Team-based learning through an interactive online medium

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ABSTRACT

Collaborative or team-based learning has been gaining in strength over the years. Also, online education has been through a significant growth during the corona pandemic as people are forced to study or teach from home. Given these circumstances research needs to be done in order to determine the most efficient way of combining team-based learning with online education. This paper will first look at existing research on both team-based/collaborative learning and online education in order to establish a working knowledge standard on which the next two steps will be based. The second part of this paper will be describing and analyzing a survey distributed amongst UT (University of Twente) staff with the goal of establishing the online tools currently utilized at the UT. Lastly, the knowledge gained in the first two steps will be put into practice by designing an interactive, online educational environment for a business process modeling class.

Keywords

Online education, remote schooling collaborative/team-based learning, survey, tools, business process modeling, gather.town

1. INTRODUCTION

Online education has been growing in popularity for years as more and more institutions see the benefits of having class online. Secondly, the COVID-19 pandemic has caused a sharp rise in popularity of remote lessons [2]. Similarly, over the last couple of years, collaborative or team-based learning has grown in use as research has shown the benefits (better results, more active student participation) of studying in a team format.

Given that both forms of education have become more prevalent, research should be done regarding combining the two. This paper will aid in the first step of that, designing a functioning configuration for a business process management class.

Team-based or collaborative learning is a form of education which is student centered and performed in teams. Students are pushed to work together on assignments and tests but team-based learning also emphasizes individual preparations out of class. Team-based learning has a very structured approach and goes as follows. Before class students study given material and then at the start of a class session, they finish a test individually, followed by the same test as a team. When that is done the teacher can provide feedback. When the collective part of the class is done, the teams go to work on an assignment and the teacher is there to support them during this. For more information on team-based learning reference [5] is recommended.

As said, the main result of this paper is the configuration of an online team-based learning environment. The platform which was decided upon to be employed is gather.town. Gather.town was chosen because it makes online education more interactive and allows for topic specific functionality, this will be discussed later throughout this paper. The platform also allows for groups to have their own private area to talk, while also being able to move into a larger common area to listen to the teacher. It also has multiple customization tools which can be adapted to the topic being taught that day. Lastly, research [3] has shown that an environment like this provide the sense to students that they are more immersed in the remote educational environment, thus increasing their motivation, and hopefully, improving their learning outcomes.

The remaining of this paper is organized as follows: section 2 presents the problem statement and research questions; section 3 describes the methods of research for this paper; section 4 presents the literature review; section 5 provides the structure and results of the survey; section 6 goes into detail on the design of the online environment and lastly, section 7 will go over the conclusions of the research and potential further research options.

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2. PROBLEM STATEMENT

Although research has been done on the effectiveness of various forms of online education, as well as on the benefits of collaborative learning, the combination of the two is not very extensively studied yet [2], [3]. This paper will analyze the literature which is already available, followed by a survey amongst UT staff to determine currently in use online tools, followed lastly by designing an interactive, online collaborative learning environment.

2.1 Research Question

The problem statement will lead to the following research question:

How to configure an interactive, online collaborative tool for a business process modeling class?

These sub-questions will aid in answering the above main research question:

1. What tools do teaching staff currently employ in their remote lessons at the University of Twente and how satisfied are they with those tools?

2. What is the current scientific consensus on best practices for online and team-based learning?

3. METHODS OF RESEARCH

Each of the three steps will require a different method in order to come to a satisfactory end result. Because of this the methods will be split up into three parts as well.

1. The first step, as explained earlier, is the literature research. The end result of this first part of the research is to have a functioning base of knowledge on team-based learning in order to produce the most optimal questions on the survey which will be distributed amongst UT teaching staff. Additionally, best practices for a team-based learning environment will be noted.
2. The second part, the survey, will be a survey distributed amongst UT teaching staff, and more specifically, teachers in

the EEMCS and BMS faculties. The survey will be focused on what online educational tools these teachers utilize and how satisfied they are with those tools. This survey will be a cross-sectional study, meaning that: “To analyze data from a population at a single point in time”[11]. The goal of this part will be to determine what tools and features the final online team-based learning educational environment should have.

3. The final part of the research is designing the configuration of the online environment. This will be based on both the best practices found in the literature research, as well as the tools the teachers supplied in the survey. This design will be done in the gather.town system.

4. LITERATURE REVIEW

4.1 Goal and need for literature review

The main goal for the literature review is twofold. First, a working knowledge base should be present on online learning, team-based learning and online team-based learning. Secondly best practices should be determined which can be applied to the final product, the online environment in gather.town.

Since the second part is most relevant to the research section 4.3 (results of the literature review) will be mostly focused on the best practices aspect. That said, interesting points drawn from the first part will be included as these can be important to answer the research questions stated earlier too.

The first part will be considered as finished when a working knowledge base has been acquired. A working knowledge base will be defined as “to be able to answer the most frequent questions on a given topic”. The topics in this scenario are, as listed above, online learning; team-based learning and online team-based learning. This knowledge base can then later be applied to make decisions in the design process.

The second part (best practices aspect) will be finished when all best aspects determined in found literature are known, and can be applied to the online environment described in Section 6 of this paper. The decision-making process for the online environment will be supported by both the literature review and the survey described in section 5 by providing insights about the best practices in TBL and by understanding the tools (including the level of satisfaction) used by the UT staff.

4.2 Search Techniques

Proposal phase

During the development of the proposal for this paper, a number of papers were analyzed. This phase is described below:

In order to make a well-supported research proposal, some related work had to be studied. This literature was gathered from two different sources. Some initial papers were found and examined for a first glance into the area of study. These papers are [1], [6], [7].

Especially [1] as this article provides an analysis of 40 papers on team-based learning literature. These 40 articles were selected on the basis of what level they were focused on team-based learning, and afterwards, for each paper it would detail what the educational context, evaluation strategy and the summary of the results are. This allows the reader to quickly gain a lot of scientific knowledge on 40 different research projects on team-based learning. Of these 40 papers, the most important observation was that students who were taught using TBL preformed consistently better than their (historical) control groups.

The second source of information was a surface level literature search online. For this search Scopus was used using the following searches were used: TITLE-ABS-KEY ("team-based learning" OR "collaborative learning") AND TITLE-ABS-KEY (online OR remote). This came up with many results (4286) so I limited it to only the last 5 years. This narrowed it down to 889 documents. Sorting by relevance led to a number of papers which were interesting to this proposal. Three of which stand out as being most relevant. In the first step of the final research paper a more in-depth analysis will be done, on more papers.

These are [8]–[10]. [6] and [7] highlight the effectiveness of team-based learning with special attention to team-based learning online. By examining these papers, we expect to understand which elements are important when configuring an online environment for team-based learning.

[8] is interesting in the sense that it describes a team developing an application for mobile team-based learning and it shows that it can be utilized in many different contexts.

Research phase:

A variety of search techniques were used throughout the literature review process. The search results for the first scan of related work can be found above. This search on Scopus was also the first search used for the more thorough literature review. As mentioned earlier, this search resulted in 889 results. A quick scan of these resulted in three relevant papers. A more in-depth analysis of the results came up with more relevant papers, which contents will be discussed in the 4.3 (results).

Next, a variety of Google Scholar searches were performed. The required papers for the purpose of this research were found by using the following search terms: “(online OR remote) education”, “(online OR remote) education best practices”, “team-based learning”, “(online OR remote) AND team-based learning”, “(survey OR questionnaire) AND team-based learning”, “(online OR remote) AND team-based learning AND best practices”.

These searches often lead to summarizing research articles. For this research, drilled down sources from those summarizing papers were also used.

4.3 Results of the literature review

In order to keep this paper concise, the most important conclusions to this research are discussed in this segment. As mentioned above, these conclusions will mostly be limited to best practices for online education, team-based learning and online team-based learning.

Online education:

- It is of crucial importance to address the unique situation of online teaching by using theoretical frameworks and a learning/teaching environment that is specifically designed for online education. [12]

- There should be support available from the organization to both the faculty performing the online research, as well as to the students receiving the education. [13]

- Students should have contact information for technical support and tutorials to the platform [14]. A tutorial is included when first logging into the gather.town application.

Team-based learning:

- The course needs to be designed well. The course and its content need to be adapted to the fact that TBL is used. [15]

- The students should be extensively explained on what TBL is and why it is being used [15]. An important part in this is linking learning outcomes to course activities and assignments [16] For this reason it would also be wise to orient the students on why gather.town is used instead of a “standard” online platform like Zoom or MS Teams.

- There should be a reasoning behind team formation. This is relevant as some teachers may feel inclined to let students simply walk to rooms in gather.town to form the groups. But according to research, TBL groups should be formed based on capabilities and diversity. [15]

- It is important that students know each other before engaging in TBL, if not, you run the risk of the TBL being far less effective. [17]

Online team-based learning:

The most important parts are already covered by the two paragraphs above since this paragraph is simply a combination of the two above. So, everything that applies for the topics above also apply for online TBL.

- "*Robust collaborative experiences for students in hybrid and asynchronous TBL applications are of particular importance in maintaining student engagement*" [16].

5. SURVEY COMPONENT

5.1 Survey goals

The goal of the survey is quite simple. It is to answer research sub-question 1. This means that the main purpose of the survey is to determine what tools current teaching staff at the UT utilize when they teach in a remote setting, and how satisfied they are with the tools they use in online education.

From this, it is of upmost importance to determine what aspects of each of these tools make teacher like them and thus, what aspects should be in the final design of the online environment in gather.town. Not all aspects will be possible to implement in gather.town but creating a list of all the best aspects of existing online tools, it can be ensured that the largest number possible will be part of the final design.

To ensure all this information is collected the survey had to be made which will be discussed next.

5.2 Survey structure

The conducted survey has a total of 11 questions, of which 4 are open questions, 5 are questions using a scale to measure a data point (more details below) and 2 multiple choice questions. Below you will find all questions, and an explanation on why they were included in the survey.

1, Open question: What courses do you teach here at the UT?

First off, it is important to note what courses a respondent teaches at the UT. While this research focusses mainly on business process management (BPMN) courses it was deemed useful to include other courses as well as this greatly improves the potential response quantity. While BPMN responses are taken into consideration more closely, other courses can provide very valuable insights as they are of course, also teachers.

2, Scaled question: Did you have any experience teaching online before the pandemic?

Teachers who taught part of their courses online before the pandemic might have more experience with the tools available as they will have had more time to work with them. Therefore, it was deemed interesting to know whether they did or did not have that experience. The scale on this question is a six point scale, from no experience to a lot of experience.

3, Multiple choice question: What tools do you use in online teaching in order to communicate with your students (Team, Zoom, Big Blue Button)?

Given all different platforms offer a slightly different "package" of functionalities it was found useful to determine what tool is most popular, as this allows the option for the online environment to mimic some of these functionalities. All three tools are supported by the UT, although other tools can be submitted in the "other" option. Teachers can list multiple answers as well.

4, Scaled question: How desirable would you say each of the following available online education functionalities are when teaching?

The goal of this question is to truly determine what online educational functionalities the teachers at the UT desire. The question lists 11 existing online teaching functionalities and asks the respondent to say how desirable each of them are (never used it – not desirable – slightly desirable – desirable – very desirable). Based upon the responses to this question, the most desirable functionalities will be included in the final design of the online educational environment. Functionalities not implementable on gather.town are discussed in section 6.

5, Open question: Are there one or more functionalities you would say are a must have for online education?

This question allows respondents to put emphasis on one or more of the functionalities listed. It also allows them to perhaps name a feature that is not on the list provided in question 4.

6, Are there any elements you miss or would like to have in an online learning environment?

Not all functionalities are currently available in online teaching tools. This question allows the respondent to bring up a functionality that they would like to have at their disposal, but currently is not available in the tools they use.

7, Multiple choice question: How often do you do group exercises with students?

This question shows how much experience the respondent has with having groups work on interactive activities in their class. If they have a lot of experience, it makes their answers on group work more relevant.

8, Scaled question: How important do you think it is for students to collaborate in (online) learning?

This is an introductory question into the field of team-based or collaborative learning. This question serves to indicate how a respondent feels towards having students work in a team-based or collaborative environment. The scale on this question is a six-point scale from 1 – not important at all, to 6 – Crucially important.

9, Scaled question: Do you feel that this type of collaborative learning is supported by the tools used at the UT?

The UT has a list of supported tools (https://www.utwente.nl/en/telt/new-website-under-construction/tools/) and gather.town currently is not part of this list. If many responses indicate that they don't feel well supported at the UT then possibly the gather.town environment can be of use to improve that situation. The scale on this question is a six-point scale from 1 – not supported at all, to 6 – supported very well.

10, Do you have experience with or have you heard of team-based learning before (as popularized by Larry Michaelsen)?

This question is rather straightforward. It is important for the next question on the survey to make sure that the respondent knows what team-based learning is. Note: This question is also preceded by an explanation of what team-based learning is.

11, If so, are there things you would like to see included in an online team-based learning environment?

People who have worked with team-based learning will have incredibly valuable insights into what is important in creating an effective environment for team-based learning. This question is in place to ensure that people who hold these insights share them in the survey.

5.3 Survey responses

Due to some COVID related difficulties (for more information you can contact me at v.l.dibbets@student.utwente.nl) the survey was distributed slightly late. It was distributed to all EEMCS research groups, as well as one BMS research group (IEBIS specifically). That said, a satisfactory number of responses were submitted. At the time analysis of the responses 39 people have filled in the survey.

These responses did come from various different research groups and domains and held some valuable insights which will be discussed in the next segment.

5.4 Results of the survey

In this segment all responses will be analyzed and conclusions will be drawn from that analysis. First, each question will be discussed and any interesting insights will be determined, then at the end, overarching conclusions will be made.

1. What courses do you teach here at the UT?

Since this is a rather practical question, it is not necessary to go very in-depth on what the responses were. The only point worth noting is that the courses mentioned ranged from a "guest lecturer on methods" to multiple different courses within both bachelor and master programs. As said above, due to the distribution method all responses come from either EEMCS or BMS.

2. *Did you have any experience teaching online before the pandemic?*

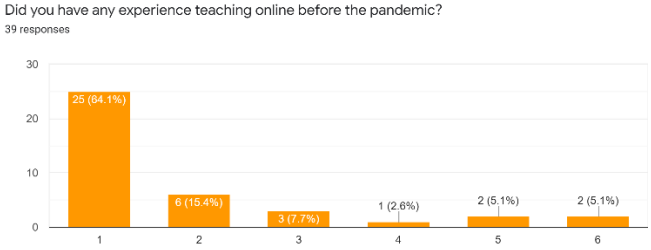

Figure 1

This question led to some more interesting observations. The main one being that a large majority of responses reported that they had no experience teaching online before the pandemic, meaning they had to adjust to online teaching when the pandemic started. Since they have only "recently" started with online education they might be more open to accepting a new platform, however "willingness to adopt a new platform is not part of this survey" so that could be part of potential follow-up research.

Only ~13% of responses scored themselves four, five or six on the 6-point scale, meaning that only a relatively small percentage of responses feel they had experience with online teaching pre-pandemic.

3.What tools do you use in online teaching in order to communicate with your students?

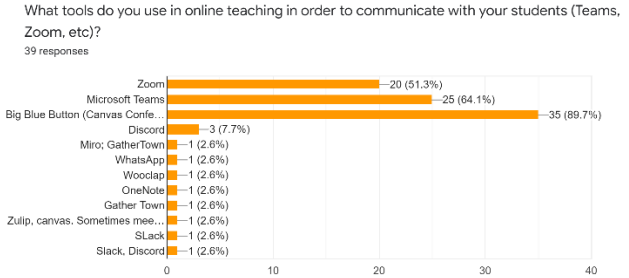

Figure 2

For this question, as expected, the large majority answered within one (or more) of the three prefilled options (Zoom, Big Blue Button and MS Teams). Of these, Big Blue Button (BBB) was the largest with almost 90% of respondents naming BBB (do keep in mind that multiple answers were possible). Second was MS Teams with 64% of respondents and lastly, Zoom with 51% of respondents.

Interesting to note is that 4 respondents (~10.3%) also wrote in Discord as a communication tool. Discord was initially started as a platform for communication during gaming but lately they started to move away from that connection [18]. The fact that more than 10% listed Discord as a communication platform could be proof of this move.

Also gather.town is mentioned twice.

4. How desirable would you say each of the following available online educational functionalities are when teaching?

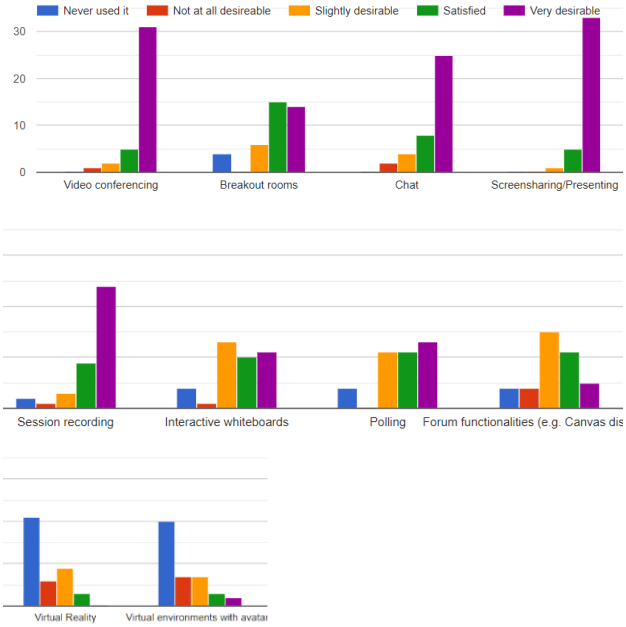

Figure 3

This question is of course very relevant for online environment design as it will help dictate which functionalities should have priority in the environment.

As expected, video conferencing, chat and screensharing are all highly desirable amongst respondents. Given that these are all core features of gather.town, they don't have to be specifically implemented.

While breakout rooms are not as skewed towards "very desirable" as the functionalities mentioned above, they are generally within the "never used it", "desirable" or "very desirable" categories (~85% of responses fell within one of those categories). Based on that information alone it would be good to have breakout rooms implemented. Moreover, since breakout rooms are essential in a team-based learning environment they will be included in the final design, especially since gather.town lends itself well to using breakout rooms as students have to digitally walk over to a room in gather.town.

The functionalities which achieved more than 85% in the three most desirable categories (slightly desirable, desirable and very desirable) are: Session recording, interactive whiteboards, polling. Forum functionalities and Q&A assisting tools also generally were looked upon in a positive light (79% and 67% respectively). The implementation of all features mentioned will be discussed in Section 6.

The survey also indicated that a majority of respondents never used a virtual environment with avatars to interact with students. So, an environment as proposed in the paper would be new to most of the respondents to the survey. It did also, however, receive the largest number of votes for "not at all desirable" meaning that getting teaching staff to adopt the environment could require significant effort and further research.

5. Are there one or more functionalities which you would say are a must have for online education?

This question ties in a lot to the previous question. The majority of the responses simply replied to take a look at the "very desirable" functionalities in question 4, or listed the functionalities they listed as "very desirable".

Others started naming elements they miss which is the next question. Because of this fact all answers to this question which named tools which were not present in question 4 were taken into consideration for question 6.

6. Are there any elements you miss or would like to have in an online learning environment?

For this question most responses fell into one of three categories. First category is suggestions which are similar to functionalities listed in question 4. The second category is suggestions that are outside the scope of gather.town/online education. And lastly, the category with suggestions which could theoretically be implemented in gather.town.

Of course, suggestions in the third category are most relevant for the design of the gather.town environment. The only suggestion which could be implemented is "interactive self study". As with the other functionalities, this will be discussed in Section 6.

Suggestions which are out the scope of gather.town/online education include "eye contact for interaction" and "Online identification of students for oral exams". While many of these suggestions are interesting and worth exploring, they fall outside the scope of this research.

7. How often do you do group exercises with student?

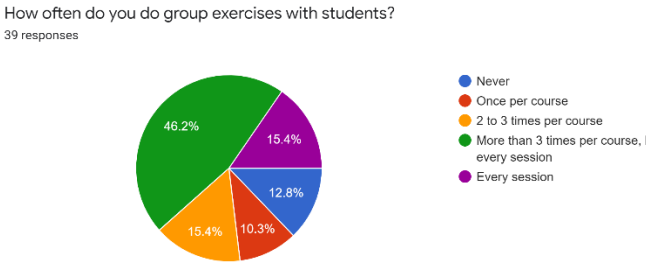

Figure 4

As can be seen in this chart above, most respondents have at least some experience with doing group work with students. This means their answers to the following questions are very credible.

8. How important do you think it is for students to collaborate in (online) learning?

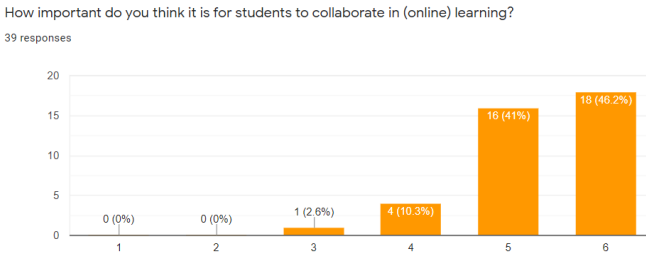

Figure 5

This bar chart shows that generally speaking the responding teachers agree that having students collaborate during their education is very important, as 1 represents "not important at all" and 6 represents "very important".

9. Do you feel that this type of collaborative learning is supported by the tools used at the UT?

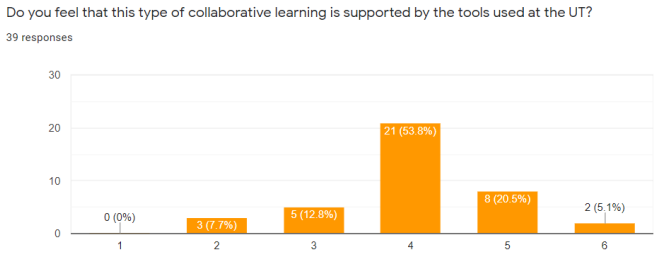

Figure 6

As can been seen in the chart above, teachers feel that the UT can be more supportive in the tools they support when it comes to collaborative learning. Since gather.town is currently not supported by the UT, this could potentially change if the UT decides to officially support gather.town.

10. Do you have experience with or have you heard of team-based learning (as first popularized by Larry Michaelsen)?

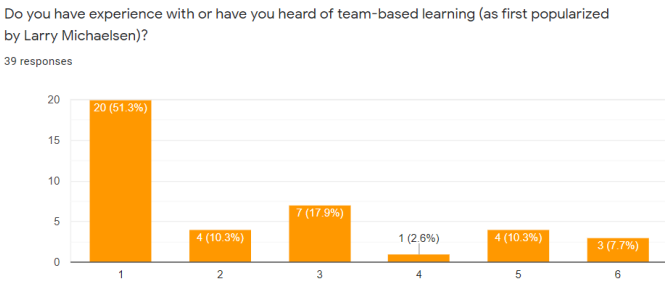

Figure 7

This chart shows that a majority of the respondents did not work with or had not heard of team-based learning. The respondents who answered they did have experience (level 4 or above) have their answers for the last question looked at more closely.

11. If so, are there things you would like to see in an online team-based learning environment?

Once again not all suggestions for this question were within the scope of the project. For example, deadline control was mentioned, but since gather.town is simply in place to facilitate the education environment, and not the assignment submissions this would not be within the scope. However, some suggestions were valuable. The suggestions from this question which will also be discussed in Section 6 are: Word cloud functionality, students being able to start sessions on their own.

6. DESIGN OF ONLINE ENVIRONMENT*

Now, based on all the information gathered and described above an optimal gather.town environment is to be designed.

First, some basic layout features will be discussed, followed by more details on small aspects of the design. Lastly, some gather.town limitations are laid out.

Basic layout

The basic layout is rather simple. The gather.town "space" (as it is called in the software) consists out of two types of rooms.

The first is a large room which is the room where all students can gather in. This is also where the class will start. This room will facilitate a

number of uses. The first use is that students will be able to do their first individual test here. In this large room the teacher can also provide additional theory and feedback on the tests. Generally speaking, this room is used when the teacher needs to speak to all students in the class.

The second type of room in the space is the breakout room. There are currently 8 configured in the design but this can be adjusted to what the course requires. Students can simply walk from the main room to their assigned room in order to join the breakout room. This room is where students will redo the test they did individually as a group, as per TBL standards. This room is also where the teams will work on the assignments in the last phase of TBL.

Details

- In gather.town you generally can not hear everybody, either you hear people close to you, or you hear others if you are in the same "speaking zone". This would be an issue of course because in the large room not everyone would be able to hear the teacher talk. To solve this problem, two speaking tiles have been added (each space is made up of different tiles). When someone stands on one of those spots, everyone in the room can hear them. One of the spots is on the teachers' podium, and one is closer to the students for questions. See figure 8 below for an impression of what the room looks like, talking tiles included.

- Each breakout room is coded with a letter which allows for easy division of all students amongst the different rooms.

Figure 8

- The next feature is in the breakout rooms. Every breakout room is equipped with an interactive whiteboard which the students can work on in parallel. For this survey, the intention is for the students to create and analyze business process models on the whiteboards. The survey showed that this feature is also very desirable amongst teachers.

- The breakout room has a table which serves as a "speaking zone" this means that as long as all students in the breakout room "sit" at the table, they can hear each other talk. Currently there are eight chairs at the table, but this can easily be increased or lowered to what is necessary for the course.

- For the purpose of this research, being able to make business process models is of crucial importance. Given this fact, every breakout room is equipped with a desk object, on which a document is placed. If students press the "X" key (standard interaction key on gather.town) then this will open *Lucidchart* in an embedded fashion on gather.town. On *Lucidchart* students can collaborate on business process models in real time. Figure 9 shows one of the breakout rooms, with the embedded website document highlighted.

Figure 9

Additional survey influences

- One of the features which was requested in the survey was "interactive self study". While this is rather vague it was interpreted as the possibility for students to use the environment as a place for self-study using the interactive features the environment provides. This is also in line with a request which was left for question 11 of the survey, "students should be able to start team sessions with the same functionality on their own". As people can always join a certain gather.town space if they have the link, gather.town fulfills this purpose well.

- In question 11 a respondent also suggested word cloud functionality. While this is not a standard feature to be implemented into a gather.town space, there are ways to achieve this goal. The first way is to simply use the whiteboard to make a word cloud. You can draw on it or use shapes which it can automatically form (similar to MS Paint). The second way is using the embedded website feature to link to a word cloud page.

Limitations

- Sadly gather.town does have some limitations. The biggest one considering the survey responses is that gather.town (currently) does not offer any screen recording functionality. Their website does list a couple of screen recording software options which users have employed in the past, but they are not officially partnered with any of them [17].

- Another rather large current limitation of gather.town is that the speaking tile can only connect to a maximum of 100 students. This means that per 100 students you would need a session.

- Specific theory applications do not have integrated functionality. This means that you either have to use an embedded site or tell students to do their work outside of the gather.town environment, which is sub-optimal. That said, given the fact that the embedded website function allows you to access the entirety of the internet, the space can be used for more than just business process management.

- Polling functionality is also currently not available in gather.town. However, a teacher could once again use either an embedded site to an external polling service like *Strawpoll*.

7. CONCLUSIONS AND FUTURE WORK

This paper has put forth a design for an online interactive environment for team-based learning intended for business process management. That said, the environment could be adjusted for TBL of other subjects, or even regular online education.

There are still some flaws, mostly related to limitations of gather.town as discussed above. These limitations however, could be resolved in the future if the developers of gather.town add the missing functionalities.

Another option to get around these limitations which are out of the scope of this research is to develop a purpose made solution for the class. This would allow all requirements from the teaching staff to be implemented which would result in a truly optimal solution for both students and teachers.

The survey showed that the teachers at the UT mostly utilize the most common online teaching tools (Video conferencing, chat, screen sharing, breakout rooms). The responses also provided valuable insights into functionalities also to be implemented in the final environment.

Further research is always recommended as it will improve the current scientific body of knowledge. In this research three potential candidates for further research primarily came up.

The first is about the fact that multiple responses covered some functionalities they desired in online education which currently are not present, but were also outside the scope of this research. Functionalities like “online identification of students in exams”, “deadline control” or “question analytics”. These are just a few of the functionalities which were mentioned but did not work for this research. Research into these topics could make online education more pleasant for both students and teachers.

Secondly, further research could be done into the acceptance of an environment like the one described in this paper. The survey showed that many of the respondents had never worked with or did not find an online environment with avatars desirable. This means that getting the teachers to adopt the environment could become an issue. Research into making that process as efficient as possible could be a positive.

And lastly, it would be recommended to put this environment into practice with real students. This will allow them to provide feedback but also offer the opportunity to determine whether this environment has the desired effect of improving students’ motivation and results in online TBL.

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