement. Then they did post-interventions surveys and found that VCSTs can motivate students by "promising flexibility". Bengochea, Luis, and Flor Budia[31] investigated the use of subtitle function in virtual classroom. They found that subtitles allow students with language difficulties to learn better and increase interest and moti-

vation, especially for those with hearing impairments.

Another type of recent work is related to COVID-19, they talk about the impacts of COVID-19 to education and VCSTs. For example, [36] and [3] believe that it is urgent to adapt and improve current VCSTs under this epidemic situation. Some functions, such as breakout rooms, attendance book, whiteboard and discussion boards are more important[3]. Besides, to create better VCSTs, all educators should work together to share their precious experiences. Reguera, Elsa Aniela Mendez, and Mildred Lopez [28] discussed new educational processes under COVID-19: To ensure academic continuity, transform learning methods used in the classroom into virtual environments. They found that students acted well when facing the new learning environment. But consistent efforts were still needed to be made for getting more students involved, as some students preferred not to engage to turning on their cameras/ microphones. They did not find the best way to solve this, and their study still need future works to make all students participate in the most natural and efficient way.

Chapter 4

Planning the Systematic Review

4.1 Introduction

The main part of my project is to do a systematic review[10] of Virtual Classroom Software Tools[1] used in higher education, which can well answer my RQ2.1 mentioned in section 1.2. This chapter only addresses RQ2.1 because it contains the framework for doing the actual work. The rest RQs are answered in the next chapter. To perform a well-organized systematic review, a modified Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA)[3] structure is used here as mentioned in chapter 3.

4.2 Aims and Objectives

The main aim of this systematic review is simple, to figure out how do current VCSTs compare in terms of the useful features and design guideline, as mentioned in chapter1 section 1.2, RQ2.

The objectives are as mentioned of sub-questions of RQ2. The first one is to find out a good framework to evaluate VCSTs (RQ2.1), which is an adaptation of well-known framework called PRISMA as introduced in chapter 3. Eligibility criteria can be used to check whether the VCSTs are qualified for researching (RQ2.1.1), and those unqualified VCSTs are dismissed. After concluding evaluation criteria for evaluating the VCSTs (RQ2.1.2), the first objective can be achieved. The next objective is to find out the best VCSTs resulting from the systematic review (RQ2.2). This can be achieved by using evaluation criteria to evaluate, grade and rank the VCSTs. The last objective is to find out what design elements can be added onto the best VCSTs to

improve their functionality and usability (RQ2.3). These features can be concluded by checking what is missing from the best VCSTs.

4.3 PRISMA methods

The following steps are modified from original PRISMA[3] for reviewing tools. I remove "Reporting bias assessment" and "Certainty assessment" sections based on the actual situation of my project. The former one refers to the methods used to describe the risk of bias resulting from loss of results in synthesis, and the latter one refers to the methods used to evaluate the certainty of evidence for results. My project did not deal with either of these things, so they were ignored.

4.3.1 PRISMA checklist

PRISMA has a checklist[37] of all sections and topics that a systematic review should have. Since it was meant to be used for reviewing papers, but I'm using it for reviewing tools, so some sections need to be modified. Here are the section I'm going to use[37].

- Title
- Abstract
- Introduction
  - Rationale: use currently acquired knowledge to describe the rationale of the review.
  - Objectives: state aims and objectives of this review.
- Methods
  - Eligibility criteria: specify all inclusion and exclusion of the review.
  - Information sources: specify all search engines and reasons.
  - Search strategy: presents a complete search strategy for all search engines, including filters and restrictions.
  - Selection process: the detailed process of filtering the results of this review.
  - Data collection process: process and methods I use to collect data for the review.

  - Data items: summarize all results of the data found, specify whether I get all the results I wanted and, if not, how to get them instead.
  - Effect measures: specify possible risks in this review and specify effect measures for outcomes used in showing and analysing results.
  - Synthesis of results: how to analyse the results.

- Results
  - VCSTs selection: the evidences of selecting VCSTs.
  - Evaluation of search results: The results and analyses of them.
  - Recommendations: recommendations of some VCSTs.
  - Conclusion: a conclusion of what I've found.

4.3.2 Eligibility criteria

When searching papers and websites, the following restrictions must be followed:

- Sources are in English.
- Sources are reliable. i.e. VCSTs official websites, research or review articles of VCSTs in higher education, GitHub[38] pages about projects related to VCSTs, market research websites that list VCSTs and description pages. Informal websites, such as blogs and wiki-style sites, are not considered.
- Only use results searched from Google[15] and Google Scholar[16].
- Sources or articles should be free/ accessible with university licences.
- Exclude Google results which are patents and citations.

For those VCSTs that are found, they must satisfy the following rules:

- Software are in English.
- Software should be free/ have free trial/ accessible with university licences.
- Software must be functional.
- People can use the software without having to provide any personal or financial information.

- Software should have had a recent update (past two years).
- Users should be able to make an account and log into the software.
- If the software is a mobile application, it should be downloadable.
- Software should have a secure account creation/ download page (i.e. https)
- Dismiss the VCSTs that involve administrators activating accounts who don't reply within 5 calendar days.

Also, only VCSTs satisfying these following rules can be kept for later evaluation, as derived from the definition of VCSTs[1] in chapter 3:

- Contains live audio streaming.
- Contains live video streaming.
- Allows screen/ application sharing.
- Has text chat function.
- Has a whiteboard.

4.3.3 Information sources

Google[15] and Google Scholar[16] are my information sources, and I only use searched information from them. Google can provide articles and webpages for identifying VCSTs, and Google Scholar can provide many reliable academic material.

4.3.4 Search strategy

Since Google[15] and Google Scholar[16] can provide a large amount of searching results, but this project has time limitation, using filters while searching is quite essential. For this project, the research direction is "Virtual Classroom Software Tools used in higher education", so "Virtual Classroom Software Tools" and "higher education" are the keywords. Besides, as mentioned in chapter 3, VCSTs have many synonyms, and the most related ones here this project uses are "virtual classroom software" and "remote learning platforms". Therefore, the final searching keywords can be ("Virtual Classroom Software Tools" OR "virtual classroom software" OR "remote learning platforms") AND "higher education". These parentheses are used for reducing syntax

errors and making a more precise and specific search[39].
Searching steps on Google[15] are as follows:

1. Modify the search settings to show English results only.
2. Using keywords mentioned above in quotation marks and conjugate AND, i.e. (“virtual classroom software tools” OR “virtual classroom software” OR “remote learning platforms”) AND ”higher education”.
3. Go to the last page to turn off the default emission of similar entries. Because Google always hides some results by default.
4. Go to the last page to see the actual number of results and record it.

Searching steps on Google Scholar are as follows:

1. Modify the search settings to show English results only.
2. Untick the boxes at the left-side bar for patents and citations.
3. Using keywords mentioned above in quotation marks and conjugate AND, i.e. (“virtual classroom software tools” OR “virtual classroom software” OR “remote learning platforms”) AND ”higher education”.
4. Go to the last page to see the actual number of results and record it.

Need to mention that, the number of results that Google[15] shows on top of searching results is an estimate, only navigating to the last page can see the actual number of results. Searching steps on Google are the same as for Google Scholar[16], except that Google does not have boxes for patents and citations, so no need to untick anything.

4.3.5 Selection process

For searching on Google, I click each one of the results and to check whether the sources meet the eligibility criteria for sources. If not, this result is dismissed. If so, the mentioned Virtual Classroom Software Tools are recorded with their names and official websites. If information is from non-official websites, but specific Virtual Classroom Software Tools are mentioned, their names are recorded and their official websites are checked for further information. Those Virtual Classroom Software Tools will be examined with eligibility criteria to see whether they are qualified for my project. Suitable Virtual Classroom Software Tools are kept, and others are dismissed.

For searching on Google Scholar, the searching results, including websites, article, papers, are all reviewed. For websites, first thing to do is to check whether they meet the eligibility criteria for sources, and then whether they mention any Virtual Classroom Software Tools names. If so, then record their names with their URL in a spreadsheet. For articles and papers, the titles and abstracts are used to roughly analyse whether the targets are related to the research direction. If related, then use eligibility criteria to check whether they are qualified for later evaluation. Only those Virtual Classroom Software Tools pass all these restrictions are kept for further evaluation. If names of Virtual Classroom Software Tools are mentioned, they are recorded with their URLs. If no names are found, then the main body of the articles and papers are checked to decide.

4.3.6 Data collection process

The list of Virtual Classroom Software Tools obtained from section 4.3.4 chapter 4 will be used for evaluation. The evaluation criteria were applied to each tool, and obtain a score for each one to reflect how many records in evaluation criteria they meet. Then rank them in the order of their scores.

4.3.7 Data items

As mentioned in section 3.2, my evaluation criteria are final results of matching pros and cons and related features, after doing many researches. These remaining features can be regarded as truly useful features, so they are qualified for evaluating VCSTs. The entire evaluation criteria are shown in a spreadsheet, and the snapshot is in Appendix A.2. For fully test VCSTs' functions, I ensure I use no less than 2 devices (a laptop and a tablet) at the same time to attend meetings, to ensure I test both in teachers' and students' view.

4.3.8 Effect measures

For each VCST, I test every feature in the evaluation criteria. If the target has this feature, it earns one point; if it doesn't have this feature, then it doesn't score. Finally, the total score of each VCST is the sum of the scores it obtains. Moreover, we calculate a score for each individual top evaluation criterion.

4.3.9 Synthesis of results

This section is called “Synthesis methods” in PRISMA. I changed the name because I only have synthesis of results to be explained here. Other items that PRISMA[3] mentions are not included in my project.

Evaluation criteria obtained in section 3.2.3 and listed in Appendix A.2 are important for assigning scores to VCSTs during evaluation. For each criterion that the VCST meets, a point is given to the VCST. Their final scores are the summation of each point. In addition, the scores given by each tool for different types of functions are also calculated(summed) and recorded in a list. These scores will be used later for analysing the overall situation of VCSTs and for each VCST, and also used for providing recommendations.

Chapter 5

Evaluation: Conducting the systematic review

This chapter shows the evaluation process and final results of systematic review. This chapter mainly focus on answering RQ2.2: the best VCSTs resulting from the evaluation, and RQ2.3: recommendations for VCSTs.

5.1 VCSTs selection

Figure 5.1 shows the general flow of the testing process.

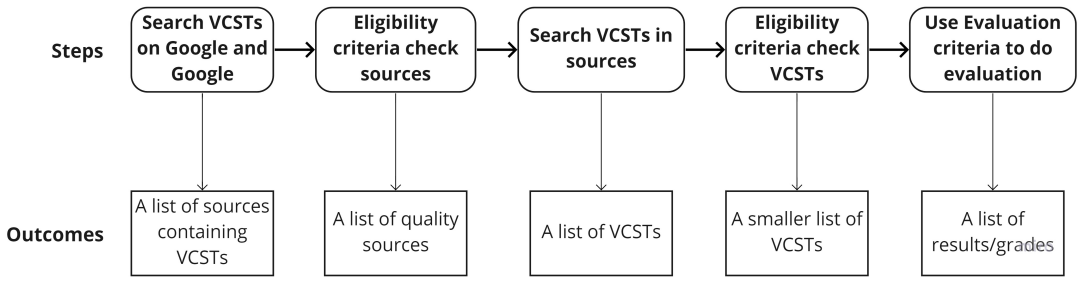

Figure 5.1: Flowchart3

By using the keywords: "("virtual classroom software tools" OR "virtual classroom software" OR "remote learning platforms") AND "higher education"" on Google[15] and Google Scholar[16], which is mentioned in section 4.3.3, I got 717 results in total: 16 pages of 301 results on Google, and 41 pages of 416 results on Google Scholar. Then I used eligibility criteria mentioned in section 4.3.1 for papers and websites to filter them to get quality sources. After checking each source carefully to find and record mentioned VCSTs, there were 244 VCSTs found in total. They were listed in a

spreadsheet with their names and official websites, which is shown in Appendix A.3. After I got this huge list, I started to use the eligibility criteria mentioned in section 4.3.1 to screen the list. I registered an account using school given email address for each VCST on their official website. Some VCSTs provide free trials or their companies answered me immediately for help, so their eligibility check was fast and easy. I marked the VCSTs that pass the eligibility criteria as green and those that did not pass them as red. The detailed reasons for passing and failing can be seen in Appendix A.3. A total of 28 VCSTs were marked in green in the table in Appendix A.3, they have passed the eligibility test and were evaluated based on the evaluation criteria.

5.2 Evaluation of search results

I tested each VCST with my evaluation criteria and my registered accounts. I matched each VCST to the evaluation criteria and listed them in a large table for my record. In my evaluation, I looked carefully for each item in the evaluation Criteria. If the target feature was available, the corresponding place in the table was marked as "1", which means "one point is scored". If the target feature was not available, then it was marked "0" for 0 score. The final score was calculated as the sum of the points obtained.
The final table is shown in Appendix A.4, where the VCSTs listed are ranked from left to right in descending order. The best 3 VCSTs with the highest scores are highlighted in red.
The full spreadsheet of detailed marks and final scores is shown in Appendix A.4. Among the tested 28 VCSTs, the VCSTs with the highest scores are Microsoft Teams[6], 91; Adobe Connect[40], 82; and Blackboard Collaborate[8], 78. The median score among these 28 tools is 64, MeritHub[41] and Mykademy[42] got this mark. The average score of these 28 tools is 60.32, and there are 16 VCSTs with a higher score.
I also checked and recorded the scoresfor each software for each top evaluation criterion in orange in Appendix A.4, and summarized in Figure 5.2.
For "Scalability" function, only Blackboard Collaborate[8] got the highest grade, which is 3 points, and this means it has the highest meeting room capacity: over 200 participants. Four other tools got 2 points, which means their capacity is 50 to 100 participants, and they were Teams[6], Adobe Connect[40], BigBlueButton[43] and BlueJeans[44], and the other tools only got 1 point, which means their capacity is 0 to 50 participants. Most of the VCSTs need to increase their meeting capacity.
For "Audio conferencing" function, Teams, eduTinker[45], Webex Meetings[46] and

Zoom[7] got the highest mark: 5 points. They are good to be used for audio meetings. They also allow users to manage background noises, while many others omitted this function.

"Video conferencing" function's highest score is 6 points, and eduTinker, Webex Meetings and Zoom got this score. They are good to be used in video conferencing, and having profile picture and allowing users changing background are two key features for getting higher grades.

For "Synchronous reactions in meeting" function, there are 7 tools that got the highest mark: 4 points, which are Teams, Adobe Connect, eduTinker, Webex Meetings, Zoom, BigBlueButton and Lessonspace[47]. The synchronous reactions are useful for tutors to know different user reactions timely, and all these 7 VCSTs have "clap", "raise hand", "thumb up" and other emojis. Most of the other VCSTs do not have "clap" emoji.

Half of the tools got the highest score, 2 points, of "Alerts for joining meeting" function, which are Teams, Blackboard Collaborate, ClassIn[48], eduTinker, Webex Meetings, Zoom, BlueJeans, Electa Live Virtual Classroom Software[49], Meritful, TurningPoint[50], ZujoNow Whitelabel[51], VEDAMO Virtual Classroom[52] and LearnCube[53]. This means half of the tools are doing well in this aspect. Most of the other tools omitted the alerts for user leaving.

For "Chat" function, the highest score is 9 points, and Blackboard Collaborate, eduTinker and Zoom were the top among all VCSTs. Private chat and emojis in chat are two most commonly omitted features.

For "Application/ Screen sharing" function, except for Teams, ClassIn, Webex Meetings, Samba Live[54], Electa Live Virtual Classroom Software, others all got the highest score, 5 points. Most of the VCSTs were doing well of this basic function because they were using Google's screen sharing function. Those that got lower marks were lacking browser tab sharing function.

Different from the former one, "Meeting scheduling" function only has one winner with 9 points, which is Teams. Other tools need to learn more from Teams to perfect their scheduling function. Users were even not allowed to schedule meetings in some VCSTs.

"Teams" function's highest score is 3 points, and Teams and Webex Meetings both got this score. It is worth mentioning here, most of the other VCSTs got 0 points, which means they didn't have this function at all. So maybe they need to add this function for future improvement.

For "Breakout Rooms" function, the winner is Webex Meetings, and it got 6 points. This function is useful, especially when tutors want to have group tutorials. However, some tools omitted this function completely. Most of the tools lack "pre-defined allocation" and "participants moving between groups" functions, and they need to pay more attention to these.

Teams and SimTek[55] with 4 points ranked maximum in "File sharing" function. This function is useful for collaborating and for tutors to add new material. Many tools with lower marks not allow users to download files.

Only Adobe Connect with 7 points was the best VCST for "Capture/ record/ playback" function. Other tools should learn from it, since the score difference is too big, most of other tools only got 3/ 2/ 0 points. They need to add the functions involved in this, especially "video recording includes chat" and "users can view recorded sessions".

"Subtitles" function's winner is Blackboard Collaborate again. Most of the VCSTs omitted this function completely. Also, it is good for accessibility, e.g. for those who cannot hear well or in noisy environment. This is useful as it can help students to have better understanding. Many tools allow users to upload subtitles after the meeting, but they still need more functions, such as add auto-generated subtitle (after meeting) added to recordings and live captioning in meetings.

ClassIn, Lessonspace and SimTek were good for "Integrated with internal/ external tools and services" function because they were scoring maximum (3 points) in this evaluation. More embedded tools can better help meetings with convenient activities, such as embedded browsers, Maths editors and text editors. Only ClassIn has embedded browser, which is good. A quarter of the VCSTs have embedded Maths editor and text editor. Others need to improve in this aspect.

Teams, Adobe Connect and Electa Live Virtual Classroom Software were the best for "Platform Accessibility" function scoring 3 points, since they allow all mobile, desktop and browser applications. Downloadable tools can get higher score in this part, so maybe other VCSTs can choose to develop their VCSTs as multi-platform software.

"Multimedia" function's highest score is 6, and Adobe Connect, eduTinker, Zoom, MeritHub, edudip and Lessonspace got this score to be the best tools, since they allow image, text, slides, video and audio display in meetings.

Kaltura Video Cloud[56], Newrow Smart[57] and WizIQ[58] were the best in "Polling & Quizzes" with 11 points. Most of the other tools only have polling function, but have no quizzes at all. There are several tools which got 0 point in this evaluation. Besides, most of them only have single answer polling with pre-defined choices and

self-defined choices, they need to add multiple answers polling and images as choices functions. What is more, their results only have one type of diagram, for example, in tables, in pie charts or in bar charts. They can provide more types of diagrams to show results.

"Whiteboard" function has 4 winners with 8 points, they are ClassIn, Kaltura Video Cloud, Newrow Smart and Lessonspace. Except for ClassIn, the other 3 tools all can import templates to whiteboard, which is a good function for other VCSTs to add. Most of the tools lack whiteboard snapshot function.

Adobe Connect, Blackboard Collaborate, ClassIn, eduTinker, Zoom, BigBlueButton BlueJeans and edudip got the highest score, 9 points, in "Participant list & right management in meeting" function. Users were not allowed to set roles before the meetings in the other VCSTs and there were no notification of reactions (like clapping and thumb up) in participant list as well. This function is important for tutors to know the current status of participants.

Adobe Connect, eduTinker, Zoom, BlueJeans and Electa Live Virtual Classroom Software got the highest score of 7 points in "Access live meeting" function. Most of the tools allow users access from links and websites and can be set as "needs permission by moderators to enter". But most of them were embedded with no waiting rooms.

From the results above, eduTinker got 9 wins, Zoom got 8, and Teams and Adobe Connect got 7. Since Teams, Adobe Connect and Blackboard Collaborate were three tools with the highest overall scores, this means eduTinker got pretty low score in other aspects ("Meeting scheduling", "Teams", "Capture/ record/ playback", "Subtitles", and "Whiteboard"), and Blackboard Collaborate got very high scores in other aspects ("Scalability", "Alerts for joining meeting", "Chat", "Application/ Screen sharing", "Subtitles", and "Participant list & right management in meeting").

5.3 Recommendations

5.3.1 Recommendations for 3 top VCSTs

Since University of Edinburgh is currently using Blackboard Collaborate[8] based virtual classroom software system, and Blackboard Collaborate ranks at 3rd position in the final list, I am starting with the recommendations based on Blackboard Collaborate's behaviour in the evaluation. It was good in "Scalability", "Alerts for joining meeting", "Chat", "Application/ Screen sharing, Subtitles" and "Participant list & right

management in meeting" aspects. However, it did not perform so good in "Teams", "File sharing" and "Polling & Quizzes" functions, so it needs improvements in other aspects to be better. Here is a list of possible improvements for perfecting Blackboard Collaborate[8].

- To provide users better experience while doing audio conferencing, they can add "manage background noise" and more other audio settings.
- To provide users better experience while doing video conferencing, they can add "changing video backgrounds" and more other video settings.
- Can add "thumbs up" and "clapping" and more other synchronous reactions in meeting.
- Better to perfect meeting scheduling functions. Can provide more channels to invite others, such as to invite the whole class or only a team. Display invitee availability is another good function that can be added as well.
- Can add "Teams" functions.
- Can support pre-defined allocation in breakout rooms by uploading files by users.
- File sharing function needs to be perfected. Can allow users to upload files in chat.
- Can allow users to save chat messages and record them while recording the audio and video.
- Can add a function to auto-generate subtitle after meeting onto recordings for better review.
- Can add some external tools, such as maths editor and text editor.
- Can add pre-defined choices and images as choices to polling.
- Can allow users to import graphics to their whiteboards for users convenience.

I also provide some recommendations for other tools, according to what I learned from my evaluation.
Teams[6] was the best VCST according to my evaluation, and from figure 5.2 we can find that it ranks at the second position often in terms of top evaluation criteria. It

got high marks in functions of “Breakout Rooms”, “Capture/ record/ playback”, “Integrated with internal/ external tools and services” and “Polling & Quizzes”. However, it needs more improvements in “Breakout Rooms” and “Polling Quizzes” functions. Here is a list of possible improvements for Teams.

- Can support pre-defined breakout rooms’ allocation and allow participants moving between groups.
- Can support video recording with text chats for better reviewing.
- Can embed with more external tools, embedded browser, Maths editor and text editor are good examples.
- Can add polling function in main room and in chat.
- Can add quizzes function.
- Can add “images as choices” functions to polling to expand diversity of polling.

Adobe Connect[40] was the 2nd best VCST among those 28 VCSTs. It got the highest scores in “Synchronous reactions in meeting”, “Application/ Screen sharing”, “Capture/ record/ playback”, “Platform Accessibility”, “Multimedia”, “Participant list & right management in meeting”, and “Access live meeting”. It got lower scores in “Meeting scheduling”, “Teams”, “File sharing”, “Subtitles”, “Integrated with internal/ external tools and services” and “Polling & Quizzes” function. Here is a list of possible improvements for Adobe Connect.

- Can add “allow users to write messages within an invitation”, and “can set recurring meetings” functions.
- Can add “teams” function.
- Can allow file sharing in teams and chat, and allow users to download files.
- Can add “allow users to upload subtitles to recording” and “allow live captioning in meeting” functions.
- Can integrate with text editors and Maths editors.
- Can add quizzes function.
- Can add “pre-defined choices” and “images as choices” to polling.

5.3.2 Recommendations for VCST which got the most top scores

In addition to the three highest scoring tools, eduTinker won 9 times in each top evaluation criterion, and its overall score ranked at 5th place overall. As a result, I think it is useful to provide recommendations to it. It got the highest scores in " Audio conferencing", "Video conferencing, "Synchronous reactions in meeting, "Alerts for joining meeting, "Chat, "Application/ Screen sharing, "Multimedia, "Participant list & right management in meeting, and "Access live meeting". It got lower scores in "Meeting scheduling", "Teams", "Capture/ record/ playback", "Subtitles", "Integrated with internal/ external tools and services", and "Whiteboard" functions, so it needs to improve more in these aspects. Here is a list for eduTinker.

- Can add more functions in scheduling, such as allow users to write messages within an invitation.
- Can add "teams" function.
- Can add places to view recorded sessions, since I did not find places to review them.
- Can add subtitle function, such as allow users to upload subtitle to recording and live captioning in meeting.
- Can integrate more tools, such as text editors and Maths editors.
- Can allow importing graphics and templates in whiteboards.

5.3.3 General recommendations

According to the evaluation results in Appendix A.4, I concluded many functions that are easily to be omitted, and made them as general recommendations of VCSTs. Here is a list of the recommendations:

- Can increase meeting scalability to over 200 participants in each meeting.
- Can let users manage background noise.
- Can let users change video background.
- Can add "clap" emoji in meeting.
- Can add alert of "users leaving".

- Can let users save chat manually.
- Can add “clapping” and “thumb up” and other emojis in chat.
- Can add “browser tab sharing” function.
- Can let users invite teams to meetings, and write messages within an invitation.
- Can set meetings as recurring meetings.
- Can add “Teams” function.
- Can include pre-defined breakout rooms’ allocation.
- Can allow participants moving between breakout rooms.
- Can allow video recordings to include chat.
- Can let users edit recorded sessions.
- Can add “upload subtitle to recording”, “auto-generated subtitle (after meeting) added to recording” and “live captioning in meeting” and other subtitle functions.
- Can embed with embedded browser.
- Can add quizzes function.
- Can add images as polling choices.
- Can show polling and quizzes results in tables and pie charts, and other types of diagrams.
- Can import graphics in whiteboard.
- Can let users set on roles before meetings.
- Can add waiting room function.

5.4 Conclusion

The best three VCSTs are Teams[6], Adobe Connect[40], and Blackboard Collaborate[8]. Although eduTinker's total score ranks at 5th place, it got the highest scores in most of the functions. It was good for audio conferencing, video conferencing, having synchronous reactions in meeting, having alerts for joining meeting, chatting, application / screen sharing, multimedia displaying, having participant list & right management in meeting, and has the most number of ways to access live meeting. However, what made it only reach 5th place were because of the deficiencies in meeting scheduling, teams, capture/ record/ playback, subtitles and whiteboard functions. Most of the VCSTs perform well in "Application/ Screen sharing" function because most tools get a full score in this category, no tool gets a zero, and the score difference is not much. This is because most of the tools use Google's[15] screen sharing functions. Teams was remarkable in "Meeting scheduling", as it allows all kinds of inviting functions and can display invitee availability. Blackboard Collaborate was remarkable in "Subtitles" function, as it allows users to upload subtitle to recording, and do live captioning in meetings. Generally speaking, there are some common functions that VCSTs need to improve or to add. Meeting room capacity can be increased to over 200 participants. Managing background noise and changing video background are two functions that most of VCSTs didn't have. Most of VCSTs didn't allow users to invite teams/ subteams/ channels to meetings, writing messages within an invitation, and displaying invitee availability. Only a few VCSTs have "Teams" and quizzes section, auto-generated subtitle to recordings, and waiting rooms, which are good features that can be added.

Combined with the above results, we can judge whether the hypotheses stated in section 1.2 were correct. H1 said that none of the VCSTs can meet all educational aims of higher education, which is correct as none of the VCSTs got full mark. H2 said that no VCST can contain all pros that would let them meet educational goals, which is also correct, as none of them has all functions that can promote all pros. H3 said that the existing VCSTs can de modified to meet educational aims in higher education. This is also correct because no VCST has all functions, means they still can improve by adding features onto them.

Scalability	Blackboard Collaborate	Teams	Adobe Connect	BigBlueButton	BlueJeans	ClassIn	eduTinker	Webex Meetings	Zoom	Electa Live Virtual Classroom Software	MeritHub	Mykademy	Samba Live	edudip	Kaltura Video Cloud	Newrow Smart	WizIQ	iTeach.world	Lessonspace	TurningPoint → Dojo360	Kneura	Unicko Virtual Classroom	SimTek	ZujoNow Whitelabel	VEDAMO Virtual Classsroom	LearnCube	Vectera	AyoTree
	3	2	2	2	2	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Audio conferencing	Teams	eduTinker	Webex Meetings	Zoom	Adobe Connect	ClassIn	Lessonspace	Blackboard Collaborate	BigBlueButton	BlueJeans	Electa Live Virtual Classroom Software	MeritHub	Mykademy	Samba Live	edudip	Kaltura Video Cloud	Newrow Smart	WizIQ	iTeach.world	Kneura	Unicko Virtual Classroom	LearnCube	TurningPoint → Dojo360	SimTek	ZujoNow Whitelabel	VEDAMO Virtual Classsroom	Vectera	AyoTree
	5	5	5	5	4	4	4	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	2	2	2	2	2	2
Video conferencing	eduTinker	Webex Meetings	Zoom	Teams	Adobe Connect	MeritHub	Mykademy	Samba Live	Blackboard Collaborate	ClassIn	BigBlueButton	BlueJeans	edudip	Kaltura Video Cloud	Newrow Smart	WizIQ	iTeach.world	Lessonspace	Kneura	Unicko Virtual Classroom	LearnCube	Vectera	Electa Live Virtual Classroom Software	TurningPoint → Dojo360	SimTek	ZujoNow Whitelabel	VEDAMO Virtual Classsroom	AyoTree
	6	6	6	5	5	5	5	5	4	4	4	4	4	3	3	3	3	3	3	3	3	3	2	2	2	2	2	2
Synchronous reactions in meeting	Teams	Adobe Connect	eduTinker	Webex Meetings	Zoom	BigBlueButton	Lessonspace	BlueJeans	Electa Live Virtual Classroom Software	MeritHub	ClassIn	edudip	iTeach.world	Blackboard Collaborate	Unicko Virtual Classroom	ZujoNow Whitelabel	LearnCube	Mykademy	Samba Live	Kaltura Video Cloud	Newrow Smart	WizIQ	TurningPoint → Dojo360	Kneura	SimTek	VEDAMO Virtual Classsroom	Vectera	AyoTree
	4	4	4	4	4	4	4	3	3	3	2	2	2	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0
Alerts for joining meeting	Teams	Blackboard Collaborate	ClassIn	eduTinker	Webex Meetings	Zoom	BlueJeans	Electa Live Virtual Classroom Software	MeritHub	TurningPoint → Dojo360	ZujoNow Whitelabel	VEDAMO Virtual Classsroom	LearnCube	Adobe Connect	BigBlueButton	WizIQ	Lessonspace	Mykademy	Samba Live	edudip	Kaltura Video Cloud	Newrow Smart	iTeach.world	Kneura	Unicko Virtual Classroom	SimTek	Vectera	AyoTree
	2	2	2	2	2	2	2	2	2	2	2	2	2	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0
Chat	Blackboard Collaborate	eduTinker	Zoom	Teams	Mykademy	BlueJeans	Electa Live Virtual Classroom Software	Samba Live	ClassIn	Webex Meetings	BigBlueButton	Lessonspace	Adobe Connect	iTeach.world	TurningPoint → Dojo360	MeritHub	edudip	WizIQ	VEDAMO Virtual Classsroom	Kaltura Video Cloud	Newrow Smart	Unicko Virtual Classroom	SimTek	ZujoNow Whitelabel	Vectera	AyoTree	Kneura	LearnCube
	9	9	9	8	8	7	7	7	6	6	6	6	5	5	5	4	4	4	4	3	3	3	3	3	3	3	2	1
Application / Screen sharing	Adobe Connect	Blackboard Collaborate	eduTinker	Zoom	BigBlueButton	BlueJeans	MeritHub	Mykademy	edudip	Kaltura Video Cloud	Newrow Smart	WizIQ	iTeach.world	Lessonspace	TurningPoint → Dojo360	Kneura	Unicko Virtual Classroom	SimTek	ZujoNow Whitelabel	VEDAMO Virtual Classsroom	LearnCube	Vectera	AyoTree	Teams	ClassIn	Webex Meetings	Samba Live	Electa Live Virtual Classroom Software
	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	4	4	4	3	2
Meeting scheduling (calendar)	Teams	Webex Meetings	BlueJeans	edudip	Adobe Connect	Blackboard Collaborate	ClassIn	eduTinker	Zoom	Electa Live Virtual Classroom Software	MeritHub	BigBlueButton	Mykademy	Samba Live	iTeach.world	TurningPoint → Dojo360	SimTek	ZujoNow Whitelabel	VEDAMO Virtual Classsroom	AyoTree	WizIQ	Kneura	Unicko Virtual Classroom	Vectera	Kaltura Video Cloud	Newrow Smart	Lessonspace	LearnCube
	9	5	5	5	4	4	4	4	4	4	4	3	3	3	3	3	3	3	3	3	2	1	1	1	0	0	0	0
Teams	Teams	Webex Meetings	ClassIn	Electa Live Virtual Classroom Software	Mykademy	Samba Live	AyoTree	Adobe Connect	Blackboard Collaborate	eduTinker	Zoom	BigBlueButton	BlueJeans	MeritHub	edudip	Kaltura Video Cloud	Newrow Smart	WizIQ	iTeach.world	Lessonspace	TurningPoint → Dojo360	Kneura	Unicko Virtual Classroom	SimTek	ZujoNow Whitelabel	VEDAMO Virtual Classsroom	LearnCube	Vectera
	3	3	2	2	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Breakout Rooms	Webex Meetings	Adobe Connect	BigBlueButton	BlueJeans	Mykademy	Samba Live	Teams	Blackboard Collaborate	ClassIn	Kaltura Video Cloud	Newrow Smart	TurningPoint → Dojo360	Unicko Virtual Classroom	Electa Live Virtual Classroom Software	iTeach.world	eduTinker	Zoom	MeritHub	edudip	WizIQ	Lessonspace	Kneura	SimTek	ZujoNow Whitelabel	VEDAMO Virtual Classsroom	LearnCube	Vectera	AyoTree
	6	5	5	5	5	5	4	4	4	4	4	4	4	3	3	0	0	0	0	0	0	0	0	0	0	0	0	0
File sharing	Teams	SimTek	eduTinker	Webex Meetings	Zoom	MeritHub	Lessonspace	Kneura	Blackboard Collaborate	ClassIn	BigBlueButton	Mykademy	Samba Live	Kaltura Video Cloud	Newrow Smart	WizIQ	iTeach.world	TurningPoint → Dojo360	VEDAMO Virtual Classsroom	AyoTree	Adobe Connect	Electa Live Virtual Classroom Software	edudip	Unicko Virtual Classroom	LearnCube	Vectera	BlueJeans	ZujoNow Whitelabel
	4	4	3	3	3	3	3	3	2	2	2	2	2	2	2	2	2	2	2	2	1	1	1	1	1	1	0	0
Capture / record / playback	Adobe Connect	BigBlueButton	BlueJeans	Teams	Blackboard Collaborate	Samba Live	edudip	ClassIn	eduTinker	Webex Meetings	Zoom	ZujoNow Whitelabel	Vectera	Electa Live Virtual Classroom Software	Mykademy	Kaltura Video Cloud	Newrow Smart	TurningPoint → Dojo360	Kneura	Unicko Virtual Classroom	WizIQ	MeritHub	iTeach.world	Lessonspace	SimTek	VEDAMO Virtual Classsroom	LearnCube	AyoTree
	7	6	5	4	4	4	4	3	3	3	3	3	3	2	2	2	2	2	2	2	1	0	0	0	0	0	0	0
Subtitles	Blackboard Collaborate	Teams	Kaltura Video Cloud	Newrow Smart	TurningPoint → Dojo360	Unicko Virtual Classroom	Adobe Connect	ClassIn	eduTinker	Webex Meetings	Zoom	BigBlueButton	BlueJeans	Electa Live Virtual Classroom Software	MeritHub	Mykademy	Samba Live	edudip	WizIQ	iTeach.world	Lessonspace	Kneura	SimTek	ZujoNow Whitelabel	VEDAMO Virtual Classsroom	LearnCube	Vectera	AyoTree
	3	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Integrated with internal / external tools and services	ClassIn	Lessonspace	SimTek	MeritHub	VEDAMO Virtual Classsroom	LearnCube	Vectera	Teams	eduTinker	Zoom	Electa Live Virtual Classroom Software	Mykademy	Samba Live	edudip	Kaltura Video Cloud	Newrow Smart	WizIQ	iTeach.world	Unicko Virtual Classroom	Adobe Connect	Blackboard Collaborate	Webex Meetings	BigBlueButton	BlueJeans	TurningPoint → Dojo360	Kneura	ZujoNow Whitelabel	AyoTree
	3	3	3	2	2	2	2	1	1	1	1	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0
Platform Accessibility	Teams	Adobe Connect	Electa Live Virtual Classroom Software	Kneura	Blackboard Collaborate	ClassIn	eduTinker	Webex Meetings	Zoom	BlueJeans	edudip	BigBlueButton	MeritHub	Mykademy	Samba Live	Kaltura Video Cloud	Newrow Smart	WizIQ	iTeach.world	Lessonspace	TurningPoint → Dojo360	Unicko Virtual Classroom	SimTek	ZujoNow Whitelabel	VEDAMO Virtual Classsroom	LearnCube	Vectera	AyoTree
	3	3	3	3	2	2	2	2	2	2	2	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Multimedia	Adobe Connect	eduTinker	Zoom	MeritHub	edudip	Lessonspace	Teams	Blackboard Collaborate	ClassIn	Webex Meetings	Electa Live Virtual Classroom Software	Mykademy	Samba Live	Kaltura Video Cloud	Newrow Smart	WizIQ	iTeach.world	TurningPoint → Dojo360	Kneura	Unicko Virtual Classroom	SimTek	ZujoNow Whitelabel	VEDAMO Virtual Classsroom	LearnCube	Vectera	BigBlueButton	BlueJeans	AyoTree
	6	6	6	6	6	6	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	4	4	1
Polling & Quizzes	Kaltura Video Cloud	Newrow Smart	WizIQ	Kneura	ClassIn	Adobe Connect	BigBlueButton	MeritHub	Teams	Blackboard Collaborate	Mykademy	Samba Live	edudip	iTeach.world	Unicko Virtual Classroom	Electa Live Virtual Classroom Software	SimTek	ZujoNow Whitelabel	eduTinker	Webex Meetings	Zoom	BlueJeans	Lessonspace	TurningPoint → Dojo360	VEDAMO Virtual Classsroom	LearnCube	Vectera	AyoTree
	11	11	11	10	8	7	7	7	6	5	6	6	5	5	5	4	4	4	1	0	0	0	0	0	0	0	0	0
Whiteboard	ClassIn	Kaltura Video Cloud	Newrow Smart	Lessonspace	Teams	Adobe Connect	Blackboard Collaborate	Electa Live Virtual Classroom Software	MeritHub	iTeach.world	LearnCube	eduTinker	Zoom	BigBlueButton	Mykademy	Samba Live	WizIQ	TurningPoint → Dojo360	Kneura	Unicko Virtual Classroom	Webex Meetings	edudip	SimTek	ZujoNow Whitelabel	VEDAMO Virtual Classsroom	BlueJeans	Vectera	AyoTree
	8	8	8	8	7	7	7	7	7	7	7	6	6	6	6	6	6	6	6	6	5	5	5	5	5	4	4	4
Participant list & right management in meeting	Adobe Connect	Blackboard Collaborate	ClassIn	eduTinker	Zoom	BigBlueButton	BlueJeans	edudip	Teams	0	Electa Live Virtual Classroom Software	MeritHub	Mykademy	Samba Live	iTeach.world	TurningPoint → Dojo360	Kaltura Video Cloud	Newrow Smart	Lessonspace	Unicko Virtual Classroom	VEDAMO Virtual Classsroom	WizIQ	LearnCube	Vectera	ZujoNow Whitelabel	Kneura	SimTek	AyoTree
	9	9	9	9	9	9	9	9	8	8	8	7	7	7	7	7	6	6	6	6	6	5	5	5	4	3	3	2
Access live meeting	Adobe Connect	eduTinker	Zoom	BlueJeans	Electa Live Virtual Classroom Software	Teams	Webex Meetings	Blackboard Collaborate	ClassIn	edudip	Kaltura Video Cloud	Newrow Smart	WizIQ	BigBlueButton	MeritHub	TurningPoint → Dojo360	Kneura	Vectera	Mykademy	Samba Live	iTeach.world	Lessonspace	LearnCube	Unicko Virtual Classroom	SimTek	ZujoNow Whitelabel	VEDAMO Virtual Classsroom	AyoTree
	7	7	7	7	7	6	6	5	5	5	5	5	5	4	4	4	4	4	3	3	3	3	3	2	2	2	2	2

Figure 5.2: Rank Results of Each Function

Chapter 6

Conclusion, discussion and future work

This chapter shows conclusion and discussion of my project, and provide possible future works.

6.1 Conclusion

In conclusion, this project did a comprehensive literature review and systematic review, and provided lists of recommendations. The literature review acquired knowledge of VCSTs' backgrounds(chapter 3), concluded eligibility(section 4.3.1) and evaluation criteria(Appendix A.2). Systematic review was conducted according to a modified PRISMA[37] protocol. the whole planning process was shown in chapter 4, and all results were shown in chapter 5. Evaluation was conducted according to evaluation criteria. For each feature the tools meet, the VCSTs can earn 1 point. The final evaluation results were displayed in grade form, and all the results were shown in Appendix A.4. According to the evaluation results, lists of recommendations for different VCSTs were provided in section 5.3.

As mentioned in section 5.4, all those three hypotheses mentioned in section 1.2 were correct according to my evaluation results. Besides, my project has fully answered all my research questions in section 1.2.

RQ1: What are the evaluation criteria of VCSTs? RQ1.1 and RQ1.2 asked about VCSTs' educational pros & cons, and they were found during literature review, shown in section 3.2.1 and section 3.2.2. Features of VCSTs found in literature review were matched with these pros and cons to find useful ones, which can promote pros or avoid

cons, and the matching results are explained in section 3.2.3. This final list of useful features became my evaluation criteria, which is shown in Appendix A.2 and it answered RQ1.3: "What are the features or design guidelines they should follow to achieve the educational aims by meeting their pros or avoiding their cons?".

RQ2: How do current VCSTs compare in terms of these features and design guidelines? I adapted PRISMA[3] as my framework, and chose eligibility criteria to narrow down the searching range. Eligibility criteria concluded in literature review show restrictions of paper, websites and VCSTs, which is shown in section 4.3.1. PRISMA[37] is an authoritative and rigorous principle used for systematic reviews. As a result, I used it for reviewing tools. However, the original PRISMA is for review papers, so I modified it for review tools better. RQ2.2 ask about "What are the best VCSTs resulting from the systematic review?", and the results with grades are shown in section 5.2 and Appendix A.4. After ranking them in order of overall grades, the top 3 VCSTs were Microsoft Teams[6], Zoom[7], and Blackboard Collaborate[8]. RQ2.3 asked about "What design elements can be added onto the best VCST to improve their functionality and usability?", and the answers were shown in section 5.3. I provided lists of recommendations for 3 top VCSTs, the VCST which got the most top scores, and a list for all VCSTs considering the functions that many of them omit.

6.2 Discussion

This section is about the overall achievements of the work, limitations, and the problems encountered and how they were resolved.

6.2.1 Overall achievements

Overall, I did a literature review about VCSTs to find out the background and research done by others about VCSTs. I also concluded my eligibility and evaluation criteria here. Then I set my searching keywords in Google[15] and Google Scholar[16]. These keywords were decided by me and my two supervisors together. According to their previous experience, resulting in around 1000 sources for me to check is the best workload, so we tested different keywords to identify good sources and VCSTs in them, which is shown in section 4.3.3. After I got all the names of tools, I started to use eligibility criteria to filter them from around 250 tools to 28 at last. Then I started to register accounts in each of these VCSTs and do the evaluation. This process went

smooth. Next, I analysed the evaluation results and made some conclusions and findings of VCSTs. Then I used the results and findings to make lists of recommendations for top 3 VCSTs, the VCST which got top score the most, and general VCSTs.

6.2.2 Experience with methodology

The whole process of the project was shown in section 2.1. As shown there, I did literature review, systematic review, evaluation, and concludes the results. Generally speaking, things went smoothly. The literature review was with a huge workload, since it was the stage of gaining knowledge, at first, I didn't know what and where to start with. So, I searched the relevant recent papers and started to read them to understand the knowledge of the relevant field and read some of their cited articles. Gradually, I gained some mastery of the relevant knowledge and found the general direction. Summarizing advantages, disadvantages and features of VCSTs is not difficult, but it is a lot of work. I need to search a huge number of papers and I took more time than I thought before, but the results were good and comprehensive. Searching tools with keywords was successful, and managing the keywords to get around 1000 sources was reasonable and feasible. After checking with my eligibility criteria, there were 28 remaining tools, and this number was feasible for performing evaluation within a few weeks as well. If I were going to use the same methodology to evaluate a different type of tools in the same time length: 3 months, I would like to follow my current plan and keep these statistics the same. I would give more time on evaluating, as I took a long time to test them.

PRISMA[37] was used here to conduct systematic review. It was used to review papers, but I used it to review tools. Most of the sections were related and can be inherited. However, some sections, like "Reporting bias assessment" and "Certainty assessment" were removed as they are irrelevant with my project because my project did not refer to the methods used to describe the risk of bias resulting from loss of results in synthesis or the methods used to evaluate the certainty of evidence for results. There were many changes in "Results" section, as the original PRISMA was more focused on reporting data results, errors, loss and other values, whereas my project was more focused on reporting and analysing simple results(only scores) and making recommendations. I modified them and I think the structure of my project is good and can be used by others to do systematic reviews of tools.

6.2.3 Problems encountered and solutions

I predefined keywords for searching st first. Then I found that they resulted in too many results. Then I asked my supervisors, and they helped me to modify keywords and narrow down the searching results to 1000. Judging from the results, getting searching results of around 1000 was indeed feasible for a three-month project.
I found difficulties in interpreting and adapting PRISMA sections for evaluating tools, since it was used for evaluating papers. Modifying the sections was difficult, since some items were vague, so I needed to look up examples of applying them in papers doing other systematic reviews, and how I could change them. There is no good way to do so, I still checked them one by one. Eventually, I solved this problem and did a fantastic job, and I think the structure in my paper can be used for other people to do systematic review of tools.

6.2.4 Limitations

There are some key limitations: I only considered VCSTs that are free/ available for free trial/ accessible through university permission. As a result, some features that require payment to unlock could not be tried and evaluated. Besides, only VCSTs applied to higher education was considered, so my study is not suitable to other tools such as tools for business. What's more, due to the number of manpower and devices (only me as tester and I only have a computer and a tablet), there were some functions that could not be fully tested, such as some functions in breakout rooms and views of alerts in different roles. But I've tried to minimize the possible errors.

6.3 Future work

Here are things that I would do next with this work, what I would do next with any similar reviews expanded from this work, and how would I disseminate the work.
For the limitations of types and numbers of devices, I think I can work with another colleague in the future to use more devices, then we can have a better and more thorough evaluation. Time was limited for my project, especially for the evaluation part. If I do this project in the future, I can find others to double-check of my evaluation results for me. Besides, if I get more time in the future, I could set looser criteria for VCSTs. For example, now I dismissed all VCSTs if they did not answer me in 5 days. Maybe in the future I can set these criteria to 10 days. What's more, if I can find funding in the

future, then I can test more tools that have good quality but require payment. Also, in the future, I would have more time, so I would make and test a prototype of a possible improvement to all VCSTs according to my findings and recommendations. I think all the items in my evaluation criteria were good to be added on it. Except for the main functions (mentioned in section 3.1): audio and video streaming, text chat, interactive whiteboard and application sharing, it can especially focus on those I mentioned in section 5.3.3 for general VCSTs.

Now I've got experiences of reviewing and testing VCSTs within my project, and it can be a cornerstone for me to do other related researches. I can make the prototype out and test its usability. If things go well, this can be implemented and developed to be an actual software. I can do more research on a particular functions of VCSTs, to explore different implementations of this function, as well as other related features. I can review and test other related type of tools in the future, such as Audience Response Systems, since they both for online teaching environments. Also, I can use my experience and my modified PRISMA[37] structure to test and write systematic reviews about other tools as well. I'm sure I would do quicker jobs and get good results.

I believe my work is valuable and can be used for reference by professionals and software designers in the industry. Through my research, scholars can build on my foundation, software designers can also improve their VCSTs or design their own based on my research. I would also like to disseminate my work, by finding places to publish it, such as journals on technology for education, the University of Edinburgh's Learning and Teaching Conference, and the School of Informatics Teaching Festival.

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Appendix A

My Appendix

A.1 Eligibility Criteria

for papers/websites	sources in English
	only use results searched from Google and Google Scholar
	sources(articles) should be free/ accessible with university licenses
	exclude Google results with patents and citations
for vcsts	software are in English
	software should be free/ have free trial/ accessible with university licenses
	software must be functional
	able to use the software without having to provide any personal information
	software should have had a recent update (past two years)
	should be able to make an account and log into it
	If the software is a mobile application, it should be downloadable
	software should have a secure account creation/download page (https)
	dismiss thoes haven't replied in 5 days
vcsts : basic features	contains live audio streaming
	contains live video streaming
	allow screen/application sharing
	text chat
	whiteboard

Figure A.1: eligibility criteria

A.2 Evaluation Criteria

				Pros															cons														
				1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	1	2	3	4	5	6	7	8	9	10	11	12	13	14
Scalability	1-50 participants in 1 meeting					Myself link: allow a great amount of participants	supporting virtual meetings																									
	50-200 participants in 1 meeting																															
	over 200 participants in 1 meeting																															
Audio conferrencing	existance			basic	basic		support interaction and engage users + supporting virtual meetings				Myself link: support interaction and engage users																					
	turn microphone on / off by user																															
	turn microphone on / off by others																															
	managing background noise						offer more flexibility (multiple levels of controls)																									
	other audio settings																															
Video conferrencing	existance				basic		support interaction and engage users + supporting virtual meetings		support interaction and engage users		Myself link: support interaction and engage users									Myself link: more passive and often behaved like they were watching TV and not attending a lesson.											
	turn camera on / off by user													11: students feel more involved and committed to participating if they cannot see each other																	
	turn camera on / off by others																															
	profile picture										Myself link: support interaction and engage users																					
	changing background													Myself link: students feel more involved and committed to participating if they cannot see each other							Myself link: more passive and often behaved like they were watching TV and not attending a lesson.											
	other video settings																															
Synchronous reactions in meeting	clap								support interaction and engage users											Myself link: difficult to make the teacher aware that they want to answer a question, which makes them frustrated and uninvolved											
	raise hand			mentioned			mentioned																									
	thumb up																															
	other emojis																															
Alerts for joining meeting	users joined																				Myself link: difficult to make the teacher aware that they want to answer a question, which makes them frustrated and uninvolved											
	users left																															
Chat	chat during meeting	in main room		basic																												
		in breakout room																														
		save chat (manually)																														
	chat outside meeting																															
	public chat			Myself link: Collaborate between participants	Good for synchronous communication		+ supporting virtual meetings		support interaction and engage users		Myself link: support interaction and engage users													not easy for tutors to follow every message							
	private chat																															
	emojis in chat	clapping									Myself link: support interaction and engage users																					
		thumb up																														
		other emojis																														
	alert for new chat messages																							not easy for tutors to follow every message							
Application / Screen sharing	screen sharing			Myself link: Computer application demonstration actice	2: Interaction between participants & instructors.		+ supporting virtual meetings + offer more flexibility (multiple levels of controls)																									
	browser tab sharing						offer more flexibility (multiple levels of controls)																									
	application sharing																															
	window sharing																															
	sharing separate camera by individual																															
Meeting scheduling (calendar)	existance					Myself link: offer more flexibility	+ supporting virtual meetings																									
	invite other users to meeting																															
	invite teams to meeting																															
	invite subteams / channels to meeting																															
	write messages within an invitation																															
	display invitee availability																															
	share links of meeting																															
	drag and drop in calendar																															
	recurring meeting	fixed / regular intervals				Myself link: offer more flexibility																										
		customize intervals																														
Teams	existence			Myself link: Collaborate between participants																												
	team channals																															
	posts																															
Breakout Rooms	existence			mentioned			support online training and tutoring		support interaction and engage users					11: None of the traditional classroom activities have to be abandoned																		
	manual allocation													Myself link: enables communication with different people, while in a classroom setting students tend to group with the same people																		
	random allocation													11: faster than in a physical classroom when allowing the program to do it automatically																		
	pre-defined allocation																															
	moderators moving between groups													11: visit the groups one at a time providing assistance when needed																		
	participants moving between groups																															
File sharing	existence (i.e. uploading functionality)	in teams			2: Synchronous instructional content presentation	Myself link: offer more flexibility	+ supporting virtual meetings																									
		in chat																														
		in meeting																														
	downloading files																															
Capture / record / playback	record sessions	video recording of shared screen in main room		mentioned	2: Synchronous instructional content presentation	Myself link: offer more flexibility	support interaction and engage users + supporting virtual meetings																									
		video recording of shared screen in breakout room																														
		video recording in main room includes chat																														
		video recording in breakout room includes chat																														
	edit recorded sessions					Myself link: offer more flexibility	support interaction and engage users + supporting virtual meetings																									
	view recorded sessions	in the menu																														
		in the chat																														
		via a link in email																														
	recording available for...	limited time																														
		forever																														
Subtitles	upload subtitle to recording																															
	auto-generated subtitle (after meeting) added to recording																	can help to strength the interest and motivation of students													
	live captioning in meeting	not saved to a recording (if recording)																														
		saved to a recording (if recording)																														
Integrated with internal / external tools and services	embedded browser				2: Participants can work with software on systems that are not locally available.		mentioned																									
	Maths editor				2: Participants can work with software on systems that are not locally available.		Regarding specific subject or a specific learner's needs																									
	text editors			mentioned	2: Participants can work with software on systems that are not locally available.		Regarding specific subject or a specific learner's needs																									
	others																															
Platform Accessibility	mobile application					Myself link: offer more flexibility												mobile learners responded more positively													
	desktop application																															
	browser application																															
Multimedia	image	9: such as text, slides, full motion audio-video, live video and interactive software on a single powerful interactive platform. 10: video, audio, electronic slides, handwritten text material, ASCII text.					mentioned				Better imitation of offline courses, to give teachers and students more real class experience		Better imitation of offline courses, to give teachers and students more real class experience																		
	text						mentioned																									
	slides						mentioned																									
	video						mentioned																									
	audio						mentioned																									
	others						mentioned																									
		existance	in main room	mentioned	2: getting feedbacks																											
			in breakout room																													
			in team posts																													
			in outside chat																													
			in meeting chat																													
			in other places																													

				Pros															cons												
				1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	1	2	3	4	5	6	7	8	9	10	11	12	13	14
Polling & Quizzes	polling	pre-defined choices			2: getting feedbacks	3: monitor student engagement within lectures + make them more involved and interact within lectures	Myself link: tracking and assessing students' learning outcomes		Immediate feedbacks																							
		self-defined choices																													
		images as choices																													
		single answer																													
		multiple answers																													
	quizzes	existance	in main room			3: monitor student engagement within lectures + make them more involved and interact within lectures	Myself link: tracking and assessing students' learning outcomes																								
			in breakout room																												
			in team posts																												
			in outside chat																												
			in meeting chat																												
			in other																												
		pre-defined choices																													
		self-defined choices																													
		images as choices																													
		single answer																													
		multiple answers																													
		open-ended questions																													
	results in statistics	in tables				3: monitor student engagement within lectures + make them more involved and interact within lectures	Myself link: tracking and assessing students' learning outcomes		Immediate feedbacks																							
		in pie chart																													
		in histogram																													
		in bar chart																													
		other types of diagrams																													
Whiteboard	whiteboard existence	In main meeting room		mentioned	2: simulating the real-world classrooms		mentioned								12: support interaction and engage users	13: support interaction and engage users + helped to preserve some of the usual conditions and class dynamics.														13: made it difficult for students to follow the course content / concentrate	
		In breakout room																													
	multiple participants can use it simultaneously				2: simulating the real-world classrooms		mentioned																								
	whiteboard snapshot																														
	shapes and lines																														
	typing texts																														
	importing graphics																														
	colors																														
	templates																														
Participant list & right management in meeting	list of participants			mentioned	mentioned																										
	roles	moderator					Different control roles in a session, Allow multiple people have presenter or moderator roles																								
		presenter																													
		participant																													
		other																													
	invite / add people to meeting					include expertise outside the institution	mentioned																								
	settings on roles before the meeting						+ supporting virtual meetings + offer more flexibility (multiple levels of controls)																								
	change roles during meeting																														
	notification of microphone status (speaking, muted) in participant list																							not easy for tutors to follow every message							
	notification of reactions (clapping, thumb up) in participant list																														
Access live meeting	from link					Myself link: less time away from the job	+ supporting virtual meetings + offer more flexibility																								
	from website																														
	from app																														
	from desktop system																														
	must log in																														
	guest access																														
	needs permission by moderator																														
	waiting room																														
1st level	2nd level																														
body	appendix																														
Others (for pros and cons)					2: Bring together participants from different geographical locations. + No expenses for travel, hotel & training facilities.	guarantee continuity of instruction and promotes student retention + Reduce travel time and costs															Myself link: radical shifts in the teachers' pedagogical methods in order to accommodate to the new technology										

A.3 All VCSTs

Name	URL	Issues	software are in English	software should be free/ have free trial/ accessible with university licenses	software must be functional	able to use the software without having to provide any personal information	software should have had a recent update (past two years)	should be able to make an account and log into it	If the software is a mobile application, it should be downloadable	software should have a secure account creation/download page (https)		contains live audio streaming	contains live video streaming	allow screen/application sharing	text chat	whiteboard	Problems
Adobe Connect	https://www.adobe.com/uk/products/adobeconnect/trial.html#	30 trial 0727	y	y	y	y	y	y	y	y		y	y	y	y	y	
AyoTree	https://www.ayotree.com/?gclid=Cj0KCQjw3f6HBhDHARIsAD_i3D_7qAe9sj-7BRAx8VoC99slg2FQOgVmtC7wSJulhM0u93kI2YMgKNYaApflEALw_wcB	trial 0727	y	y	y	y	y	y	-	-		y	y	y	y	y	
BigBlueButton	https://bigbluebutton.org/		y	y	y	y	y	y	-	-		y	y	y	y	y	
Blackboard Collaborate	https://www.blackboard.com/en-uk/try-blackboard?utm_medium=cpc&utm_source=google&utm_campaign=UK_CollaborationWebConferencingBrand&utm_term=blackboard%20web%20conferencing	request sent	y	y	y	y	y	y	y	y		y	y	y	y	y	
BlueJeans	https://www.bluejeans.com/downloads?mkt_tok=Nzc3LVpSVS00MzcAAAF-i2HwP1MAfhRVss8NLxwwcQAOIcu07_g5rqoGhjxlb5Uxhf8JWzLKHUbB0TEj1E8YXYQ6rZCr8zsNbAd31IL7Av_jNfmcf23Wwf7-CCTzWpep6Rc		y	y	y	y	y	y	y	y		y	y	y	y	y	
ClassIn	https://www.classin.com/en/higherEducation.html		y	y	y	y	y	y	y	y		y	y	y	y	y	
edudip	https://www.edudip.com/	14 triaql 0727	y	y	y	y	y	y				y	y	y	y	y	
eduTinker	https://edutinker.com/		y	y	y	y	y	y	y	y		y	y	y	y	y	the same as zoom!!!
Electa Live Virtual Classroom Software	https://www.e-lecta.com/		y	y	y	y	y	y	y	y		y	y	y	y	y	
Kaltura Video Cloud	https://corp.kaltura.com/meeting-solution-edu-free-trial/		y	y	y	y	y	y				y	y	y	y	y	
iTeach.world	https://iteach.world/en/virtualclassroom		y	y	y	y	y	y				y	y	y	y	y	
Kneura	https://kneura.com/		y	y	y	y	y	y	y	y		y	y	y	y	y	
LearnCube	https://www.learncube.com/		y	y	y	y	y	y				y	y	y	y	y	
Lessonspace	https://www.thelessonspace.com/		y	y	y	y	y	y				y	y	y	y	y	
MeritHub	https://merithub.com/		y	y	y	y	y	y				y	y	y	y	y	
Mykademy	https://mykademy.com/		y	y	y	y	y	y				y	y	y	y	y	
Newrow Smart	https://www.newrow.com/		y	y	y	y	y	y				y	y	y	y	y	
Samba Live			y	y	y	y	y	y				y	y	y	y	y	
SimTek	https://www.simteklearning.com/	request sent	y	y	y	y	y	y				y	y	y	y	y	
Teams	https://www.microsoft.com/en-gb/microsoft-teams/group-chat-software		y	y	y	y	y	y	y	y		y	y	y	y	y	
TurningPoint → Dojo360	https://www.turning.com/		y	y	y	y	y	y				y	y	y	y	y	
Unicko Virtual Classroom	https://www.unicko.com/		y	y	y	y	y	y				y	y	y	y	y	
Vectera	https://go.vectera.com/?gclid=CjwKCAjwr56IBhAvEiwA1fuqGhUZ9szMTYq8Ovs1LAtOytKXVC5sbjyyvIRppQvmky3yToqKJAGD7BoC0JwQAvD_BwE&utm_campaign=branded&utm_medium=cpc&utm_source=google&utm_term=vectera		y	y	y	y	y	y				y	y	y	y	y	
VEDAMO Virtual Classsroom	https://www.googleadservices.com/pagead/aclk?sa=L&ai=DChcSEwjo3qPKmZPyAhVI1O0KHcrsBUMYABACGgJkZw&ae=2&ohost=www.google.com&cid=CAESQOD2r2pmIcdTEFgDaqVVNIMr7-R729nu3XDjYJQoGMYIH9HuQXt-SCh8trTWY1-a6ba83S0fB6Ik5gZ8a6f7Uvc&sig=AOD64_2fgugVjlERns3UjbYoYKuFrBS1cA&q&adurl&ved=2ahUKEwjd65vKmZPyAhUTlFwKHdNqDNYQ0Qx6BAgCEAE		y	y	y	y	y	y				y	y	y	y	y	
Webex Meetings	https://www.webex.com/pricing/index.html?utm_medium=Paid&utm_source=Paid_Search&utm_channel=Brand&utm_campaign=Online_Webex&team=WW&utm_term=webexmeeting&gclsrc=aw.ds&gclid=CjwKCAjwr56IBhAvEiwA1fuqGqmJmf3r0ifd3vf3MW7D3DKehY3-j-9RU2mLz_C-I37JpgqIAF1vEBoCLc8QAvD_BwE	14 trial 0730	y	y	y	y	y	y	y	y		y	y	y	y	y	
WizIQ	https://www.wiziq.com/		y	y	y	y	y	y	y	y		y	y	y	y	y	
Zoom	https://zoom.us/		y	y	y	y	y	y	y	y		y	y	y	y	y	
ZujoNow Whitelabel	https://www.zujonow.com/whitelabel/education	request sent	y	y	y	y	y	y				y	y	y	y	y	
1CoreSolution	https://1coresolution.com/	sent request	y	y		request a discovery call with personal info										x	
2be Live	https://www.2belive.net/en/home-en/	sent request	y			request a demo with personal info											
Abre	https://abre.io/	email sent	y	y		request free trial with personal info											
Accops Digital Workspace	https://www.accops.com/products/digital-workspace	sent request	y			request a demo with personal info											
Agora.io	https://www.agora.io/en/	error when getting sign up verification code															
Airstack	https://airstack.com/	30 trial 0727 only avaliable in us	y	y	y	y	y	y	y	y		x	x	x	x	x	
AnyClassroom	https://www.anyclassroom.com/en	registered but no answer, need recheck	y	y	y	y	y	y	y	y		x	x	x	x	x	lms
AppSquadz	https://www.appsquadz.com/	business		x													
AvenoCam Virtual Classroom	x																
Aveon College Management Software	http://aveoninfotech.com/aveon-lms/	no "trial" entrance		x													
Beehively	https://beehively.com/	External Meeting										x	x	x	x	x	
BigMarker	https://www.bigmarker.com/	7 trial 0727	y	y	y	y	y	y	-	-		y	y	y	y	only if uploaded files	
BitMeeting	https://www.bitmeeting.it/		x	y	y	x	y	y									
Blink Session						card?											
BrainCert	https://www.braincert.com/?roomId=1136450&userId=225939&userName=Kun%20Zhao&isTeacher=1	trial										y	y	x	y	y	
calimatic												x	x	x	x	x	
Catchapp	https://www.googleadservices.com/pagead/aclk?sa=L&ai=DChcSEwiG_PvZ9oLyAhUM1O0KHRl-B9cYABADGgJkZw&ae=2&ohost=www.google.com&cid=CAESQOD2rllC4VyhC64FbF3enafYJa9Qi0O3619KqYxyY3ViDGJMLnSnH8F7zIUZYhy3vHRTyoXNhEIfFOH0yyLRCG8&sig=AOD64_26D1hmZIZjvU7dH4QxXJAlMAacQw&q&adurl&ved=2ahUKEwjM1vLZ9oLyAhVNecAKHa2RA5UQ0Qx6BAgCEAE		y	y	y	y	y	y				x	x	x	x	x	external meetings
Cerebrum iEMS	x		y	x													
chalk	https://www.chalk.com/resources/thank-you/?submissionGuid=c0dd4dfb-0793-467e-80c5-bb0b02a69c5c	email sent. do not provide demo															
Cisco Webex Training		7 trial 0727		x													
Classcraft	https://www.classcraft.com/		y	y	y	y	y	y				x	x	x	x	x	game style lms
Classe365	https://www.classe365.com/	15 trial 0727	y	y	y	y	y	y				x	x	x	x	x	
Classilio Via			x														
ClassLink	https://www.classlink.com/higher-ed/overview	request sent. x reject my apply															
ClassOnLive			x														
classroom cloud	https://classroom.cloud/teaching-platform/?gclid=Cj0KCQjw3f6HBhDHARIsAD_i3D_46U9bz7Qa9son7aoVfIJHXOaeKX9UFw84D3BS_dZe8giT8xxlxrAaAqU3EALw_wcB		y	y	y	y	y	y				x	x	y	y but ont instant	x	
CoCalc	https://cocalc.com/doc/teaching.html		y	y	y	y	y	y				x	x	x	x	x	online coding platform
CollegeOne	https://www.collegeone.net/		y	y	y	x need many school info											
ConexED	https://conexed.com/	only for US															
COOL School Portal	https://www.cloudwise.cool/	not for he															
Cornerstone Learning Suite	https://www.googleadservices.com/pagead/aclk?sa=L&ai=DChcSEwib28_YhoPyAhXo6O0KHQH8A_4YABADGgJkZw&ae=2&ohost=www.google.com&cid=CAESQOD2stZKCrp034G6L5Yvv1Pru2TpTatr5Kh1baPi0EOhb1qliUivwVxfxYSW4aYG5Al-r-aUBZ7l_WO56MCW0CA&sig=AOD64_2bbZy8AZ6mBSCeqCWkWDC45Hd4lg&q&adurl&ved=2ahUKEwj80cfYhoPyAhUhQEEAHUsTCOsQ0Qx6BAgEEAE	request sent, answered through phone, not for he	y	x													
Coursables	https://coursables.com/		y	x charged by no. of students								x	x	x	y	y	
Da.scuola			x not in English														
DESKERA	https://www.deskera.com/	15 trial 0727 for business	y	y	y	y	y	y				x	x	x	x	x	
DialTM		fail when creating meetings															
Dimdim	http://www.dimdim.com/	for business															

Docebo	https://www.docebo.com/products/learn-lms/schedule-demo/?utm_term=docebo&utm_campaign=12034826852&utm_source=adwords&utm_medium=ppc&gclid=Cj0KCQiw3fiHBhDHARIsAD_I3D82X3s08S6fyXR7SlmWT-Z6HGKc4Zz8N4wISScKW090-GvsdexQ2uoaAu6wEALw_wcB	14 trial 0727	y	y	y	y	y	y				x	x	x	x	x	
Dreamtek Virtual Classroom	https://dreamtek.tv/virtual-classrooms/		y	x													
Edgenuity Courseware	https://www.edgenuity.com/online-courses/		y	x													
Edmentum Accucess	https://www.edmentum.com/products/assessments/accucess		y	x													
edmodo	https://new.edmodo.com/		y	y	y	y	y	y				x	x	x	y	x	
Edsby	https://www.edsby.com/?locale=en	request sent	y	x													
EdSoft	https://www.edsoft.us/	request sent. but fail while login										y	y			y	
Edumeet	https://edumeet.geant.org/		y	y	y	y	y	y				y	y	y	y	x	
Edvance360 Software	https://edvance360.com/lms/	30 trial 0727	y	y	y	y	y	y				x	x	x	x	x	lms
eFront	https://www.googleadservices.com/pagead/aclk?sa=L&ai=DChcSEwjP4NiFnIPyAhVlnu0KHSGQD1gYABABGgJkZw&ae=2&ohost=www.google.com&cid=CAESQOD2CKEE8OqsPX1IjlulRl66wJFVJC_cQPURNMNlmyBqeBszXylcP9Seye2Fa5FRmWtzRoEqc8d7stLYGq2PLx8&sig=AOD64_16dfbSEaf4E-GDEKrADffRj7Fjq&q&adurl&ved=2ahUKEwiGus3FnIPyAhUThlwKHddMCuYQ0Qx6BAgEEAE	for business														
eLecture	http://www.umediaserver.net/electure/overview.html		y	y	x				y	y		x	x	x	y	x	
Enfin Technologies	https://enfintechnologies.com/									x							
Enrollware	https://www.enrollware.com/			x													
Enrolmy	https://enrolmy.com/nz			x													
eProfessor	https://www.eprofessor.in/											x	x	x	x	x	for buying online lessons
eSUITE	https://esuite.itworks.com/	for business															
eTrainCenter	https://www.etraincenter.com/		y	y	y	y	y	y	-	-		x	x	x	x	x	lms
ezeeLEARN	https://ezeelearning.co.uk/		y	y	y	y	y	y	y	y		x	x	x	x	x	lms
ezTalks	https://eztalks.com/	not a software															
FACTS	x																
Flumind	https://flumind.com/en/homepage-en/		x														
Forum	x																
Frontline Insights Platform	https://www.frontlineeducation.com/insights/what-is-the-insights-platform/	lms															
Genius SIS for Virtual Schools	https://www.geniussis.com/	request sent	y	y	y	y	y	y				x	x	x	x	x	lms
Glisser	https://present.glisser.com/join	i dont know how to use	y	y	y	y	y	y				x	x	x	x	x	
Glowbl	https://www.glowbl.com/en/	request sent	y	y	y	y	y	y				y	y	x	y	x	
GoBrunch	https://gobrunch.com/		y	y	y	y	y	y				y	y	y	y	x	
GoPad	http://www.gopad.online/	14 trial for business															
GoReact	https://get.goreact.com/		y	y	y	y	y	y	y	y		x	x	x	x	x	
GoToMeeting	https://www.goto.com/meeting	sad	y	y	y	y	y	y	y	y		y	y	y	y	x	
GoToWebinar	https://www.gotomeeting.com/en-gb/webinar	same↑															
GroupMap	https://maps.groupmap.com/		y	y	y	y	y	y				x	x	x	x	x	external meeting
Hoppin' World	https://hoppin.world/	VR?															
Idukay	https://idukay.net/#/login		x														
IGLU Classroom	https://www.iglu.education/	server error	y	x													
Illumine	https://illumine.app/nursery-management-software/	request sent	y	x													
interwise	x																
Jamf School	https://www.jamf.com/products/jamf-school/?att=google_ads-brand-search-shared&gclid=CjwKCAjwxo6IBhBKEiwAXSYBs_ioIhur0qZKY1Uyf5YdNkkReWBt_yHWDBB1LWMbdAhoiKon284IFRoCtRwQAvD_BwE	request sent. must have a Apple Push Certificate															
JetVideo	https://jetvideo.en.softonic.com/	multimedia player	y	y	y	y	y	y	y	y		y	y	x	x	x	
Jitsi	https://meet.jit.si/	:(	y	y	y	y	y	y				y	y	y	y	x	
JotForm	https://www.jotform.com/	for form															
K12 online	https://www.k12.com/	online courses															
Kami	https://www.kamiapp.com/		y	y	y	y	y	y				x	x	x	x	y	
KEYSERV Video	https://maestrovision.com/keyserv-video/		y	y	y	x credit card info	y	y	y	y							
Knowmia	https://www.techsmith.com/tutorial-knowmia-welcome.html		y	x													
Koala Online Classroom	https://www.teachwithkoala.com/download	k-12															
Learn EAS Institute	https://www.learneas.co.uk/		y	x													
LearnMagica	https://learnmagica.com/learnmagica/		y	x													
Learnyst	https://www.learnyst.com/signup		y	y	y	y	y	y				x	x	x	x	x	lms
LessonUp	https://www.lessonup.com/site/en		y	y	y	y	y	y				x	x	x	x	x	
Lightspeed Classroom Management	https://www.lightspeedsystems.com/en-uk/solutions/lightspeed-classroom-management/		y	x													
Live Learning	x																
LiveBoard	https://liveboard.online/	14 trial 0730	y	y	y	y	y	y				x	x	x	x	y	
Medwhiz LMS	https://medwhiz.in/		y	y	y	y	y	y	y but only APP	y							
MindScroll LMS			y	x													
My Online School			y	x													
MyClassboard		lms	y	x													
MyClassCampus		it wants me to register a digital institution															
Nearpod		pre-uploaded online coureses															
NetSupport School	https://www.netsupportschool.com/	30 trial 0802. IDK how to use	y	y	y	y	y	y	y	y							
NewGenEducationApp	https://web.newgeneducationapp.com/LoginServlet		y	y	y	y	y	y				x	x	x	x	x	lms
OnSync	x	the same as Samba															
OpenEduCat	https://openeducat.org/		y	x													
Osmo Live	https://www.playosmo.com/en-gb/		y	x													
Pocket Study	https://pocketstudy.app/	ask me to register an instituition															
ProProfs	https://www.proprofs.com/	15 trial 0802	y	y	y	y	y	y				x	x	x	x	x	
Radix VISO TeacherView	https://www.radix-int.com/solution/viso-teacherview/	fail to login															
RemoteHQ	https://www.remotehq.com/		y	y	y	x cridet card info											
Saba Cloud	x																
SAP Litmos	https://www.litmos.com/	14 trial 0802	y	y	y	y	y	y				x	x	x	x	x	
Scaffold Platform	x																
ScholarLMS	https://www.scholarlms.com/		y	y	y	y	y	y				y	y	x	y	x	
Scholica	http://www.scholica.com/ x cannot access																
School Diary	https://schooldiary.me/	request sent															
Schoology	https://www.schoology.com/	request sent															
SCL	https://www.wearescl.co.uk/		y	x													
Scribblar	https://scribblar.com/		y	y	y	y	y	y				y	y	x	y	y	
Servv	https://servv.ai/		y	x	x												
Sibme	https://www.sibme.com/	30 trial 0802	y	y	y	y	y	y	y	y		x	x	x	x	x	lms
SimpleHelp VCR	https://simple-help.com/	not for vc															
SimSci	https://www.aveva.com/en/training/simsci/	online courses															
Skugal ERP	https://erp.skugal.com/		y	y	y	y	y	y				x	x	x	x	x	lms
SkyPE	https://www.skype.com/		y	y	y	y	y	y	y	y		y	y	y	y	x	
SkyPrep	https://skyprep.com/	request sent															
Smart Owls	https://www.smartowls.in/	x doesn't accept uk mobile number															
SmartClass	https://www.smartclass.com.tr/en/home	request sent															
SOFTAULA	https://softaula.net/		x														
Speexx	https://www.speexx.com/	request sent															
Splashtop Education	https://www.splashtop.com/remote-desktop-access?utm_source=google&utm_medium=cpc&utm_campaign=UK_Brand&utm_content=splashtop%20phrase&utm_term=splashtop&utm_device=c&lqid=engine:google|campaignid:10113245200|adid:521072496716|gclid:CjwKCAjwr56IBhAvEiwA1fuqGq11vBIXGZXp851z66FmAm9cpShLSQHGQHBofODxpHjQbZJ73I3A93xoCGlwQAvD_BwE&gclid=CjwKCAjwr56IBhAvEiwA1fuqGq11vBIXGZXp851z66FmAm9cpShLSQHGQHBofODxpHjQbZJ73I3A93xoCGlwQAvD_BwE	not for vc. I think it is for repairing pc remotely														
SPOT	x																
StandUp Meet	https://www.standupmeet.com/		y	y	y	y	y	y				y	y	y	y	y	
STONEWARE	x																
STRIVR	https://www.strivr.com/	vr															

TabSchool	https://tabschool.in/	7 trial 0802	y	y	x demo is not well functional												
TakeLessons	https://takelessons.com/		y	x													
talent lms	https://www.talentlms.com/	using BBB. So basically BBB. dismiss this															
Teacherly	https://teacherly.io/		y	y	y	y	y	y				x	x	x	x	x	lms
Teachmint	https://www.teachmint.com/	must download	y	x													
Teameo	https://teameo.com.au/	must download															
Techtud	https://www.techtud.com/	using other software															
Teleskill Live	https://www.teleskill.it/en/servizi/teleskill-videoconference-live/		x														
Thinkific	https://www.thinkific.com/start-now/?utm_source=google&utm_medium=cpc&utm_campaign=13456125335&utm_term=thinkific&gclid=CjwKCAjwr56IBhAvEiwA1fuqGpwga1XF8eIuiLkaJBDCZf5tfzp6mVcD2qk9ghYgcBimsr6UexfNRxoCebcQAvD_BwE		y	y	y	x credit card info											
Thinkzoom	https://www.ej4.com/elearning/thinkzoom-learning-management-system	request sent	y	y	y	y	y	y				x	x	x	x	x	lms
Tovuti LMS	https://www.tovutilms.com/		y	x								y	y	y	y	y	
TutorCruncher	https://tutorcruncher.com/	request sent	y	y	y	y	y	y				x	x	x	x	x	
Tutor Ocean	https://www.tutorocean.com/	online courses															
TutorRoom	https://tutorroom.net/en/home/		y	y	x demo is not functional												
Unik	https://unik.prepaze.com/		y	y	y	x credit card info											
Verxact	https://verxact.com/		y	x													
Vico	https://vicocom.com/	must download															
Virtual Office	x																
Walkabout Workplace	https://walkaboutworkplace.com/		y	x													
webtrain	https://www.webtrain.com.au/		y	x													
weConnect	https://we-connect.io/		y	y	y	x											
WhoTeach	https://www.whoteach.it/		x														
Wimba	x																
X2O Virtual Classroom	https://www.x2omedia.com/en/solutions/oneroom/classroom/		y	x													
Yo!Coach	https://www.yo-coach.com/		y	x													
Yousician	https://yousician.com/lp/yousician?utm_source=google&utm_campaign=Yousician%20-%20Brand%20Name%20-%20Tier%202&utm_medium=cpc&utm_term=yousician&gclid=CjwKCAjwr56IBhAvEiwA1fuqGiI_fMPsISggfa1NQK32PWni73xZnX_Ceg9NadmuHWYfhL0-je8n1BoCbwsQAvD_BwE	a platform for music	y														
Zoho Meeting	https://www.zoho.com/meeting/		y	y	y	y	y	y	y	y		y	y	y	y	x	
Alma	https://www.getalma.com/	sent request															
APPeL	https://www.softwaresuggest.com/us/appel	sent request															
Byndr	https://www.byndr.com/#	request sent	y	y	y	y	y	y								x	
Class (Class Technologies Inc.)	https://www.class.com/	request sent															
Classpro	https://www.classpro.in/	request sent															
Clever	https://clever.com/	request sent															
clickto	https://clickto.live/	request sent															
CollPoll	https://www.collpoll.com/contact.html#subscribe	request sent															
ConnexMe	https://corp.evenium.com/en/event-app/	request sent															
Coursio	https://coursio.com/	request sent															
Creatrix Campus	https://www.creatrixcampus.com/	request sent															
CYBEROffice	https://www.cyberhorizon.com/	request sent															
D2l Corporation	https://www.d2l.com/en-eu/	request sent															
Deskle																	
DyKnow	https://www.dyknow.com/	request sent															
EduGyaan	https://edugyaan.com/	request sent															
EduKool Classroom	https://www.edukool.com/	request sent															
Edumarshal	https://edumarshal.com/	request sent															
eduplus	https://eduplus.co.th/cms/index.php/en/home-page/	request sent															
EduWave	https://www.itgsolutions.com/en/solutions/education/eduwave-k-12/	request sent															
Edvidi	https://www.edvidi.com/	waiting for code															
ElevenSight	https://11sight.com/	request sent															
Elvis Virtual Classroom	https://elviserp.com/	request sent															
Emtrain	https://emtrain.com/	request sent															
enabley	https://enabley.io/	request sent															
Engage VR	https://app.engagevr.io/																
Engageli	https://www.engageli.com/	request sent															
EngagePlus	https://www.engageplus.io/	request sent															
eTutor	https://www.etutor.co/	request sent															
Google Classroom	https://edu.google.com/intl/en_uk/products/classroom/?gclsrc=aw.ds&gclid=Cj0KCQjw3f6HBhDHARIsAD_i3D8JOCOsVNBsAby0u1DNkziUphqlqrsmWO4S5mQwQl0C6qG3eQz3C_laAuy5EALw_wcB			x													
Groupworld	https://www.groupworld.net/	request sent															
HowNow	https://gethownow.com/?utm_term=hownow&utm_campaign=2020%20-%20HowNow%20-%20Brand%20Keywords%20%28Exact%29&utm_source=adwords&utm_medium=ppc&hsa_acc=7814108248&hsa_cam=11646749903&hsa_grp=114999724282&hsa_ad=480493133988&hsa_src=g&hsa_tgt=kwd-796534041495&hsa_kw=hownow&hsa_mt=e&hsa_net=adwords&hsa_ver=3&gclid=CjwKCAjwxo6IBhBKEiwAXSYBs7Gtq6-oFY9Bq63FJTIzsEjDQiPuY69kQvFtUqOexKRuNQW3BamtyhoCMg0QAvD_BwE	request sent															
Impartus	**https://impartus.com/education/**	request sent															
Impero	https://www.imperosoftware.com/impero-classroom/?ppc_keyword=virtual%20classroom%20software&gclid=CjwKCAjwr56IBhAvEiwA1fuqGhXYALJNMy0UMquOJfcB5P00Izo2Cvx4F3oyvM_tGhe6Q4phsMAQJhoCZHMQAvD_BwE	request sent															
INFOR	https://www.infor.com/en-gb/products/learning-management-system	request sent															
Jigsaw Interactive	https://jigsawinteractive.com/	request sent															
Kaplan Rapidly Deployable Virtual Classroom	https://www.kaplansolutions.com/en-uk/virtual-classroom	request sent															
LanSchool	https://lanschool.com/gb	request sent															
Learnpod	https://learnpod.in/	request sent															
MagicBox	https://www.getmagicbox.com/thank-you-contact-us/?submissionGuid=a3fc3b1f-0fe6-4de9-9de2-a384f051095b	request sent															
MEDIASHAREiQ	https://www.mediashareiq.com/	request sent															
NuClass	https://nuclass.in/	request sent															
ORACLE CORPORATION	https://www.360quadrants.com/software/virtual-classroom-solutions/oracle-corporation	request sent															
Panopto	https://www.panopto.com/	request sent															
Paradiso LMS	https://www.paradisosolutions.com/	request sent						y			y	y	y	y	y		
PeopleLink	https://www.peoplelinkvc.com/	request sent															
Pesofts	https://pesofts.com/	request sent															
PowerSchool Unified Classroom	https://www.powerschool.com/solutions/unified-classroom/	request sent															
Presence	https://www.presence.io/	request sent															
Quickstart's CLIPP	https://www.quickstart.com/solutions/clipp-platform/learning-management-system-software.html	request sent															
Remark Test Grading	https://remarksoftware.com/products/test-grading/	request sent															
Remo	https://remo.co/	request sent															
RingCentral Video	https://www.ringcentral.co.uk/video.html?BMID=GGUKSB&RCMT=e&RCKW=ringcentral%20video&AD=521207175509&CID=sem&gclid=CjwKCAjwr56IBhAvEiwA1fuqGqMDo6ZbPeM5B5YPt2riWZnxNFYw-7D-N3ZkuJ_aosFAzBfM-dl8wxoC8woQAvD_BwE	request sent															
Sanako Connect	https://sanako.com/connect/	request sent															
The Brainier LMS	https://www.brainier.com/	request sent															
Timeless Learntech Virtual Classroom	https://www.timelesslearntech.com/virtual-classroom.php	request sent															
Top Hat	https://tophat.com/	request sent	y														
Traliant	https://www.traliant.com/	request sent															
YuJa	https://www.yuja.com/	request sent															
ZeClassroom	https://zeclassroom.online/	request sent															

A.4 Evaluation results

TOOL NAMES				Teams	Adobe Connect	Blackboard Collaborate	ClassIn	eduTinker	Webex Meetings	Zoom	BigBlueButton	BlueJeans	Electa Live Virtual Classroom Software	MeritHub	Mykademy	Samba Live	edudip	Kaltura Video Cloud	Newrow Smart	WizIQ	iTeach.world	Lessonspace	TurningPoint → Dojo360	Kneura	Unicko Virtual Classroom	SimTek	ZujoNow Whitelabel	VEDAMO Virtual Classsroom	LearnCube	Vectera	AyoTree
Scalability	1-50 particiipants in 1 meeting			1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
	50-200 particiipants in 1 meeting			1	1	1	0	0	0	0	1	1	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0
	over 200 particiipants in 1 meeting			0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
				2	2	3	1	1	1	1	2	2	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Audio conferencing	existance			1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
	turn microphone on / off by user			1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
	turn microphone on / off by others			1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	1	1	0	0	0	1	0	0
	managing background noise			1	0	0	1	1	1	1	0	1	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0
	other audio settings			1	1	0	0	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
				5	4	3	4	5	5	5	3	3	3	3	3	3	3	3	3	3	3	4	2	3	3	2	2	2	3	2	2
Video conferencing	existance			1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
	turn camera on / off by user			1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
	turn camera on / off by others			0	1	1	1	1	1	1	0	1	0	1	1	1	1	1	1	1	1	1	0	1	1	0	0	0	1	0	0
	profile picture			1	0	1	0	1	1	1	0	1	0	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	changing background			1	1	0	0	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0
	other video settings			1	1	0	1	1	1	1	1	0	0	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
				5	5	4	4	6	6	6	4	4	2	5	5	5	4	3	3	3	3	3	2	3	3	2	2	2	3	3	2
Synchronous reactions in meeting	clap			1	1	0	0	1	1	1	1	1	1	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0
	raise hand			1	1	1	1	1	1	1	1	1	1	1	0	0	0	0	0	0	1	1	0	0	1	0	1	0	1	0	0
	thumb up			1	1	0	0	1	1	1	1	1	0	1	0	0	1	0	0	0	0	1	0	0	0	0	0	0	0	0	0
	other emojis			1	1	0	1	1	1	1	1	0	1	1	0	0	1	0	0	0	1	1	0	0	0	0	0	0	0	0	0
				4	4	1	2	4	4	4	4	3	3	3	0	0	2	0	0	0	2	4	0	0	1	0	1	0	1	0	0
Alerts for joining meeting	users joined			1	1	1	1	1	1	1	1	1	1	1	0	0	0	0	0	1	0	1	1	0	0	0	1	1	1	0	0
	users left			1	0	1	1	1	1	1	0	1	1	1	0	0	0	0	0	0	0	0	1	0	0	0	1	1	1	0	0
				2	1	2	2	2	2	2	1	2	2	2	0	0	0	0	0	1	0	1	2	0	0	0	2	2	2	0	0
Chat	chat during meeting	in main room		1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	1	1	1	1	1	1	1	1	1
		in breakout room		1	1	1	1	0	1	0	1	1	1	0	1	1	0	1	1	0	1	0	1	0	0	0	0	0	0	0	0
		save chat (manually)		0	0	1	1	1	0	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	chat outside meeting			1	0	0	1	1	1	1	0	0	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
	public chat			1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	1	1
	private chat			0	1	1	0	1	1	1	1	1	1	1	1	0	1	0	0	1	0	0	1	0	0	1	0	1	0	0	0
	emojis in chat	clapping		1	0	1	0	1	0	1	0	0	0	0	1	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0
		thumb up		1	0	1	0	1	0	1	0	0	0	0	1	1	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0
		other emojis		1	0	1	0	1	0	1	0	1	0	0	1	1	0	0	0	0	1	1	0	0	1	0	0	0	0	1	0
	alert for new chat messages			1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	0	1	0	1	1	0	0	0	1	1	0	0	0
				8	5	9	6	9	6	9	6	7	7	4	8	7	4	3	3	4	5	6	5	2	3	3	3	4	1	3	3
Application / Screen sharing	screen sharing			1	1	1	1	1	1	1	1	1	1	1	1	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
	browser tab sharing			0	1	1	0	1	0	1	1	1	0	1	1	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
	application sharing			1	1	1	1	1	1	1	1	1	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
	window sharing			1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
	sharing separate camera by individual			1	1	1	1	1	1	1	1	1	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
				4	5	5	4	5	4	5	5	5	2	5	5	3	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5
Meeting scheduling (calendar)	existance			1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	0	0	1	0	1	0	0	1	1	1	0	0	1
	invite other users to meeting			1	1	0	1	1	1	1	1	1	1	1	1	0	1	0	0	1	1	0	1	0	1	1	1	1	0	1	1
	invite teams to meeting			1	0	0	1	0	1	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	invite subteams / channels to meeting			1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	write messages within an invitation			1	1	0	0	0	1	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	display invitee availability			1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
	share links of meeting			1	1	1	1	1	1	1	1	1	1	1	1	0	1	0	0	1	1	0	1	0	0	1	1	1	0	0	0
	drag and drop in calendar			0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	recurring meeting	fixed / regular intervals		1	0	1	0	1	0	1	0	1	1	1	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0
		customize intervals		1	0	1	0	0	0	0	0	1	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
				9	4	4	4	4	5	4	3	5	4	4	3	3	5	0	0	2	3	0	3	1	1	3	3	3	0	1	3
Teams	existence			1	0	0	1	0	1	0	0	0	1	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
	team channals			1	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	posts			1	0	0	1	0	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
				3	0	0	2	0	3	0	0	0	2	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
Breakout Rooms	existence			1	1	1	1	0	1	0	1	1	1	0	1	1	0	1	1	0	1	0	1	0	1	0	0	0	0	0	0
	manual allocation			1	1	1	1	0	1	0	1	1	1	0	1	1	0	1	1	0	1	0	1	0	1	0	0	0	0	0	0
	random allocation			1	1	1	1	0	1	0	1	1	0	0	1	1	0	1	1	0	0	0	1	0	1	0	0	0	0	0	0
	pre-defined allocation			0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	moderators moving between groups			1	1	1	1	0	1	0	1	1	1	0	1	1	0	1	1	0	1	0	1	0	1	0	0	0	0	0	0
	participants moving between groups			0	1	0	0	0	1	0	1	1	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
				4	5	4	4	0	6	0	5	5	3	0	5	5	0	4	4	0	3	0	4	0	4	0	0	0	0	0	0
File sharing	existence (i.e. uploading functionality)	in teams		1	0	1	1	0	1	0	0	0	0	1	0	0	0	0	0	1	0	0	0	1	0	1	0	0	0	0	1
		in chat		1	0	0	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0	1	1	0	0	1	0	0	0	0	0
		in meeting		1	1	0	0	1	1	1	1	0	1	1	1	1	1	1	1	1	1	1	0	1	1	1	0	1	1	1	0
	downloading files			1	0	1	1	1	1	1	1	0	0	1	1	1	0	1	1	0	1	1	1	1	0	1	0	1	0	0	1
				4	1	2	2	3	3	3	2	0	1	3	2	2	1	2	2	2	2	3	2	3	1	4	0	2	1	1	2
Capture / record / playback	record sessions	video recording of shared screen in main room		1	1	1	1	1	1	1	1	1	1	0	1	1	1	1	1	1	0	0	1	1	1	0	1	0	0	1	0
		video recording of shared screen in breakout room		1	1	1	1	0	1	0	1	1	0	0	1	1	0	0	0	0	0	0	1	0	1	0	0	0	0	0	0
		video recording in main room includes chat		0	1	0	0	1	0	1	1	0	0	0	0	0	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0
		video recording in breakout room includes chat		0	1	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	edit recorded sessions			0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	view recorded sessions	in the menu		0	0	1	0	0	0	0	1	1	0	0	0	1	1	0	0	0	0	0	0	0	0	0	1	0	0	1	0
		in the chat		1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		via a link in email		0	1	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	recording available for...	limited time		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		forever		1	1	1	1	1	1	1	1	1	1	0	0	1	1	0	0	0	0	0	0	1	0	0	1	0	0	1	0
				4	7	4	3	3	3	3	6	5	2	0	2	4	4	2	2	1	0	0	2	2	2	0	3	0	0	3	0
Subtitles	upload subtitle to recording			0	0	1	0	0	0	0	0	0	0	0	0	0	0	1	1	0	0	0	1	0	1	0	0	0	0	0	0
	auto-generated subtitle (after meeting) added to recording			0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	live captioning in meeting	not saved to a recording (if recording)		1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		saved to a recording (if recording)		0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
				1	0	3	0	0	0	0	0	0	0	0	0	0	0	1	1	0	0	0	1	0	1	0	0	0	0	0	0
Integrated with internal / external tools and services	embedded browser			0	0	0	1	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Maths editor			0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	1	0	0	0	1	0	1	1	1	0
	text editors			0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	1	1	0	1	0	1	0
	others			1	0	0	1	1	0	1	0	0	0	1	1	1	1	1	1	1	1	1	0	0	0	1	0	0	1	0	0
				1	0	0	3	1	0	1	0	0	1	2	1	1	1	1	1	1	1	3	0	0	1	3	0	2	2	2	0
Platform Accessibility	mobile application			1	1	1	1	1	1	1	0	1	1	0	0	0	1	0	0	0	0	0	0	1	0	0	0	0	0	0	0
	desktop application			1	1	0	1	1	1	1	0	1	1	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0
	browser application			1	1	1	0	0	0	0	1	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
				3	3	2	2	2	2	2	1	2	3	1	1	1	2	1	1	1	1	1	1	3	1	1	1	1	1	1	1
Multimedia	image	interactive software on a single powerful interactive platform. 10: video, audio.		1	1	1	1	1	1	1	1	1	1	1	0	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0
	text			1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0
	slides			1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0
	video			1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
	audio			1	1	1	1	1	1	1	0	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0
	others			0	1	0	0	1	0	1	0	0	0	1	1	1	1	0	0	0	0	1	0	0	0	0	0	0	0	0	0
				5	6	5	5	6	5	6	4	4	5	6	5	5	6	5	5	5	5	6	5	5	5	5	5	5	5	5	1
Polling & Quizzes	polling	existance	in main room	0	1	1	1	0	0	0	1	0	1	1	1	1	1	1	1	1	1	0	0	1	1	0	1	0	0	0	0
			in breakout room	0	1	1	1	0	0	0	1	0	1	0	1	1	0	1	1	1	1	0	0	0	1	0	0	0	0	0	0
			in team posts	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
			in outside chat	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
			in meeting chat	0	1	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
			in other places	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		pre-defined choices		1	0	0	0	0	0	0	1	0	1	0	0	0	0	1	1	0	0	0	0	1	1	0	0	0	0	0	0
		self-defined choices		1	1	1	1	0	0	0	1	0	0	1	1	1	1	0	0	1	1	0	0	0	0	0	1	0	0	0	0
		images as choices		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		single answer		1	1	1	1	0	0	0	1	0	1	1	1	1	1	1	1	1	1	0	0	1	1	0	1	0	0	0	0
		multiple answers		1	1	1	1	0	0	0	0	0	0	0	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	quizzes	existance	in main room	0	0	0	0	0	0	0	0	0	0	1	0	0	0	1	1	0	0	0	0	1	0	1	0	0	0	0	0
			in breakout room	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0
			in team posts	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0
			in outside chat	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
			in meeting chat	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
			in other	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0
		pre-defined choices		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0
		self-defined choices		0	0	0	0	0	0	0	0	0	0	1	0	0	0	1	1	1	0	0	0	1	0	1	0	0	0	0	0
		images as choices		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		single answer		0	0	0	0	0	0	0	0	0	0	1	0	0	0	1	1	1	0	0	0	1	0	1	0	0	0	0	0
		multiple answers		0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	0	0	0	0	0	0	0	0	0	0	0
		open-ended questions		0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	0	0	0	1	0	0	0	0	0	0	0
	results in statistics	in tables		0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	1	0	0	0	0	0
		in pie chart		0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0
		in bar chart		1	1	1	1	0	0	0	1	0	0	1	1	1	0	1	1	0	1	0	0	1	0	0	1	0	0	0	0

	Shapes	other types of diagrams		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0
				6	7	6	8	1	0	0	7	0	4	7	6	6	5	11	11	11	5	0	0	10	5	4	4	0	0	0	0	0
Whiteboard	whiteboard existence	In main meeting room		1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
		In breakout room		1	1	1	1	0	1	0	1	1	1	0	1	1	0	1	1	0	1	0	1	0	1	0	0	0	0	0	0	0
	multiple participants can use it simultaneously			1	1	1	1	1	0	1	1	0	1	1	1	1	0	1	1	1	0	1	1	1	1	0	0	1	1	0	0	
	whiteboard snapshot			1	1	1	1	1	0	1	0	0	0	1	0	0	1	0	0	0	1	1	0	0	0	0	1	0	1	0	0	
	shapes and lines			1	1	1	1	1	1	1	1	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
	typing texts			1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
	importing graphics			0	0	0	1	0	0	0	0	0	1	1	0	0	0	1	1	1	1	0	1	0	1	0	1	0	0	1	0	0
	colors			1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
	templates			0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0	0	1	0	0	0	0	0	0	0	0	0	0
				7	7	7	8	6	5	6	6	4	7	7	6	6	5	8	8	6	7	8	6	6	6	5	5	5	7	4	4	
Participant list & right management in meeting	list of participants			1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0
	roles	moderator		0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	0	1	1	1	1	0
		presenter		1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0
		participant		1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	0	1	1	1	1	0
		other		0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	invite / add people to meeting			1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	1	1	1	1	1	1	1	1
	settings on roles before the meeting			1	1	1	0	1	0	1	1	1	0	1	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	change roles during meeting			1	1	1	1	1	1	1	1	1	1	0	1	1	1	1	1	0	1	0	1	0	1	0	0	1	0	0	0	
	notification of microphone status (speaking, muted) in participant list			1	1	1	1	1	1	1	1	1	1	0	0	0	1	1	1	1	1	1	1	0	1	1	1	1	1	1	1	1
	notification of reactions (clapping, thumb up) in participant list			1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	0	0	1	1	0	0	0	0	1	0	0	0	0	
				8	9	9	9	9	8	9	9	9	8	7	7	7	9	6	6	5	7	6	7	3	6	3	4	6	5	5	2	
Access live meeting	from link			1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	1	1	1	1	1	1	1	1
	from website			0	1	1	0	1	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	0	0	0	0	1	0	
	from app			1	1	1	1	1	1	1	0	1	1	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0
	from desktop system			1	1	0	1	1	1	1	0	1	1	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0
	must log in			1	1	1	1	0	1	0	0	0	1	0	0	0	1	1	1	1	1	0	1	1	0	0	0	0	0	0	0	1
	guest access			1	1	0	0	1	1	1	1	1	1	1	1	1	1	1	1	1	0	1	0	0	1	1	1	1	1	1	1	0
	needs permission by moderator			1	1	1	1	1	1	1	1	1	1	0	0	0	1	1	1	1	0	0	1	0	0	0	0	0	1	1	0	
	waiting room			0	0	0	0	1	0	1	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
				6	7	5	5	7	6	7	4	7	7	4	3	3	5	5	5	5	3	3	4	4	2	2	2	2	3	4	2	
FINAL SCORE				91	82	78	78	74	74	73	72	68	67	64	64	63	62	61	61	57	56	54	52	51	51	43	43	42	48	48	29	