The Effect of a Preparatory Activity Meant to Foster the Activation of Prior Knowledge on a Learner's Engagement in an Online Synchronous Learning Environment.

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Abstract

The purpose of this study is to test if prior knowledge activation is an underlying mechanism in the engagement of students during an online synchronous learning session. In this experimental study the participants in the experimental condition (n=14) drew a concept map of their knowledge on music theory during one minute before the start of the session. The participants in the control condition (n=14) did not perform this preparatory activity. Students' level of engagement was coded during the first two assignments of the session using a coding scheme based on the ICAP-framework of Chi and Wylie (2014). The first assignment was a brainstorm activity, the second assignment was a CSCL assignment. The two conditions and two assignments were compared on their mean of observed engagement using two t-tests. Between the two conditions no significant difference was found, implicating that there was no effect of the preparatory activity on students' engagement. Between the two assignments there was found a significant difference. This can either implicate that a CSCL assignment has a stronger effect on engagement than a brainstorm activity, or that a brainstorm activity fosters community forming and thereby has a positive effect on engagement in the activities that follow.

Keywords: preparatory activity, activation of prior knowledge, online synchronous learning, engagement, ICAP-framework

Introduction

During the last two decades there have been tremendous changes in the way internet has taken a place in our lives. These technological developments have not only changed the way we keep in contact, but also the way we educate (Shacher & Neuman, 2010). The recent COVID-19 pandemic increased this online trend by demanding many educational institutes worldwide to switch to distance education almost overnight (Daniel, 2020). In these distance learning environments students experience more psychological distance between them, their peers and the instructor (Rovai, 2002). More psychological distance and thereby less community feeling, make it harder to engage students (Young & Bruce, 2011). It is important to find the underlying mechanisms that can foster this engagement because of the long-understood relationship between engagement and positive learning outcomes such as higher order thinking skills, an increased retention and improved grades (Dixon, 2010; Hamane, 2014).

In this introduction first there will be given more background information about distance education and the current trends. After this brief introduction of background information, the gap in knowledge relevant for this study will be pointed out. Subsequent the most relevant concepts of this study will be further elaborated followed by the description of the present study.

Background information

Generally, distance learning can be classified into two different categories. The first category is asynchronous distance learning, which takes place regardless of the presence of an instructor. The second category is synchronous distance learning, where instructor and learner are both present and communicate instantly (Allen et al., 2004). The major benefits of synchronous learning are the possibility of immediate feedback, the increased level of motivation and the obligation to be present and participate (Chen, Ko, Kinshuk & Lin, 2005).

The trend within online education goes in the direction of a more blended approach, where synchronous and asynchronous distance learning are combined. In this blended construction, synchronous learning has the function of narrowing the psychological distance and thereby engaging the students (Chen, Ko, Kinshuk & Lin, 2005).

The gap in knowledge

Synchronous distance learners score fairly equal on engagement in comparison to campus-based learners. Except for active and collaborative learning activities. This remains an unresolved issue in the quality of the learning experience in synchronous distance learning environments (Chen, Gonyea and Kuh, 2008). To solve this issue there should be more in-depth analysis about the underlying mechanisms of engagement in online synchronous learning environments (Martin, Ahlgrim-Denzel & Budhrani, 2017).

Different researchers focused on the way specific activities in online synchronous education fostered engagement among students (Dixon, 2010; Hamane, 2014; Martin & Bollinger, 2018). In their studies facilitating social contact with peers and the instructor turned out to be the most essential factor in engaging the students (Dixon, 2010; Martin & Bollinger, 2018). Martin and Bollinger (2018) found that an icebreaker, or introduction discussion and working collaboratively using online communication tools were rated the most beneficial to engage students. In her research Dixon (2010) focused on activities and communication channels that fostered the engagement of students. Though she did not find specific activities that enhanced engagement, she had a couple of findings that suggest that meaningful and multiple ways of interacting had a strong correlation with high student engagement. Martin and Bollinger (2018) mention that teacher presence is more important than learner to learner or content interaction for the engagement of students. *"They want to know that someone "on the other end" is paying attention."* (p. 218). Which further indicates the importance of social presence as underlying mechanism in online student engagement.

In his theory of transactional distance Moore (1993) describes three factors that influence the psychological distance in distance education. These are the structure of the course, the possibility for dialogue and the level of autonomy of the learner. Regarding the structure of the course this means the more a course provides room for the individual needs of students, the less psychological distance students experience. The factor of dialogue could be linked to the underlying mechanism of social presence. When students feel that there is room for dialogue, they feel less psychological distance. Regarding autonomy, Moore concludes that autonomous students are better able to deal with transactional distance. According to Song and Hill (2007) learners have a high level of autonomy in a field that they are familiar with. This could mean that when learners see the link between their prior knowledge and a certain aspect, they will act more autonomous. According to Moore's transactional theory (1993), this would lead to the experience of less psychological distance. And according to Young and Bruce (2011) less psychological distance means that learners act more engaged.

In their research, Spires and Donley (1998) discovered the relation between prior knowledge activation and engagement with informational texts among high school students. Chi & Wylie (2014) also link knowledge change processes that connect new learned knowledge with prior knowledge to higher forms of engagement. Therefore, it might be that the link to prior knowledge is another underlying mechanism in the engagement level in online synchronous learning environments.

Prior knowledge

The prior knowledge of students should be activated before presenting new material to increase the possibility that students link the presented knowledge to their prior knowledge (Christen & Murphy, 1991; Merrill, 2002; Surma, 2019). To do this, an activity that fosters the activation of prior knowledge can be added to the design as preparatory activity (Rubens, 2020). An activity that is often used to foster the activation of prior knowledge is drawing a

concept map (Rubens, 2020; Yuksel, 2012). By drawing a concept map a learner describes a certain concept by linking verbs to each other in order to describe the way these verbs relate. Yuksel (2012) defines a concept map as followed: *"A schematic device for representing a set of concept meanings embedded in a framework of propositions."* (p. 1199). A concept map can be used to summarize or clarify a topic, but also to activate one's prior knowledge if somebody is asked to draw a concept map of a topic up front (Yuksel, 2012). This means that, in order to integrate or infer the information with or from their prior knowledge, leaners must know in which way the new learned material is relevant to their prior knowledge. If learners see the connection between their prior knowledge and the new material, engagement might increase further (Chi & Wylie, 2014).

Engagement

Chi & Wylie (2014) created a model of overt behavior that can be used to measure engagement by observation. This is a practical tool that can be used by teachers to determine if the activity they used indeed fosters engagement. Chi & Wylie (2014) described an increase of engagement in their ICAP-framework as a taxonomy of overt behaviors. In their model the lowest form of engagement is passive engagement, followed by active engagement, constructive engagement and interactive engagement. When participants are passively engaged, they are just receiving information. This behavior turns into active engagement when the participant actively processes the information. Students are constructively engaged when they link the new concepts to their prior knowledge in order to enrich the material. When participants are engaged in a dialogue and thereby enrich each other's mental schema's in a way that they would not be able to just by themselves, they are interactively engaged. But if, for example, one of them is speaking and the other listening, the speaking participant is being constructive while the just listening participant will be passive or active depending on its contribution to the dialogue.

Chi and Wylie (2014) also link these forms of engagement to types of knowledge change processes, being: Store, Integrate, Infer and Co-Infer. When a participant is just storing information, knowledge is memorized in an encapsulated way. When a participant is actively engaged, he integrates the new knowledge with prior knowledge. A step higher in the taxonomy a participant first integrates the knowledge with prior knowledge and after that infers new knowledge from that. When participants are Co-Inferring they infer new knowledge from themselves and from the input of the other. Table 1 puts the modes of engagement and the types of knowledge change processes against each other.

Table 1

Engagement and knowledge change processes

Mode of engagement	Type of knowledge change processes
Passive	Store
Active	Integrate
Constructive	Infer
Interactive	Co-Infer

The present study

As the trend of increasing use of distance education continues, it becomes more important to understand what the underlying mechanisms of student engagement are in synchronous distance learning environments. In this study focus will be on testing the effect of prior knowledge activation on engagement by answering the following research question: What is the effect of an activity that fosters the activation of prior knowledge on a learner's engagement during an online tutorial session.

The hypothesis of the researcher is that there is an effect of prior knowledge activation on engagement, indicating that the link between the presented material and one's prior

knowledge is an underlying mechanism of engagement in synchronous distance learning environments.

Method

Research Design

To answer the research question, an experimental research design was used (figure 1) in which half the participants were in the experimental condition and half the participants in the control condition. Participants in the experimental condition were asked to draw a concept map in one minute before watching the video lecture in order to activate their prior knowledge. After the preparatory activity both conditions followed the same procedure, namely, watching a video lecture and participating in the assignments of the tutorial session.

Figure 1

Schematic research design

<table>
<tr><td>Experimental Condition</td><td>Concept Map</td><td rowspan="2">Video Lecture</td><td rowspan="2">Assignments</td></tr>
<tr><td>Control Condition</td><td>-</td></tr>
</table>

Participants

The participants in this research consisted of 28 university students from three different universities (21 participants from Utrecht University, 6 participants from Erasmus University and 1 participant from the Vrije Universiteit). The participants were between 18 and 53 years old (*M* = 24.11 and *SD* = 6.36) and differed on their prior knowledge between 1 and 6 on a 7-point Likert scale (*M* = 3.07 and *SD* = 1.68). There was no significant difference in self-reported prior knowledge between the two conditions (*Mexperiment* = 3.21 and

Mcontrol = 2.93). With a sample of n = 28, a power of .80, a confidence level of .95 and the participants equally distributed across the two conditions, the minimum detectable effect is .596. This is an above average effect compared with other educational effect studies (*M* = .40) (Hatti, 2012). All participants gave informed consent and were selected using convenience sampling. In compensation for their participation, a living room concert or custom-made book shelve were raffled among the participants.

Instrumentation

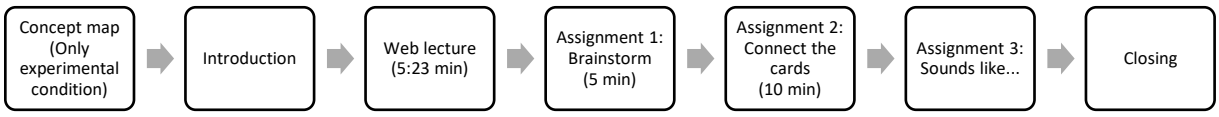
The procedure of the registration process is shown in figure 2 and the process of the experiment is shown in Figure 3. Before the entire procedure is elaborated, the instruments used in this registration process and experiment are explained separately. The instruments are divided in instruments that are used during the registration process, instruments that are used during the tutorial session and instruments that are used during the entire tutorial session.

Figure 2

Flow chart registration process

Figure 3

Flow chart tutorial session



Registration process. The following instrument was used during the registration process.

Google forms. In Google forms the participants were asked to register themselves for a workshop from a range of possible dates and times. In this form the participants filled in their general information and estimated their prior knowledge about music theory on a 7-point likert scale (1 = none, 7 = expert). In this digital registration form the participants were also informed about the study, the workload of participating and the praises they could win by participating. The registration form is added to appendix A.

Tutorial session. The following instruments were used during the tutorial session.

Concept map. All participants were asked to bring a piece of paper and a pen to the workshop. Only the participants in the experimental condition used this paper and pen in order to draw a concept map as preparatory activity. There was not given any further explanation about how to draw a concept map.

Web lecture. As a web lecture for this tutorial the TEDed video "How to read music - Tim Hansen" was used. The video takes 5:23 minutes and explains the basic principles of music notation. It is an animated instructional video, which can be seen in a screenshot of the video in figure 4. In appendix B there is added a link and an elaborated script of the video.

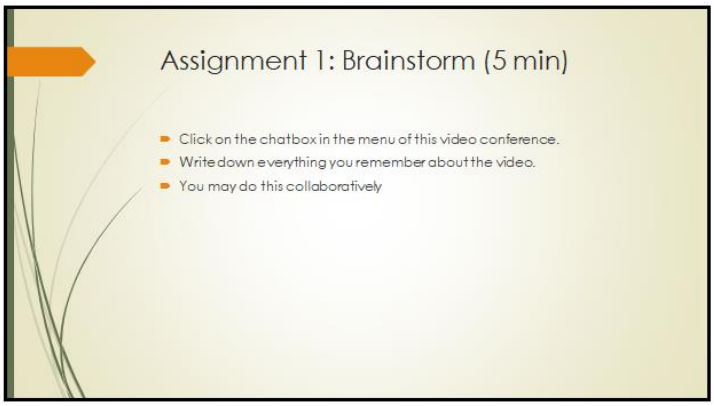
Figure 4

Screenshot web lecture: How to read music

Assignment 1. The slide for assignment 1 is shown in figure 5 and contained the instructions for the assignment. In this assignment participants were asked to brainstorm about the concepts they remembered from the video. The output of the brainstorm must be written in the chat box in the videoconference application Microsoft teams. A complete elaboration of the PowerPoint presentation is added to appendix C.

Figure 5

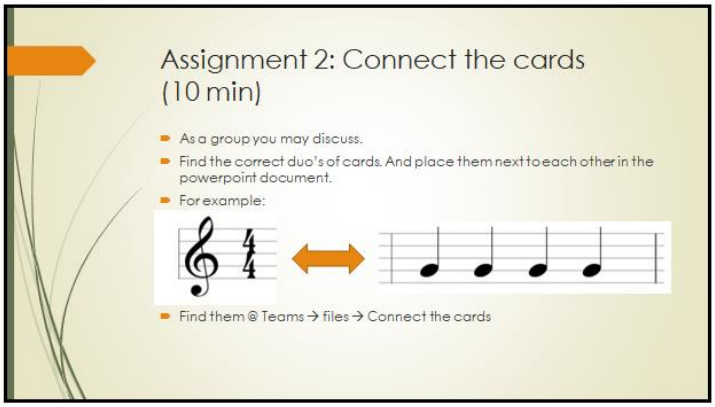
Screenshot PowerPoint slide: Assignment 1



Assignment 2. The slide for assignment 2 is shown in figure 6 and contained the instructions for the assignment. In this assignment participants need to connect cards in an interactive PowerPoint document. A complete elaboration of the PowerPoint presentation is added to appendix C.

Figure 6

Screenshot PowerPoint slide: Assignment 2



Interactive PowerPoint document. In this interactive PowerPoint document, there are several cards spread along the PowerPoint sheets as shown in figure 7. The participants could see each other selecting and moving the cards. Between the cards there are duo's that belong together. These should be placed next to each other as shown in figure 8. A complete elaboration of the interactive PowerPoint documents is added to appendix D.

Figure 7

Screenshot interactive PowerPoint slide: Raw version

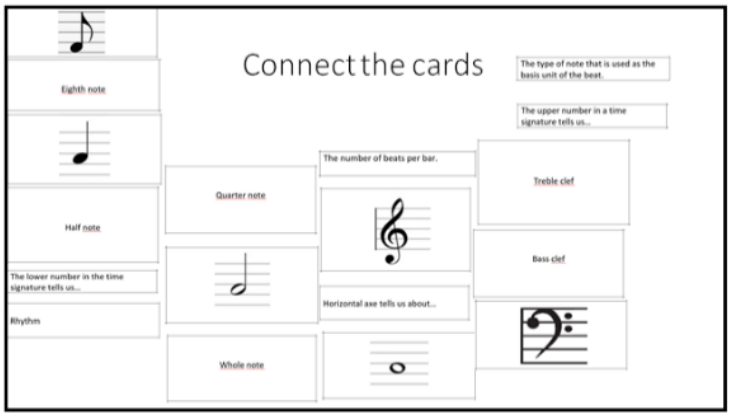
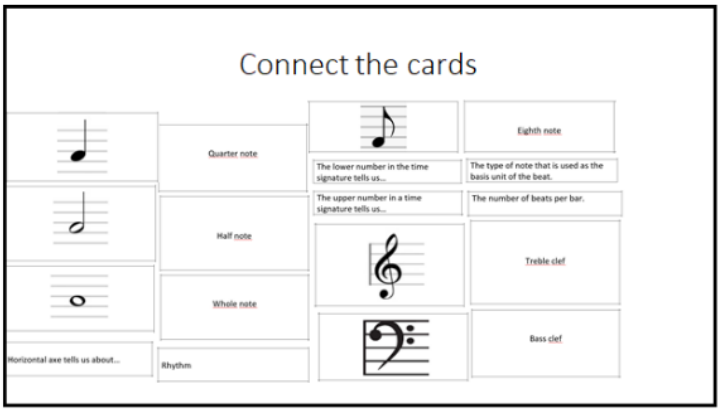


Figure 8

Screenshot interactive PowerPoint slide: Completed version

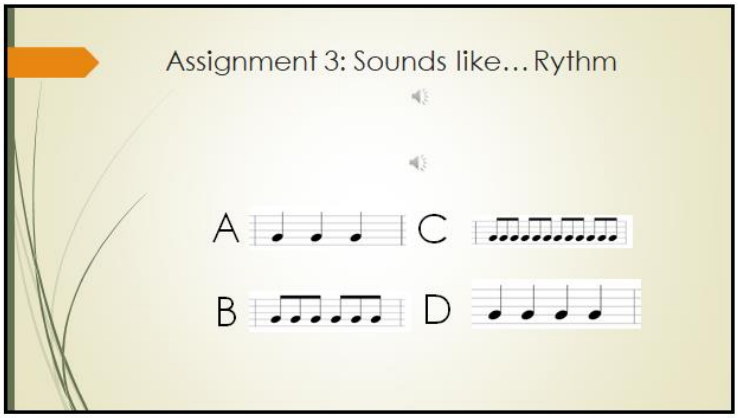


Assignment 3. Assignment 3 consisted of five sound fragments (2 about rhythm, 3 about pitch) across five slides, in which the participants needed to choose (A, B, C or D) between four written pieces of music that could match the sound fragment. In figure 9 the

slide of the first sound fragment is shown. A complete elaboration of the PowerPoint presentation is added to appendix C.

Figure 9

Screenshot PowerPoint slide: Assignment 3



Entire tutorial session. The following instruments were used during the entire tutorial session.

Microsoft teams. The tutorial session was provided in Microsoft teams. A web conference application where all students from different universities were familiar with. Still they received an instruction document to be sure about their competency with the application. Within Microsoft teams there is a record function that captures the whole screen.

Script. The instructor of the tutorial session used a script (appendix E) to minimize differences between groups.

PowerPoint Presentation. The tutorial session was presented with the use of a PowerPoint presentation. The PowerPoint consisted of 13 slides and followed the procedure of the session.

Coding scheme. During the first (5 minutes) and second (10 minutes) assignment every 30 seconds the mode of engagement was categorized in one of the four modes as described in the ICAP-framework of Chi & Wylie (2014) with the use of a coding scheme (table 2).

Table 2

Coding scheme engagement

Category	Observed Behavior
Passively engaged	• The participants eyes are pointed at the material or teacher. • Participant gives embodied signs of attention. • No overt behavior related to learning is shown.
Actively engaged	• The participant shows some form of motoric action related to the learning material. • The participant undertakes physical manipulation of the learning material.
Constructively engaged	• The participant generates verbal outputs that go beyond what was provided in the learning materials. • The participant generates written outputs that go beyond what was provided in the learning materials.
Interactively engaged	• *"Substantive statements and responses of each student build upon those of the other, indicating a shared line of reasoning."* (Chi & Wylie, 2014). • *"Conclusions are co-constructed with both students involved fairly equally in determining what to write."* (Chi & Wylie, 2014).

By giving a number to the mode of engagement (Passive = 1, Active = 2, Constructive = 3, Interactive = 4) the average mode of engagement during the entire tutorial session can be quantified to a mean between 1 and 4. A complete coding scheme is elaborated in appendix I.

In order to ensure the reliability of the observation an interrater reliability test was conducted. When there was decided to code assignment 1 and 2 every 30 seconds, a sufficient agreement was reached with a Cohen's Kappa of .97.

Procedure

Registration process First participants were asked to fill in the registration form (appendix A) in which they were asked about their preferred time of participation and basic descriptions. An automatic response was sent in which the participant was thanked for registration. An invitation e-mail (appendix F) in which the participant was reminded of their registration, was sent to the participants one week before the start of the workshop. This mail also contained an informed consent form (appendix G), which they were asked to return by e-mail, and an installation manual for Teams (retrieved from the website of the Teacher Academy of Utrecht University). In the third e-mail, twenty-four hours before the tutorial session, a reminder to fill in and return the informed consent form was sent with a link to the team in Microsoft Teams (Appendix H).

Experiment At the beginning of the experiment the participants were welcomed. After welcoming the participants in the experimental condition were asked to draw a concept map about their prior knowledge on the topic of music theory. They got one minute to complete this assignment in order to reduce differences in time on task. After the concept map both conditions followed the same procedure.

The instructor gave an introduction of the workshop, followed by the web lecture.

After the web lecture the first assignment started. The participants were told that they could communicate verbally during the brainstorm. They got five minutes to name as much as they remember about the video.

The second assignment was called: connect the cards. In this assignment the participants got 10 minutes. The participants were told that they could communicate verbally.

After these 10 minutes the participants were asked to quit, and the course continued to assignment 3. After this assignment the participants were thanked for their participation and informed about the next steps of this inquiry.

Analysis

The analysis was conducted in SPSS version 25. The means of engagement scores were calculated by dividing the total sum of scores by the number of time frames. The means of the two conditions are compared using an independent sample *t*-test in SPSS. The means of the two assignments were compared using a paired sample *t*-test. For the assignments separately the means of the two conditions were compared using an independent sample t-test. For this research a significance level of .05 was chosen.

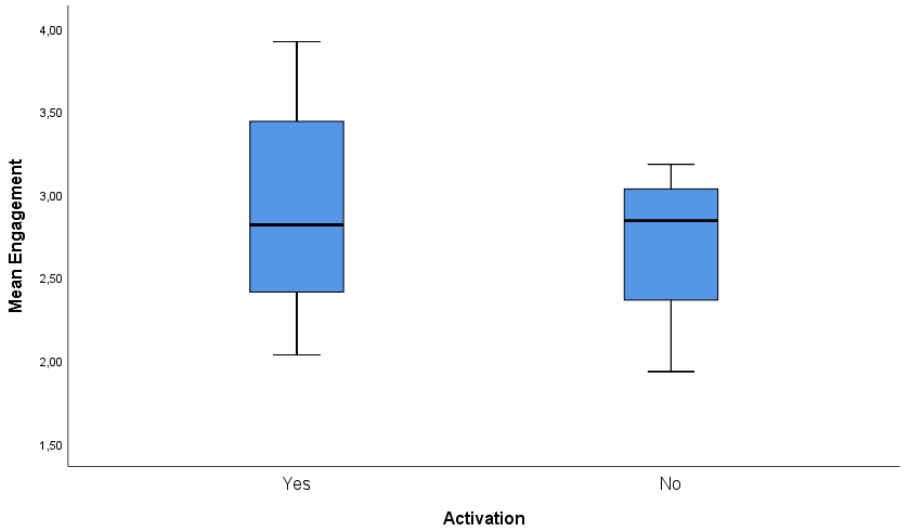
Results

Before the *t*-tests were conducted the assumptions of the t-test were checked. There was created a histogram which showed a normal distribution. Though in the Shapiro-Wilk test, the experimental condition was distributed normally (p = .38) but the control condition was not (p = .046). Also the sample size of n = 28 is relatively small.

As shown in figure 10, there was no significant difference between the engagement in the experimental condition (M = 2.94 and SD = .60) and the control condition (M = 2.67 and SD = .47), $t(27) = 1.32$, p = .20.

Figure 10

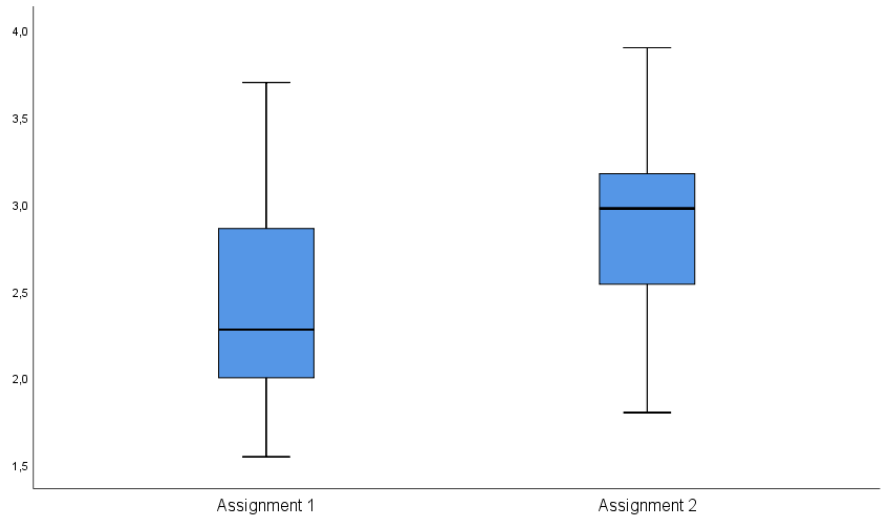
Boxplot results t-test mean engagement conditions



There is a significant mean difference in engagement between assignment 1 (*M* = 2.42, *SD* = .55) and assignment 2 (*M* = 2.87, *SD* = .55), *t*(27) = -3.36, *p* = .002. This indicates that the participants where more engaged during the second assignment (figure 11).

Figure 11

Boxplot results t-test mean engagement assignments



For assignment 1 separately, no significant difference between the control condition (*M* = 2.398, *SD* = .451) and the experimental condition (*M* = 2.44, *SD* = .66) was found, *t*(26) = .21, *p* = .83. As well for assignment 2 separately, there was found no significant difference between the control condition (*M* = 2.78, *SD* = .55) and the experimental condition (*M* = 2.97, *SD* = .55), *t*(26) = .94, *p* = .36.

Another relevant finding is that the person that stated the first question or suggestion at the beginning of the assignment, about which approach should be taken as a group, scored the highest levels of observed engagement within that session.

Discussion

Learners in synchronous online learning environments score fairly equal on engagement compared to campus-based learners. Except for active and collaborative learning

activities. This remains an unsolved issue in the quality of the learning experience in synchronous distance education (Chen, Gonyea, & Kuh, 2008). Previous research uncovered a link between prior knowledge and engagement (Spires & Donley, 1998; Chi & Wylie, 2014). Therefore, this research focused on testing if the activation of prior knowledge is an underlying mechanism of engagement in a synchronous online learning environment. The research question of this study was: *"What is the effect of an activity that fosters the activation of prior knowledge on a learner's engagement during an online tutorial session."*

To answer this question the means of observed engagement of both conditions were compared, but there was no significant effect. Indicating that there is no effect of prior knowledge activation on engagement, though both groups showed high levels of engagement in general. The means of observed engagement for both assignments were also compared. These means differed significantly, indicating that the participants scored better on the second assignment.

Implications

The fact that both conditions scored high on engagement could be explained by the session being well-designed, incorporating collaborative learning activities and multiple ways of communicating, which facilitated social contact with peers in both conditions (Dixon, 2010; Martin & Bollinger, 2018; Merrill, 2002). Besides, the instructor was present the whole session which also might have increased the engagement level because of the mechanism of social presence (Martin & Bollinger, 2018). This study further indicates the importance of these design principles and underlying mechanisms.

As these characteristics were present in both assignments, there could be two possible explanations for the difference in engagement between the two assignments. The first explanation has to do with the type of the assignment. It could be that a brainstorm activity, as

in assignment 1, has a stronger effect on engagement than a computer supported collaborative learning (CSCL) assignment, as in assignment 2.

The second explanation has to do with the phases of group formation. Tuckman (1977) distinguishes five phases of group formation: Forming, storming, norming, performing and adjourning. During the forming phase the focus of the group is on orientation to the task. During the storming phase focus of the group is on an emotional response to task demands. During the norming phase the focus of the group is on an open exchange of relevant interpretations, in this phase personal opinions are expressed. During the performing phase the group energy is channeled on the task, therefore solutions can emerge in this phase. During the final phase, adjourning, the focus of the group is on evaluation of the task.

In every group, at the beginning of the first assignment, there was one person that took the lead. As the roles and the assignment were clarified for all, this gave direction to the groups purpose. These actions could be referred to step one and two of Tuckman's model (1977). When this was done the group started to brainstorm about concepts in the video and trying to get agreement about those concepts, correcting each other's misconceptions. This can be referred to the third phase of Tuckman's model (1977). During the next assignment, participants could therefore start in the performance phase. This phase is characterized by high levels of interactivity and therefore high levels of observed engagement. This implies that the brainstorm activity has been an effective preparatory activity to foster engagement during the following assignment.

Limitations

The first, and most reasonable explanation of the non-significant effect between the two conditions is that only a small sample size was used in this study. The sample size of n=28 with a power of .80, a confidence level of .95 and the participants equally distributed across the two conditions doesn't detect effect sizes smaller than .596. Hattie (2012) mentions in his

book visible learning that effect sizes from .40 are average in educational research. This would mean that it is possible that there is an above average effect that cannot be measured because of a to small sample size.

Another possible explanation might be the short manipulation of one minute. It might be that, to get a longer lasting or larger effect of prior knowledge activation on engagement, a longer manipulation is necessary.

Besides the biggest limitations of this study being the relatively small sample size and the short manipulation time, it should be mentioned that the recordings did not contain a view of the participants manipulation of the learning material. Therefore, a less reliable distinction could be made between passive and active engaged students. This might have influenced the internal validity of this research though both raters scored fairly equal on the interrater reliability test (Cohen's Kappa = .97).

Future research

Future research should focus on the distinction of the two possible explanations mentioned in the implications. First, the effectiveness of the computer supported collaborative learning assignment could be tested in other settings without other activities before it. Second, future research should focus on the effect of preparatory of activities that are meant to foster community forming on engagement.

By doing further in dept analysis about the underlying mechanisms that foster engagement the increasingly used synchronous distance learning environments could be optimized to benefit student's performance.

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Appendix A: Registration form

Figure A1

Screen capture of the registration form

Registration form - Micro course: How to read and write music

Hello,

Duo to COVID-19 I unfortunately couldn't do the previous round of experiments in real life. Therefore I have changed and my research to an online course. I realy hope you want to help me to finish my master this academic year.

For my master thesis I'm doing reseach about the effects of prior knowledge activation on cognitive engagement in digital classrooms. The experiment is an online micro course about music theory. In this course you'll learn about the basics of how to read and write music. The course will take no more than one hour and will take place at Microsoft Teams.

As an incentive for participating in this micro course there will be raffled a self-made bookshelf of pallet wood. (Or a living room concert by me when this pandemic is over!) Further in this form there will be asked about your name, e-mail adress and phone number. Also, you will have to choose between different times/dates to make a planning for the days the course will take place. Your personal data will be given to no one else exept me, and will only be used to update you about the schedule.

Thank you for participating!

Kind Regards,

Ruben Marciante
* Required

1. Email address *

2. E-mail adress *

3. What is your full name? *

4. What is your age? *

5. What is your phone number? *

6. What do you study? (If you are doing a second study, please write both and seperate with a comma.) *

7. How do you estimate your prior knowledge about Music Theory *

Mark only one oval.

	1	2	3	4	5	6	7	
None	◯	◯	◯	◯	◯	◯	◯	Expert

8. What is your preferred date/time of participation?

Please select one option!

Check all that apply.

	15.00 - 16.00	20.00 - 21.00
20-05-2020	☐	☐
22-05-2020	☐	☐
25-05-2020	☐	☐

Appendix B: TEDed How to read music

TED-ed video: How to read music - Tim Hansen [5:23]

Link to video

https://www.ted.com/talks/tim_hansen_how_to_read_music?utm_campaign=tedspread&utm_medium=referral&utm_source=tedcomshare

Script

When we watch a film or a play, we know that the actors probably learned their lines from a script, which essentially tells them what to say and when to say it. A piece of written music operates on exactly the same principle. In a very basic sense, it tells a performer what to play and when to play it. Aesthetically speaking, there's a world of difference between, say, Beethoven and Justin Bieber, but both artists have used the same building blocks to create their music: notes. And although the end result can sound quite complicated, the logic behind musical notes is actually pretty straightforward. Let's take a look at the foundational elements to music notation and how they interact to create a work of art. Music is written on five parallel lines that go across the page. These five lines are called a staff, and a staff operates on two axes: up and down and left to right. The up-and-down axis tells the performer the pitch of the note or what note to play, and the left-to-right axis tells the performer the rhythm of the note or when to play it. Let's start with pitch. To help us out, we're going to use a piano, but this system works for pretty much any instrument you can think of. In the Western music tradition, pitches are named after the first seven letters of the alphabet, A, B, C, D, E, F, and G. After that, the cycle repeats itself: A, B, C, D, E, F, G, A, B, C, D, E, F, G, and so on. But how do these pitches get their names? Well, for example, if you played an F and then played another F higher or lower on the piano, you'd notice that they sound pretty similar compared to, say, a B. Going back to the staff, every line and every space between two lines represents a separate pitch. If we put a note on one of these lines or one of these spaces, we're telling a performer to play that pitch. The higher up on the staff a note is placed, the higher the pitch. But there are

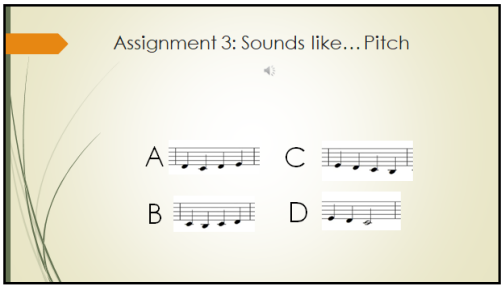
obviously many, many more pitches than the nine that these lines and spaces gives us. A grand piano, for example, can play 88 separate notes. So how do we condense 88 notes onto a single staff? We use something called a clef, a weird-looking figure placed at the beginning of the staff, which acts like a reference point, telling you that a particular line or space corresponds to a specific note on your instrument. If we want to play notes that aren't on the staff, we kind of cheat and draw extra little lines called ledger lines and place the notes on them. If we have to draw so many ledger lines that it gets confusing, then we need to change to a different clef. As for telling a performer when to play the notes, two main elements control this: the beat and the rhythm. The beat of a piece of music is, by itself, kind of boring. It sounds like this. (Ticking) Notice that it doesn't change, it just plugs along quite happily. It can go slow or fast or whatever you like, really. The point is that just like the second hand on a clock divides one minute into sixty seconds, with each second just as long as every other second, the beat divides a piece of music into little fragments of time that are all the same length: beats. With a steady beat as a foundation, we can add rhythm to our pitches, and that's when music really starts to happen. This is a quarter note. It's the most basic unit of rhythm, and it's worth one beat. This is a half note, and it's worth two beats. This whole note here is worth four beats, and these little guys are eighth notes, worth half a beat each. "Great," you say, "what does that mean?" You might have noticed that across the length of a staff, there are little lines dividing it into small sections. These are bar lines and we refer to each section as a bar. At the beginning of a piece of music, just after the clef, is something called the time signature, which tells a performer how many beats are in each bar. This says there are two beats in each bar, this says there are three, this one four, and so on. The bottom number tells us what kind of note is to be used as the basic unit for the beat. One corresponds to a whole note, two to a half note, four to a quarter note, and eight to an eighth note, and so on. So this time signature here tells us that there are four quarter notes in each bar, one, two, three, four; one, two, three, four, and so on. But like I said before, if we just stick to the beat, it gets kind of boring, so we'll replace some quarter notes with

different rhythms. Notice that even though the number of notes in each bar has changed, the total number of beats in each bar hasn't. So, what does our musical creation sound like? (Music) Eh, sounds okay, but maybe a bit thin, right? Let's add another instrument with its own pitch and rhythm. Now it's sounding like music. Sure, it takes some practice to get used to reading it quickly and playing what we see on our instrument, but, with a bit of time and patience, you could be the next Beethoven or Justin Bieber.

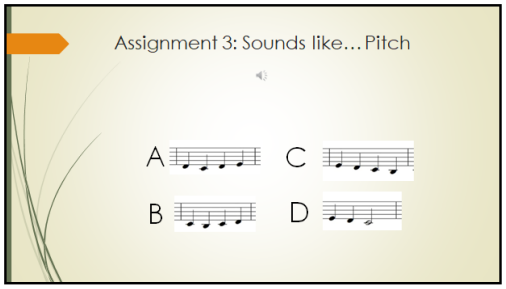
Appendix C: PowerPoint of the tutorial session

Figure C1

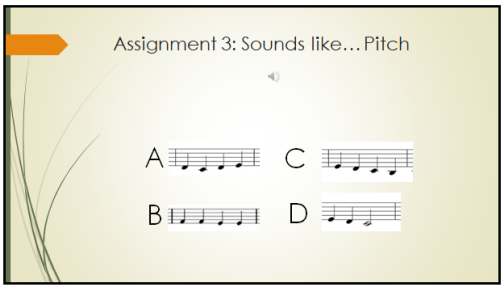
PowerPoint of the tutorial session


Assignment 3: Sounds like… Pitch
A
C
B
D

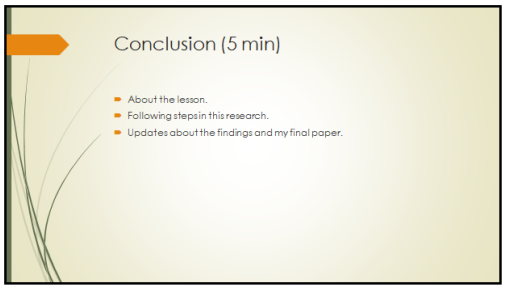
9


Assignment 3: Sounds like… Pitch
A
C
B
D

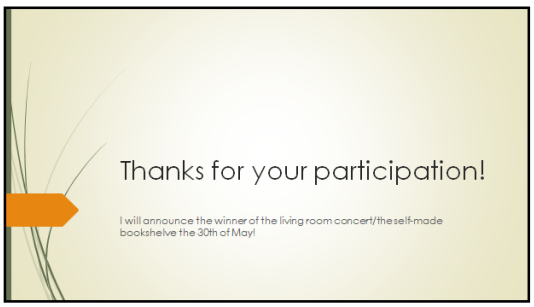
10


Assignment 3: Sounds like… Pitch
A
C
B
D

11


Conclusion (5 min)
About the lesson.
Following stepsin this research.
Updates about the findings and my final paper.

12


Thanks for your participation!
I will announce the winner of the living room concert/the self-made bookshelve the 30th of May!

13

Appendix D: Connect the cards

Figure D1

Raw version of the PowerPoint 'connect the cards'

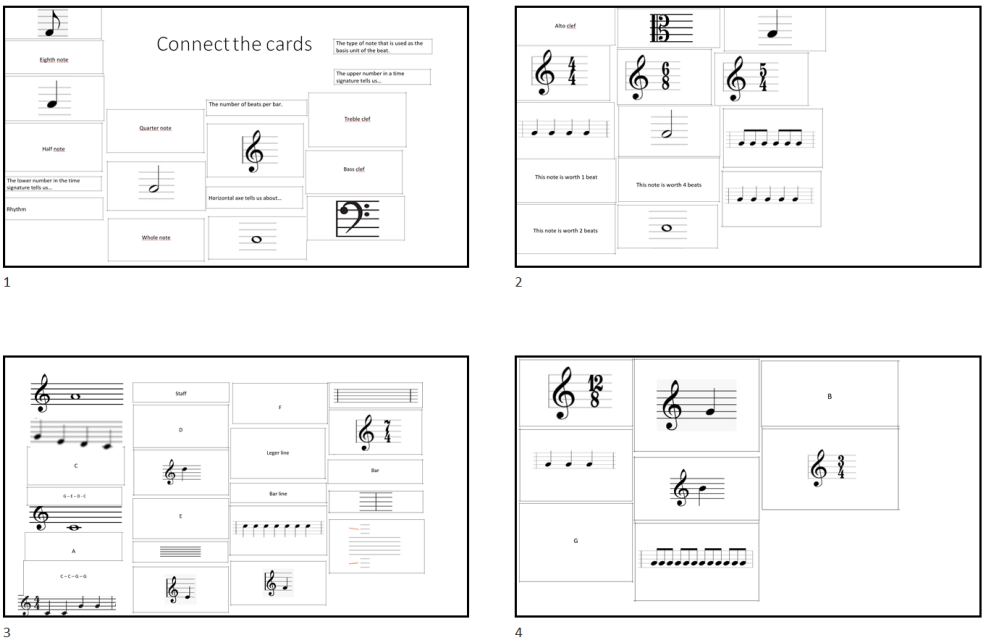
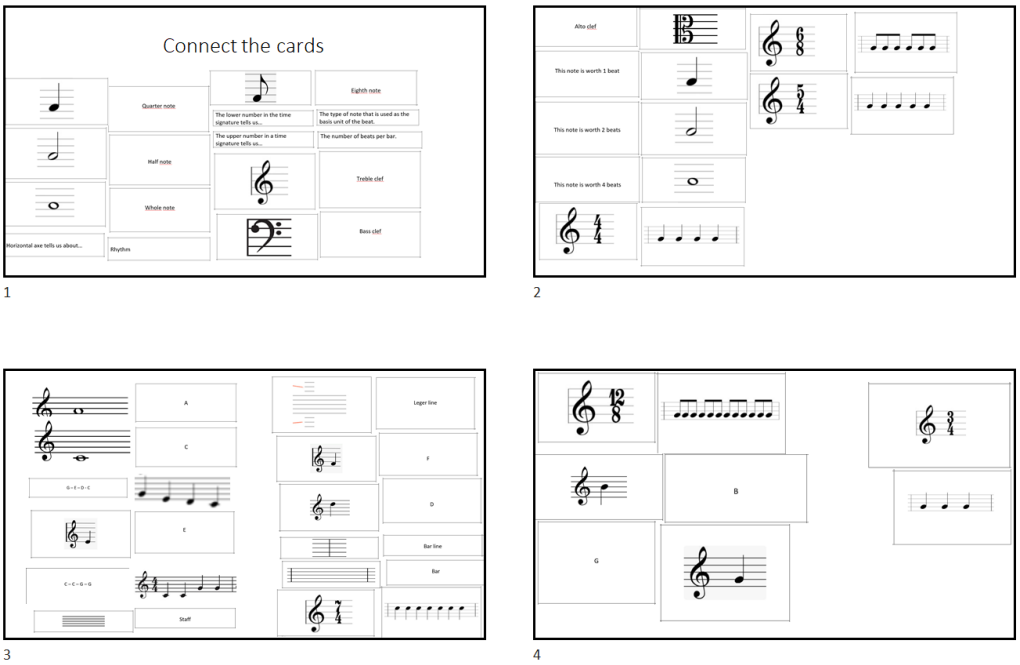


Figure D2

Completed version of the PowerPoint 'connect the cards'



Appendix E: Script tutorial session

Welcome to a crash course in music theory. In this course you will learn the basics of how to read and write music.

First, I will show you a little video which contains the theory we will discuss in this course. It will take approximately five minutes.

[Video shown]

How did you like the video? (Ask all participants)

Did one of you notice the mistake in the video?

After this class you will. We are going to do three assignments. In the first assignment you will brainstorm about the concept you heard in the video. In the second assignment we will connect the cards of these concepts in a messy PowerPoint slide and in the third assignment we will take it back to music. I have five sounds fragments and I will ask you which written piece of music matches the sound fragment.

Let's start with the first assignment: the brainstorm. In the menu of this video conference you will find a speech cloud. This is the chatbox. During the brainstorm you have to write everything you remember from the video here. You may do this collaboratively and I'll set a timer on five minutes. Please let me know if you found the chatbox so I can start the time.

[Assignment 1 conducted]

In this second assignment we are going to connect the right duos of cards. These cards consist of concepts which were all in the video. If you found a correct duo of cards, you place them next to each other in the interactive PowerPoint presentation. For example: You see here that a four quarter beat matches four quarter notes in one bar. You may do this assignment collaboratively and you can see each other moving the cards in the PowerPoint. You can find

the PowerPoint when you click on ‘teams’ in the left column. The you click on ‘files’ or ‘bestanden’ if you have a Dutch version of teams. Please let me know when you are in the PowerPoint presentation so I know when I can start the time. You will get ten minutes to complete this assignment.

[Assignment 2 conducted]

In this final assignment you will get five sound fragments in total. Two will be about rhythm, three will be about pitch. I’ll give you four answer options: A, B, C and D. You may discuss with your group about the right answer. Please let me know if you cannot hear the sound.

[Assignment 3 conducted]

Thanks for participating in this course! You were in the [experimental/control] condition. Which means you [did/did not] receive a preparatory activity to activate you prior knowledge. After this class, for every time sample I’ll code your level of engagement. And after my thesis is completed I’ll inform you about my results!

Again: Thanks for participating! I will announce the winner of the living room concert or the self-made book shelve the 30th of May!

Appendix F: Invitation e-mail

Subject: Crash course in music theory – [DATE] [TIME]

Hi,

Thanks for participating in the workshop on [DATE] from [TIME] to [TIME]. Here is a short briefing to inform you about the procedure.

1. Make sure that you install **Microsoft Teams**. I'll send you the code of participation 24 hours before the workshop. If you do not have Microsoft Teams installed yet, please follow the steps in the installation manual which is attached to this email to install.

2. Please read and sign the **informed consent** form which is attached to this e-mail. By agreeing to this form you confirm to have read it and accept participating in this research. Please return the signed form to me **before** participating in the workshop.

3. Please **bring a blank piece** of paper and a pen or pencil to the workshop. You will need this for some assignments.

If you have any questions please contact me at r.marciante@students.uu.nl or send me a text/WhatsApp at +31 648474875.

Again, thanks for participating. I look forward to seeing you next week!

Kind regards,

Ruben Marciante

Appendix G: Informed consent form

This letter contains an informed consent form for the study:

The effect of preparatory activity that fosters the activation of prior knowledge on a learner's engagement during the tutorial session in a flipped classroom design.

This study is done in trend of a master thesis. The results of this study may give a new insight in a possible effective preparatory activity on a learner's engagement in flipped classroom design.

The research takes approximately 60 minutes and will take place online on Microsoft Teams. It is important that you take a blanc piece of paper and a pen or pencil with you at the beginning of the workshop.

Note that the workshop will be recorded, this is necessary for answering the research question. Your data will be processed anonymously and saved in a highly secured digital environment which are conform the European privacy standards.

In this form (PARTICIPANT) agrees to be fully informed, orally and/or in writing, about the study's purpose and the collection and registration of data. The participant can leave the experiment at any time without explanation or consequences.

If you have any questions about the research, please sent an e-mail to t.h.breel@students.uu.nl. If you have any official complaints about the study, please contact klachtenfunctionaris-fetcsocwet@uu.nl.

Name participant: ……

Date [jjmmdd]: ……..

Signature: ……..

Appendix H: E-mail with link to team

Subject: Link to tomorrow's workshop!

Hi!

This is the link to the workshop on teams for tomorrow at [TIME]:

https://teams.microsoft.com/l/channel/19%3af716e078c566423f892aae3c525df9bb%40thread.tacv2/Algemeen?groupId=fb13a93e-0dfe-452a-8657-b1af288edeb1&tenantId=d72758a0-a446-4e0f-a0aa-4bf95a4a10e7

Just a friendly reminder for who didn't do this yet:

- Install Microsoft Teams and join the team;

- Please return a signed informed consent form before the workshop;

- Bring a blank piece of paper and a pen.

See you tomorrow!

Kind regards,

Ruben Marciante

Appendix I: Coding scheme – engagement

Code	Category	Description	Observed Behavior	Example	Reference
1	Passively engaged	*"learners being oriented toward and receiving information from the instructional materials without overtly doing anything else related to learning" (Chi & Wylie, 2014).*	The participants eyes are pointed at the material or teacher;	The participant looks at his monitor or into the camera when someone is talking.	Chi & Wylie, 2014
			Participant gives embodied signs of attention;	The participant nods when the other participant is talking.	
			No overt behavior related to learning is shown.	The participant is not doing anything related to learning.	
2	Actively engaged	*"Learners' engagement with instructional materials can be operationalized as active if some form of overt motoric action or physical manipulation is undertaken" (Chi & Wylie, 2014).*	The participant shows some form of motoric action related to the learning material.	Repeating or rehearsing.	Chi & Wylie, 2014
			The participant undertakes physical manipulation of the learning material.	Highlighting text, clicking in the document.	
3	Constructively engaged	*"learners generate or produce additional externalized outputs or products beyond what was provided in the learning materials" (Chi & Wylie, 2014).*	The participant generates verbal outputs that go beyond what was provided in the learning materials.	Comparing and contrasting cases; Making plans; Reflecting and monitoring one's own understanding and other self-regulatory activities; Self-explaining.	Schwartz & Bransford, 1998; Pea & Kurland, 1984; Azevedo et al, 2006; Chi et al., 1989; Chi & Wylie, 2014;
			The participant generates written outputs that go beyond what was provided in the learning materials.	Generating examples, Comparing and contrasting cases.	
4	Interactively engaged	Participants are involved in *"dialogues that meet two criteria: (a) both partners' utterances must be primarily constructive, and (b) a sufficient degree of turn taking must occur" (Chi & Wylie, 2014).*	*"Substantive statements and responses of each student build upon those of the other, indicating a shared line of reasoning."*	Arguments in the dialogue are based on one and other;	Chi & Wylie, 2014; Menekse & Chi, 2019
			"Conclusions are co-constructed with both students involved fairly equally in determining what to write."	The final answer that is written down is a product of the reasoning of all involved.	

Table I1 *Coding scheme engagement*

Appendix J: FETC form

Section 1: Basic Study Information

1. Name student:

Ruben Marciante

2. Name(s) of the supervisor(s):

Anouschka van Leeuwen

3. Title of the thesis (plan):

The effect of preparatory activity that fosters the activation of prior knowledge on a learner's engagement during the tutorial session in a flipped classroom design.

4. Does the study concern a multi-center project, e.g. a collaboration with other organizations, universities, a GGZ mental health care institution, or a university medical center?

No

5. Where will the study (data collection) be conducted? If this is abroad, please note that you have to be sure of the local ethical codes of conducts and permissions.

The data will be collected on during tutorial session on Microsoft Teams.

Section 2: Study Details I

6. Will you collect data?

Yes

7. Where is the data stored?

At YoDa

8. Is the data publicly available?

No

9. Can participants be identified by the student? (e.g., does the data contain (indirectly retrievable) personal information, video, or audio data?)

Yes

10. If the data is pseudonymized, who has the key to permit re-identification?

No, the data is not pseudonymized.

Section 3: Participants

11. What age group is included in your study?

18-53 years old students.

12. Will be participants that are recruited be > 16 years? Yes
13. Will participants be mentally competent (wilsbekwam in Dutch)? Yes
14. Does the participant population contain vulnerable persons? (e.g., incapacitated, children, mentally challenged, traumatized, pregnant) No
15. If you answered 'Yes' to any of the three questions above: Please provide reasons to justify why this particular groups of participant is included in your study.

Participants are students between 18-53 that are voluntary taking part in an experiment.

16. What possible risk could participating hold for your participants?

There is no possible risk in participating.

17. What measures are implemented to minimize risks (or burden) for the participants?

-

18. What time investment and effort will be requested from participants?

From participants there will be needed 1 hour of their time. In this hour they will draw a concept map about music theory, they watch a video of 6 minutes about music theory and they participate in a tutorial session of 45 minutes about music theory.

19. Will be participants be reimbursed for their efforts? If yes, how? (financial reimbursement, travelling expenses, otherwise). What is the amount? Will this compensation depend on certain conditions, such as the completion of the study?

There will be raffled a living room concert or self-made bookshelf among the participants.

20. How does the burden on the participants compare to the study's potential scientific or practical contribution?

The only burden of participants is the one-hour time investment they have to make. This in comparison to an important question about the effect of a preparatory that fosters the activation of prior knowledge on a learners' cognitive engagement.

21. What is the number of participants? Provide a power analysis and/or motivation for the number of participants. The current convention is a power of 0.80. If the study deviates from this convention, the FERB would like you to justify why this is necessary.
(Note, you want to include enough participants to be able to answer your research questions adequately, but you do not want to include too many participants and unnecessarily burden participants.)

To reach a power of .80 with a significance level of .05 199 participants should be included in this study. Because of the unforeseen constraints around COVID-19 for this research there is chosen to only use 28 participants in this study. With the same significance level (.05) and power (.80) there can be measured effect sizes from .596 and larger.

22. How will the participants be recruited? Explain and attach the information letter to this document.

The participants will be recruited by convenience sampling. There will be send an e-mail to participants that agreed on participate in the previous research plan. These participants were recruited actively with a registration form at Utrecht University.

23. How much time will prospective participants have to decide as to whether they will indeed participate in the study?

The participants have to decide instantly if they want to participate in the study.

24. Please explain the consent procedures. Note, active consent of participants (or their parents) is in principle mandatory. Enclose the consent letters as attachments. You can use the consent forms on Blackboard.

Active consent is needed from participants. They will receive a consent form at the beginning of the experiment.

25. Are the participants fully free to participate and terminate their participation whenever they want and without stating their grounds for doing so? Explain.

Participants can terminate their participation whenever they want during the experiment. This is also told at the beginning of the experiment and will be written in the consent form as well.

26. Will the participants be in a dependent relationship with the researcher?

No

27. Is there an independent contact person or a general email address of a complaint officer whom the participant can contact?

Participants can contact a fellow student who is mentioned on the informed consent form.

28. Is there an independent contact person or a general email address of a complaint officer whom the participant can contact in case of complaints?

t.h.breel@students.uu.nl

Section 4: Data management

29. Who has access to the data and who will be responsible for managing (access to) the data?

Only the researcher (me, Ruben Marciante) and the University supervison (Anouschka van Leeuwen) will have access to the YoDa folder.

30. What type of data will you collect or create? Please provide a description of the instruments.

The videos of the tutorial session and some forms with general information about the participants will be collected.

31. Will you be exchanging (personal) data with organizations/research partners outside the UU?

No

32. If so, will a data processing agreement be made up?

-

33. Where will the data be stored and for how long?

The data will be stored at YoDa for as long as the research takes.

34. Will the data potentially be used for other purposes than the master's thesis? (e.g., publication, reporting back to participants, etc.)

No, the data will be only used for the purpose of the master's thesis.

35. Will the data potentially be used for other purposes than the master's thesis? (e.g., publication, reporting back to participants, etc.)

No