



JÖNKÖPING UNIVERSITY

*School of Engineering*

# Creating a sense of normality

A quantitative study examining how a digital collaborative tool impacts students' experiences in online synchronous group discussions

**Main Subject area:** *Informatics*

**Author:** *Aleksandra Voronenko & Agnes Johansson*

**Supervisor:** *Ida Serneberg*

**JÖNKÖPING** *2021 June*

This final thesis has been carried out at the School of Engineering at Jönköping University within the field of Informatics. The authors are responsible for the presented opinions, conclusions and results.

Examiner: Bruce Ferwerda  
Supervisor: Ida Serneberg  
Scope: 15 hp (first-cycle education)  
Date: 2021-06-07

## Abstract

**Purpose** – The unexpected yet drastic influence of the COVID-19 pandemic resulted in a rapid transition of education to be conducted in digital environments. Replacing face-to-face classrooms with synchronous online learning requires a number of appropriate adjustments which were heavily restricted by the urgency of this global change taking place. With the observed issues of student participation and involvement in online learning, the purpose of this research was to investigate the potential that digital collaborative tools have and if they can improve the quality of online group discussions among students aged 12 to 16 years old.

**Method** – This study employs a quantitative data collection approach and makes use of the Community of Inquiry framework. A close-ended questionnaire based on the Community of Inquiry survey tool was used to collect students' impressions and attitudes after they had participated in the experimental study. The experiment consisted of control and experimental groups that partook in online group discussions as part of a regularly scheduled lesson.

**Findings** – Digital collaborative tools were found to change the way in which students experience online group discussions. The attained rates of the Community of Inquiry were overall higher among students in the experimental group. Our findings tested to be statistically significant together with the effect size falling between medium to large extent. This further supports the notion that digital collaborative tools bring in a positive difference into online group discussions and have a potential to increase the quality of online learning when implemented carefully and thoughtfully.

**Implications** – This study emphasizes the importance of developing a clear strategy of how to implement suitable digital collaborative tools into online learning in the most optimal manner that would increase the quality of online learning. This paper can be considered as a starting point for future research that could construct further knowledge within the field and extend our findings by investigating other aspects that have an influence on and can have beneficial effects for younger students in online education.

**Keywords** – digital collaborative tools, online learning, group discussions, synchronous e-learning, Community of Inquiry, CoI survey, COVID-19 pandemic, quantitative research, experimental study

# Table of contents

<b>Abstract</b>	<b>2</b>
<b>Table of contents</b>	<b>3</b>
<b>1 Introduction</b>	<b>5</b>
1.1 Background	5
1.2 Definitions	6
1.3 Problem statement	6
1.4 Purpose and research questions	8
1.5 Scope and limitations	8
1.6 Disposition	9
<b>2 Method and implementation</b>	<b>10</b>
2.1 Approach	10
2.2 Research design and implementation	11
2.2.1 Survey adjustments	11
2.2.2 Relevance of the teaching presence	12
2.2.3 Readability tools	12
2.2.4 Feasibility of the experiment	13
2.3 Work process	14
2.4 Data collection	15
2.5 Data analysis	17
2.6 Validity and reliability	19
2.6.1 Reliability	20
2.6.2 Internal validity	21
2.6.3 External validity	22
2.7 Considerations	23
2.7.1 Consent	23
2.7.2 Anonymity and confidentiality	24
2.7.3 Young survey respondents	24
2.7.4 Communication with the school	25
2.7.5 Personal connection	25
2.7.6 Recruitment process	26
2.7.7 Pandemic	26
<b>3 Theoretical framework</b>	<b>28</b>
3.1 Collaborative learning and group discussions	28

3.2 Collaborative learning in a digital context	28
3.3 Community of Inquiry	29
3.3.1 Framework	29
3.3.2 Survey	30
<b>4 Results</b>	<b>31</b>
<b>5 Discussion</b>	<b>39</b>
5.1 Result discussion	39
5.1.1 Size of the impact	39
5.1.2 Nature of the impact	41
5.2 Method discussion	44
<b>6 Conclusions and further research</b>	<b>47</b>
6.1 Conclusions	47
6.1.1 Practical implications	47
6.1.2 Scientific implication	47
6.2 Further research	48
<b>7 References</b>	<b>50</b>
<b>8 Appendixes</b>	<b>59</b>
Appendix 1. The adapted Col survey instrument	59

# 1 Introduction

## 1.1 Background

According to statistics presented by UNESCO (n.d.) collected during the year of 2020 when the COVID-19 pandemic began, the highest number of learners enrolled in and affected by the closure of schools was 1,484,712,787 learners, which corresponds to 84.4%. This extensive closure of schools has resulted in students learning from home, and teachers operating from home as well (UNESCO, 2020). It has led to educational organizations across the globe having to act very fast in order to switch from the traditional face-to-face teaching approaches to education that is conducted remotely. The approximation made by Hodges et al. (2020) states that it would require from 6 to 9 months to properly adjust a course that was developed for in-presence teaching to fit and work in an online environment. Therefore, it is not a surprise that such an emergency transition resulting from the COVID-19 pandemic has been abrupt and rather painful for most schools and institutions.

Group discussions play an important role in the educational process since they facilitate interpersonal communication between students and contribute significantly to the formation of knowledge and personal development (Jung & Brady, 2020) and interactions between students have been shown to lead to active learning (Hernández-Sellés et al., 2019; Ku et al., 2013). Over 168 studies conducted during the 1900's demonstrate that a cooperative approach has greater effect on the individual achievements in learning, compared to the effects of competitive or individualistic learning (Johnson et al., 1998). The importance of incorporating group discussions in education is further proven by the content presented in the curriculum for the compulsory school, developed by the Swedish National Agency for Education (Skolverket, 2018). Several of the general knowledge goals that are defined in the curriculum relate to both the student's ability to learn and work together with others as well as the use of digital tools when attaining knowledge (Skolverket, 2018).

Research has proven that different types of technology can offer positive support in collaborative learning. Usage of multimedia tools and online collaborative tools can strengthen interdependence, promote teacher-student interaction and social presence as well as enable both resource sharing and activities that require higher-order thinking (Hernández-Sellés et al., 2019; Kirschner et al., 2014; Ku et al., 2013). However, to ensure these beneficial outcomes, deliberate implementation of the correct tools that provide support, control and encouragement is required (Jaggars & Xu, 2016).

This study stems from these notions, both that group discussions are important and beneficial in educational situations as well as the potential that digital tools have of promoting and assisting in collaborative learning activities. With the COVID-19 pandemic being the main reason for urgently transitioning education into an online environment, these issues become even more important and relevant. Based on these concepts, the study therefore intends to explore what role digital tools can play specifically in this new context of remote, online learning for younger students.

## 1.2 Definitions

Since *digital collaborative tools* are one of the main aspects in our work and this term comes up repeatedly throughout the thesis, a clear definition of what is meant by digital collaborative tools specifically in the context of online education is necessary. The key reason behind using digital collaborative tools is to support cooperation between remotely located participants as well as to enable clear and productive communication (Xu & Zhang, 2008). Many variations of digital collaborative tools are currently available. These vary in design and functionality as they target diverse industries and aim to address some specific needs of users, for example, communication, coordination and cooperation. In the educational environment, digital collaborative tools primarily intend to facilitate sharing of opinions, group discussions and cooperative work. These tools can be used in both synchronous and asynchronous classes. According to Xu and Zhang (2008), synchronous collaboration tools are used by groups of people for simultaneous work and real-time communication, while asynchronous collaboration tools assume that participants have flexibility when making their individual input to the common project at different times. Synchronous collaboration tools could include, but are not limited to, white boarding, collaborative brainstorming, file sharing as well as organization and categorization of information. Throughout this paper, when using the term digital collaborative tools, we will refer particularly to the concept of synchronous collaboration tools that are used complementary to the video conference platforms. Specifically in this study, we used Padlet which is a free collaborative resource that allows for visualization and documentation of group work by posting various content such as text, images and links. Padlet is a digital collaborative tool in question in our research and it is used within Google Meet, which is a regular video conference platform utilized throughout the school to host online lessons.

*Group discussion* is another prominent term in our work and it refers to the process of social interaction between three or more people that results in information exchange or sharing of ideas and opinions. In this thesis, we use the term of group discussions to define single-time occasions in which students are placed in groups of five participants in order to work on a task or talk through certain issues posed by the teacher. Group discussions in this case do not imply repeated long-term collaboration, and are limited in time to around 10 up to 20 minutes.

*Student's experience* is an important element in this research and it is treated as a basis for comparison of the impact that digital collaborative tools have on group discussions. In the case of this study, students' experiences primarily consisted of their opinions, attitudes and impressions formed as a result of participating in a group discussion. These concerned students' general perception of group discussions, and specifically their perspective on the teacher's level of involvement, subject of the overall course and of this particular lesson together with the challenges it posed, the feeling of belonging to a group and communication through the video conference platform Google Meet.

## 1.3 Problem statement

When reviewing currently available literature around the topic of online education during the COVID-19 pandemic, we noticed that lessons that were initially designed to be conducted in face-to-face classrooms were oftentimes involuntarily transferred into an online environment.

This was made without many adaptations, thus compromising on the social interactions and group discussions (Chaturvedi et al., 2021; Jung & Brady, 2020; Santiago et al., 2021). Research has shown that the advantages of online classes are less likely to apply to younger, dependent learners, as they may not yet possess certain skills related to self-motivation, structure and time-management that would allow them to engage optimally in remote education (Di Pietro et al., 2020). Furthermore, the majority of students of a younger age have before the pandemic not been in the position of participating in online classes, since the fundamental idea of Swedish elementary and upper secondary school is to be conducted in a face-to-face classroom (Sjögren et al., 2021).

A few studies regarding online discussions have shown that students often display low rates of participation, which can possibly result in a negative impact on the discussion in regards to coherence, depth and efficiency (Lee & Recker, 2021). This has also been proven true in face-to-face classroom discussions, where “64% of students never, rarely or only occasionally asked or responded to a question in the classroom” (Caspi et al., 2008, p. 718). There is also a tendency for participation rates being even lower in web-based instructional environments (Caspi et al., 2008). Participation levels among students in class have been identified by Fassinger (1996) as relating to factors such as student confidence, interaction norms in class and student-to-student interaction.

Previous studies have explored different aspects such as social identities, the design of the discussion, gender differences as well as group sizes and how these factors impact students’ experiences and participation in group discussions (Caspi et al., 2008; Eddy et al., 2017; Lee & Recker, 2021; Pollock et al., 2011). There are also a number of studies that present ideal circumstances for collaborative learning online in general. These include sufficient instructions, involvement and guidance from teachers, meaningful tasks of appropriate size as well as the use of reliable and convenient technologies (Clark, 2014; Kirschner et al., 2014; Ku et al., 2013; Ng, 2012). Other research within the field has specifically focused on the use of different digital collaborative tools in learning, their influence on different aspects and the importance of incorporating them in a beneficial manner (Hernández-Sellés et al., 2019; Jaggars & Xu, 2016; Kirschner et al., 2014; Ornellas & Muños Carril, 2014). These studies are mainly limited to contexts of asynchronous education and/or formal cooperative learning (group work with longer duration) and some of the studies investigated digital tools from a more general perspective, as integrated in a course rather than implemented in a specific situation. Moreover, through the literature review we identified a trend of the focus for this research being on age groups of students within tertiary education. Presumably because that is where online education mainly and commonly has been implemented before the COVID-19 pandemic (Sjögren et al., 2021). Some more recent studies have also been presented regarding remote learning as a consequence of the COVID-19 pandemic. These discuss the impact it has had on students’ learning and how remote learning functions as a solution in this time (Dhawan, 2020; Di Pietro et al., 2020; Sjögren et al., 2021).

As our literature review has identified, there are many different angles from which the issues of online learning, group discussions and digital collaborative tools have been explored. However, the novelty of the situation that is being investigated in this paper is caused by the



COVID-19 pandemic that ties all these aspects together under the same umbrella of a unique context that is yet to be explored. As a result, when synchronous online classes are substituting education in face-to-face classrooms, there is a lack of research on younger age groups in online education and limited research covering the use of digital collaborative tools. This is where we see an opening in the research field. Taking this into account together with the previously introduced issues of low participation rates, we identify an opportunity for this study to hopefully lead to a research outcome that is valuable. The identified opening in the research field motivates the basis of this study, which is to investigate if digital collaborative tools could contribute to improved online, synchronous discussions.

#### **1.4 Purpose and research questions**

Drawing on the problem statement, it is evident that there is a need to identify how to maintain quality levels of education for younger learners when it is being transferred online. As online digital tools have previously been proven to support collaborative learning activities (Hernández-Sellés et al., 2019), there is an opportunity to explore the potential of using them in this major shift in how teaching and learning is conducted today. Furthermore, it is evident that improvements can be done in regards to participation rates both in group discussions and in lessons.

Therefore, the purpose of this study is to explore how, and to what extent, the use of a digital collaborative tool in online synchronous group discussions can influence the students' experiences.

The first research question of this study aims to measure the level of impact: **[1] To what extent can the use of a digital collaborative tool in online synchronous discussions influence the students' experiences?**

Through the second research question we focus on understanding what kind of influence digital tools have on collaborative activities of students: **[2] How does a digital collaborative tool impact students' experiences in group discussions that occur as part of synchronous online classes?**

#### **1.5 Scope and limitations**

The study has a limited target group consisting of students aged 12-16, who participate in remote, synchronous classes.

We exclusively investigate how a digital collaborative tool is used in informal cooperative learning groups. This entails temporary discussions and group constructions that have a limited duration from a few minutes up to one lecture (Johnson et al., 1998).

The aim is **not** to measure the objective performance of the students but rather the personal experiences of them when learning within this context.

We intend to study digital collaborative tools that are external to the video conference platform where the lesson is conducted. Specifically, this excludes video conference platforms and online environments used asynchronously such as messaging channels and discussion forums.

## **1.6 Disposition**

In the second chapter of this thesis work we describe our approach to the study, explain what methods we used to collect data and how these methods were relevant. The third chapter introduces theories and previous research that are applicable to our defined area of study. This is followed by presentation and analysis of collected data in chapter 4. Then, chapter 5 discusses the outcomes of the study. Finally, in chapter 6 we draw conclusions, specify how the result connects and contributes to the research field as well as make suggestions for further research.

## 2 Method and implementation

### 2.1 Approach

A quantitative approach was chosen as this methodology allows for retrieving numerical data that can explain trends, determine relationships between variables and compare participant groups (Roni et al., 2020a). Since the aim was to investigate the impact of using digital collaborative tools, they constitute the independent variable of the study and the dependent variable is the students' experiences, more specifically in the context of group discussions within synchronous online classes. The independent variable is the cause of an event, while the dependent variable is affected by the cause (Roni et al., 2020a). A quantitative approach was relevant to implement, since the aim was to be able to investigate the influence of the independent variable on the dependent variable in a comparative manner between the groups. More extensive data, obtained by using a quantitative approach, was assumed to allow for easier identification of patterns in the groups which further aligns with the aim of the study.

In this thesis work we followed experimental research design. An experimental study explores and evaluates effects on dependent variables that occur as a result of manipulating independent variables (Donnon, 2012). The main reason for implementing experimental research design in a study is "to demonstrate that any changes in a dependent variable are the direct result of implementing a specified intervention" (Gersten et al., 2005, p. 157). Since randomized assignment of participating students to control and experimental groups did not pose any empirical or ethical concerns, we decided to implement fully randomized design that would also decrease a potential of selection bias affecting the results. Our approach could be further categorized as a between-subjects design. In a between-subjects design each participating group is exposed to one condition only, and the comparison is then made by looking at the distinctions between the groups that were placed under different conditions (Bhandari, 2021). In the case of our study, it means that each group was either participating in group discussions with the usage of a digital collaborative tool or without, but there are no groups that combined both consecutively.

It is important to note that we did not deliberately select some particular students or school years for the experiment, but rather we let it be guided by the natural flow of recruitment of the teachers who happen to teach some students but not others. In connection to that, there were 4 students who partook in the experimental study twice, in groups both with and without employment of the intervention. Such overlapping was due to the fact that those students were enrolled into both courses that the same teacher professed. This made those 4 students perform as within-subjects in the experiment which means that "every individual receives each of the experimental treatments consecutively, and their responses to each treatment are measured" (Bevans, 2021, Between-subjects vs. within-subjects, para. 3). We believe that this minor overlapping does not pose any threats to the result nor to the validity of this study. Even though the majority of the participants were assigned to a single group only, those 4 students who took part in both group discussions, within control and experimental group, were still encouraged and able to share their perspectives by filling out a survey after each group discussion. Apart from that, there was no possibility to exclude those few overlapping

participants from one of the group discussions since they were incorporated into regularly scheduled lessons.

## **2.2 Research design and implementation**

### **2.2.1 Survey adjustments**

In order to collect information about how the digital collaborative tool impacted the students' experiences, we asked the students to fill out a survey after the lesson. Surveys are suitable for collecting information easily from a large number of respondents and they can be used to measure factors such as behavior, attitudes and emotions (Salkind, 2010a). The survey that we used is based on the Community of Inquiry (CoI) theory that, according to previous research, proved to be a reliable measurement tool of participants' involvement into cooperative learning processes (Stewart, 2019). The Community of Inquiry framework focuses on three main components: social presence, cognitive presence and teaching presence. This framework is further described in 3.3. In our study, we used the existing survey instrument, Community of Inquiry Survey developed by Arbaugh et al. (2008) that covers all of these main components. With adjustments made to the survey we aimed to ensure clear and straightforward communication with our target group.

As compiled and expressed by Roni et al. (2020b), there are several factors to consider in designing surveys specifically for young participants. These are, amongst others, using simple and explicit language, not including too many questions as well as being concrete and clear (Roni et al., 2020b). The structure and presentation of a survey can affect the data quality, as they have an impact on the motivation and concentration of the respondents, especially if they are younger (Omrani et al., 2019). To avoid issues with ambiguity, response bias, satisficing techniques and burden being placed on the respondents, the survey design needs to be clear, concise, consistent and simple throughout (Omrani et al., 2019). In the adjustments of the CoI survey for this study, these factors were considered.

The 34 items that the CoI survey consist of, we found to be more suitable for students in higher education in how they are phrased. This, together with items being written in English, made them less suitable for implementation within our target group and motivated the relevance of them being somewhat adjusted for this study.

The CoI survey that we took as a base is structured in a way that aims to gather students' impressions and attitudes with the intention to evaluate a course and offer quality improvements according to the feedback received. Research conducted by Bangert (2009) puts forward the idea that the CoI survey offers good prospects to be employed as an instrument to measure success and efficiency of online courses. When the survey instrument was initially created it was tested on students taking courses on master and doctoral levels (Swan et al., 2008). This is also where the survey seems to have a tendency to be implemented, with goals such as assessing bachelor and master courses (Watts, 2017). This is further exemplified in the systematic review by Stenbom (2018). Out of the 103 journal papers that were analyzed, a modest number of two studies were performed in elementary education and three within professional development, whilst the rest were in different levels of tertiary education (Stenbom, 2018). Above mentioned examples illustrate the most common ways and contexts where the CoI survey is utilized. Taking into consideration the

suitability of using the survey in online education, our end goal however was not to evaluate long-term courses but rather collect students' impressions. Therefore, some of the statements from the original CoI survey were not applicable to this study because the duration of a course is typically several months, while group discussions are single-time events that last for about 10 to 20 minutes. Adaptations to those statements were therefore made to concentrate on the experiences in group discussions instead.

Certain research has also concluded that it is of relevance to modify and refine the CoI survey items (Heilporn & Lakhal, 2020; Lowenthal & Dunlap, 2014), which further justifies us doing so in this study as well. These modifications are regarded as relevant due to the observation that certain items are overlapping and interpreted by respondents as asking about the same thing (Heilporn & Lakhal, 2020). The CoI survey instrument was also first developed in the start of the 21st century and since then there has been a major development in the digital world (Lowenthal & Dunlap, 2014). This also demonstrates the relevance for adjusting the items in order to ensure that they yield results that provide an accurate reflection and understanding of online teaching (Heilporn & Lakhal, 2020).

In addition to simplifying the existing CoI survey, it was further adapted to the young respondents by lowering the number of survey items (from an initial number of 34 to 20), displaying one question at a time and using word based response options. Furthermore, the instructions presented before the survey were accommodated to young respondents in both wording and length. The teacher was also asked to verbally guide the students through the instructions before they started the survey to ensure that every individual was fully informed.

### **2.2.2 Relevance of the teaching presence**

Teaching presence is the section that is least relevant for our study because it primarily assesses the contribution of the teacher to the course. However, in our study we try to find out about students' experiences in group discussions where the teacher does not have the same number of occasions to be present as during an entire course. Several group discussions that were part of this experiment took place simultaneously. This means that the teacher had less opportunities where they could impact the students and did not take the role of a moderator but rather occasionally guided the groups when needed. It was important to include the teaching presence to some extent, because all three elements in the Community of Inquiry framework are closely connected to and affect each other. As explained by Stewart (2019) teaching presence "puts students in situations where they are likely to develop sufficient social presence to support cognitive presence" (p. 39). Another important point is that over the past decade several researchers were continuously emphasizing the fact that teaching presence is a fundamental component of the CoI framework, and therefore no other presences can be cultivated without instructor's reinforcement (Stewart, 2019). This is why we came to a decision to keep teaching presence in the survey, and made necessary changes to the original statements so that they focus directly on the group discussions instead of a full course.

### **2.2.3 Readability tools**

Roni et al. (2020b) mention pilot testing as highly important in order to ensure a well-designed and appropriate survey. By using an existing, previously implemented survey instrument in our study we consider extensive pilot testing of the survey itself to be

redundant. This decision is further supported by the fact that this study is conducted within a shorter time frame of approximately 2 months. However, with the adjustments made to the established CoI survey, we believe there is a need for some type of further assessment. The altered CoI survey items were therefore run through several readability tools, in order to ensure that the phrasings are understandable for the age group of the participants. The survey items were tested on a total of four online readability tools and the average SMOG index was 9.1 which corresponds to sixth grade (StoryToolz, 2016; TextCompare.org, 2021; WebFx, 2021; wordcalc, 2020). To contextualise, the original survey items were also tested in the same tools and the average index for them was ~10.8, which also corresponds to sixth grade but is noticeably higher. As the final version of the survey items were also translated to Swedish, they were tested in a tool measuring their LIX value. LIX calculates a readability score based on the mean of words per sentence together with the number of long words that consist of more than six letters (Ezat, 2019). The LIX readability score of the translated survey items in this study was 39 which is within the range of the second step of the scale. It is interpreted to be classified as easy to read text and equivalent to the readability level of fictional literature and popular magazines (LIX, n.d.).

#### **2.2.4 Feasibility of the experiment**

In order to gather information about the current status of the school and get an insight into teacher's perspectives and experiences with online teaching, we decided to conduct a semi-structured interview before having the experiment. In addition to the readability tests, the teacher who was recruited reviewed our adapted survey statements, as they know the students' average level of comprehension. This was done to further confirm the appropriateness of the language used.

Through the semi-structured interview, the responding teacher confirmed that the survey was suitable for the intended target group. A note of the somewhat wordy instructions was made, in regards to the low probability that the students would read them entirely. As a result, we decided to adjust them by adding clear and concise headlines to each instruction. The teacher also assessed the digital collaborative tool in question, Padlet, and concluded that it would be possible to implement it in a functional manner during group discussions despite the participants being first-time users. A need for continuous collaboration was also discovered, in order to solve certain digital aspects before the experiment was conducted.

It was also established, through the semi-structured interview, that the responding teacher had not regularly used digital collaborative tools during previous lessons or group discussions. However, the teacher had occasionally used different digital tools in full class to host quizzes, such as Kahoot. When asked about group discussions, the teacher described a definite decrease in possibilities and additional difficulties to conduct them when having lessons online compared to the situation in a physical classroom. The teacher explained that it had been tried one time before, but with deficient results. The main issues that were expressed concerned the organization of online group rooms, supervision of the discussions and therein the subsequent difficulty of securing that the task was executed properly or at all by the students. The teacher also expressed an ambition and hope of being able to implement these types of group discussions online.

The school used Google Meet to host their online lessons, but altered that with having the students present in school some weeks. In further communication with the teacher after the interview, it was discovered that the school did not use the paid version of G Suite Education which would enable the break out room function. Therefore, conducting group discussions needed to be done in an alternative, somewhat more complex practice. Insights received through the semi-structured interview were helpful when planning for and preparing the experiment in order to implement it in the most appropriate way.

### **2.3 Work process**

The initial step of the study was to design and adapt the survey that was intended for the students to answer after participating in online group discussions. The strategy of how the digital collaborative tool, Padlet, would be incorporated was also proposed in the initial stages. We, the researchers, were not responsible for executing the lessons ourselves where the group discussions took place, but it was incorporated by a teacher at the school. Therefore, the strategy was initially seen as a proposal that could possibly be altered depending on the teacher's ability to implement it.

In the next phase of the study, we contacted the school and communicated our plan for the study and roughly how it would be carried out. This was done through the principals and after having their approval we reached out to a teacher to conduct the semi-structured interview. A semi-structured interview is an informal conversation based on a set of questions that researchers decide in advance, yet it proceeds in a way that allows some flexibility to deepen into certain relevant issues (Longhurst, 2016). We have chosen this interview format because it both served as a guideline for us to navigate through the questions, while it also offered enough freedom to explore some particular topics that emerged as the conversation was flowing.

The interview was conducted digitally through the video conference platform Microsoft Teams. It lasted for 50 minutes and was recorded in order for us to review it further afterwards and be able to accurately reference what had been said. As part of the semi-structured interview session we introduced the digital collaborative tool Padlet and demonstrated to the teacher how it could be used.

After recruiting a teacher who expressed an interest in implementing group discussions, we entered into the negotiation phase with a common goal of finding the most suitable and convenient way to conduct the experiment. The factors that were discussed together with the teacher regarding the implementation of the study at this stage were: randomized placement of students into group discussions, the choice and usage of an appropriate video conference platform and how to enable online group rooms, as well as structure and creation of the Padlet boards. This communication process was continuous over a two-week time period in order to ensure that the study would be feasible and be planned to yield valuable results.

The next step was to conduct the experiment and carry out group discussions as part of regularly scheduled online lessons. Since the objective of this study was to discover how, if at all, a digital collaborative tool affects the students, we intended to minimize the teacher's active involvement. Research suggests that instructors who strive to be ever-present will not

ensure high levels of teaching presence but rather prevent students from actively participating in the learning process and discourage them from taking the initiative (Watts, 2017). This is why we aimed to keep the main focus on the digital collaborative tool and prevent the teacher from acting as another intervention and influencing students' experiences.

## **2.4 Data collection**

The data was collected from 25 students, where 10 had participated in group discussions **with** the use of a digital collaborative tool and 15 had participated in group discussions **without**.

The population that this study is researching, as previously defined, consist of students at the age of 12-16. More specifically, the population is students in Sweden who at the time of the experiment received education fully or partially online. There were, in the school year of 2020/21, a total of 4,789 comprehensive schools in Sweden (Skolverket, 2020). This is the population of which a sample for this study was selected to collect data from. Although not all of these schools can be assumed to include 12-16-year-old students, and therefore not be a viable sample in this study, the number indicates a generous selection of alternatives.

The school that was part of this study was selected since one of the researchers previously attended this school. The personal connection to the school is further discussed in section 2.7.5. In this study there were multiple levels of sampling, and therein recruitment, that was required. Firstly, as mentioned, a school needed to be chosen and contacted. Secondly, one or multiple teachers needed to be recruited. A teacher was recruited who would conduct the experiment with two different groups of seventh graders. The two participating groups were not deliberately selected due to any particular characteristic that they possessed as a group. The only important requirement was that the two groups were as similar as possible to exclude confounding variables, which could in theory be achieved by several other group combinations as well. These seventh graders were then the third level of sampling, and the recruitment involved prompting the students to answer the survey.

Both of the research questions were aimed to be answered by the data collected through the CoI survey. All survey items had six different response options in order to measure the extent of agreement that a student had regarding each statement. The response options were presented in Swedish and were phrased as follows (translated to English): A = "I strongly disagree", B = "I disagree", C = "Neutral", D = "I somewhat agree", E = "I agree", F = "This question does not apply to my experience". Each survey item was presented separately to ensure clarity and allow the respondent to focus. The survey was distributed online through the website Question Scout where the responses also were stored.



[↑ Gå tillbaka](#)

Läraren förklarade tydligt för oss vad uppgiften handlar om och vad vi skulle göra i gruppdiskussionen / gruppuppgiften.

☐ A Jag håller verkligen inte med

☐ B Jag håller inte med

☐ C Varken eller

☐ D Jag håller med till viss del

☐ E Jag håller helt med

☐ F Denna fråga passar inte in på min upplevelse

För att skicka in måste du välja ett alternativ

Nästa → Eller tryck på Enter

*Image 1. Example of a survey item as it was presented to the respondents on the website Question Scout.*

To answer the first research question, the data needed to be easily compared to identify differences between the two groups. By opting for close-ended questions we ensured that the survey participants were confined to a selection of predefined response options. This also meant that we could more easily analyze the data in a comparative manner. In order to answer both of the research questions, the collected data also needed to consist of some evaluation which could be translated into numerical values. When analyzing the data, this would allow for easy identification of different trends and the direction of them. By using the Likert scale as response options this was made possible.

The original CoI survey instrument uses a 5-point Likert scale, ranging from 0 (= strongly disagree) to 4 (= strongly agree), to score the responses (Arbaugh et al., 2008). Therefore, it was also chosen for the survey of this study. An additional opt-out possibility for situations when the statement did not apply to the student's experience was also included. This is due to the previously mentioned fact that the CoI survey instrument initially was developed to be suitable for evaluation of courses at tertiary levels. The same items, although rewritten, in this context could therefore sometimes be not applicable. The Likert scale was also selected because it is a suitable option for younger respondents compared to both dichotomous scales and multiple choice formats (Omrani et al., 2019). The Likert scale, unlike dichotomous scales, offers a way to measure intensity and is less probable to cause correct guessing in comparison to multiple choice formats (Omrani et al., 2019).

## 2.5 Data analysis

In order to examine quantitative data collected through the use of the survey we employed statistical analyses. According to Drew et al. (2008a), the use of statistical analyses is appropriate for discovering “what occurred and whether ... [an] intervention or treatment was effective” (p. 244).

Initially, each response option in the survey was verbally labeled, but to allow for numerical analysis of the data the options were later translated to a number between 0 and 5. The neutral point is represented by a 3, where any value larger than that ( $> 3$ ) indicates an agreeing attitude to the statement and any value smaller than the neutral point ( $< 3$ ) indicates a disagreeing attitude. The opt-out response option was translated to the value of 0, as it indicates a statement that was somehow deemed not applicable to the students’ experiences.

The second step of familiarising with our data meant putting each of these translated values in a spreadsheet. This provided an overview of the answers of each respondent for all survey items and allowed for reviewing the collected data. Mertens et al. (2017) explain how cleaning data means increasing credibility of the results by removing unreliable data or invalid cases. The decision to delete a case should be made carefully, but it is important to do so when it threatens the reliability or validity of the study (Mertens et al., 2017). This was considered when reviewing the data collected in this study, to ensure credible results before analysing them further. Extreme tendencies and so called outliers, where the values of a case are extreme in any direction (Mertens et al., 2017), were the types of unreliable data that were most probable to appear in this study.

In order to present the data in a convenient and effective manner, we constructed a contingency table. Each survey item was put in the rows, with the mean from the two different groups and the difference between them displayed in the columns. With the use of cross tabulation in a contingency table our aim was to analyze and showcase the correlations between the multiple variables. Cross tabulation is used to categorize, group and classify data to allow for comparisons (Sreejesh et al., 2013). Typically, contingency tables are designed so that demographic factors are represented in the columns which can be seen as “indicators of state of mind” (Sreejesh et al., 2013, p. 174). The rows represent the behaviour of the different states of minds, which then allows for comparison and analysing connections between the two factors (Sreejesh et al., 2013). The table we present in this study displays the group as either control or experimental as an indication of state of mind, whilst the attitudes are documented as the means of the survey responses. Therefore, this allows us to compare and identify potential relationships between group belonging and attitudes.

The first research question of this thesis aims to examine a potential difference between the usage and non-usage of a digital collaborative tool and therefore, inferential statistics were relevant to use. According to Drew et al. (2008c), inferential research is helpful in building conclusions when it comes to comparison of or relationships between the data. Therefore, a comparison of the data collected from the experimental group with the data collected from the control group was made. It was done by reviewing the size of the variation in the data collected from the two groups. Calculating the mean of each item from the CoI survey

enabled us to differentiate the levels of impact that digital collaborative tool, Padlet, and its absence had on students' experiences in group discussions.

When comparing means, with the intention to identify if they differ, the simplest way is to just inspect the mean values and draw conclusions based on them. However, when doing that it would only be possible to infer about the observed samples instead of the entire population (Iversen & Norpoth, 1987). By using inferential statistics, such as the analysis method student's t-test, researchers can determine whether the results are statistically significant which implies that the means are also representative of the population where the samples are drawn from (Boslaugh, 2012; Drew et al., 2008c). When results are proven to be statistically significant, it also means that the observed difference between them did not occur based on chance or random error but instead can be interpreted to have occurred based on a true relationship between the variables (Tashakkori & Teddlie, 2009).

Since we wished to infer about the effect of a digital collaborative tool beyond our drawn sample, we decided to test the significance level. There are several assumptions about the data that have to be met in order for researchers to be able to conduct the previously mentioned student's t-test (Boslaugh, 2012). According to Boslaugh (2012), one of the assumptions requires that "the population from which ... [a] sample was drawn has an approximately normal distribution" (p. 156), which was not the case with our data set. Since we were unable to fulfill all the criteria for conducting a t-test, we opted for the alternative nonparametric equivalent of the unpaired t-test known as Mann-Whitney U test.

In the Mann Whitney U test, a null hypothesis ( $H_0$ ) is assumed to be true until proven otherwise by analysis (Willard, 2020). As explained by Herzog et al. (2019) "the null hypothesis claims that, even though an observed difference of sample means occurs, the difference comes from undersampling, i.e., from the noise-alone distribution" (p. 33). The researcher should also state an alternative hypothesis ( $H_1$ ). Our hypotheses for this study were as follow:

Null hypothesis: There is no difference between the two groups.

Alternative hypothesis: There is a difference between the two groups.

A U-value will be computed from the test which then will be compared with a critical U-value to determine whether the null hypothesis can be rejected (Willard, 2020). If the obtained value is smaller or equal to the critical value, the null hypothesis can be rejected which implies that the difference is real within the population and not caused by chance (Willard, 2020). The purpose of calculating if the results are statistically significant, can therefore be seen as preventing us from drawing faulty conclusions about the population. The significance in itself does however not disclose anything particular about the results of the study, which implies that further discussion and presentation of the effect size is necessary (Herzog et al., 2019).

The effect size of the results is therefore also reported in this study as it indicates the magnitude of the effect (Durlak, 2009; Grissom & Kim, 2011). This is helpful for answering the first research question of this study, as it serves as a measurement of the extent of the observed difference. Reporting the effect size is also strongly advised and considered important according to several articles, in order to communicate the importance of the

findings to the reader in a clear way (Fritz et al., 2012; Grissom & Kim, 2011; Thompson, 2007). The most straightforward estimate of effect size is directly comparing the difference in the means of the groups (Durlak, 2009; Fritz et al., 2012). However, this often means that it is more difficult to compare with the effect sizes of other studies which suggests standardized effect size calculations as a more appropriate choice (Durlak, 2009). This is further supported by the fact that a report of effect size based on the difference between the means does not take variability of the data in consideration which “can conceal important properties of the effect” (Fritz et al., 2012, p. 3). Therefore, calculation of the correlation coefficient, signified as  $r$ , with the help of the z-score which was proposed by Cohen (Fritz et al., 2012), will be used for this study. It is a calculation recommended by Fritz et al. (2012) to be implemented on data without normal distribution and where a nonparametric test, such as the Mann Whitney U, has been used. Even though reporting  $r$  is most appropriate in this study based on the qualities of the collected data and because it will yield more accurate results, it was also later translated into Cohen’s  $d$  in order to ensure that our findings can be put in the context of prior relevant studies so that reasonable conclusions can be drawn. The probability of superiority (PS) is also reported in this study in order to clarify the effect size in “a more concrete and meaningful way than the standardized difference” (Fritz et al., 2012, p. 14). As explained by Fritz et al. (2012) this statistic is presented as a percentage which represents the number of times “a randomly sampled member of the distribution with the higher mean will have a higher score than a randomly sampled member of the other distribution” (p. 14).

The second research question addresses the nature of impact (positive and negative) that a digital collaborative tool, Padlet, has on students’ experiences. To interpret and present our findings related to this research question we utilized descriptive statistics. These allow for evaluation and explanation of performance, scores or characteristics of groups (Drew et al, 2008a). By aiming to describe the type of impact that a digital collaborative tool had on students’ experiences in our sample, it was suitable to provide central tendency measures. The arithmetic average was calculated in order to reflect whether the CoI was more present in the control or in the experimental group. This was also helpful in establishing whether the digital collaborative tool contributed to a more productive and engaging group discussion or if it had a negative effect on students’ experiences. The use of central tendency measures, and more specifically the mean values, helps us to identify the most common and frequent responses in both groups, which are then used as a basis for making judgements about the kind of effect that a digital collaborative tool brought into group discussions.

Bar graphs were created to visualize the aspects of the students’ experiences where the digital collaborative tool had the biggest impact. The six items where the mean of the answers from the control group differed the most from the experimental group were selected. Visualizing the distribution of answers from each group for these six items allows for easier identification of the nature of impact.

## **2.6 Validity and reliability**

In this section we address the most important factors that were taken into account in order to ensure that the methodology as well as the overall thesis work are valid and reliable.

### 2.6.1 Reliability

Reliability and validity are the primary and most desirable properties of assessment tools (Bangert, 2009; Carrig & Hoyle, 2011). Replication is fundamental in scientific method, but by using measurement tools that are not reliable means that the research results are not replicable (Swan et al., 2008). There are several approaches to ensure that an assessment tool is reliable which often depend on using “statistical models of measurement and/or definitions of the set of replications across which reliability will be assessed” (Carrig & Hoyle, 2011, p. 129). A simple method to ensure reliability of a survey instrument is to provide clear and unambiguous measures. This would be done in order to ensure that, if repeated with the respondents, the results from the survey would to a large extent be similar (Andres, 2012). This was one of the goals of adjusting the CoI survey items to accommodate the target group of this study, as previously described.

Validating a test or an assessment instrument is a process that spans over an extended period of time and includes several independent studies that utilize that test or assessment instrument to produce evidence of its usefulness and relevance (Bangert, 2009). Even though many papers suggest that additional investigations should be conducted to further prove the validity and appropriateness of the CoI survey in a variety of contexts, Bangert (2009) asserts that “there is adequate evidence to date to support the use of the CoI survey in its present form as a formative assessment that can be used by faculty to improve the design and delivery of their online courses” (p. 111).

According to Arbaugh et al. (2008) “Cronbach’s alpha yielded internal consistencies equal to 0.94 for teaching presence, 0.91 for social presence, and 0.95 for cognitive presence” (p. 135). This indicates that a set of statements for each presence is truly measuring the same fundamental notion, which in turn proves that CoI survey is a reliable assessment tool. Furthermore, the CoI survey has through multiple other studies been shown to yield reliable and valid results (Stenbom, 2018). This has been concluded through both exploratory and confirmatory factor analysis in these studies that were conducted over a span of about 10 years in different learning contexts (Stenbom, 2018).

Sample size is another factor that impacts the reliability of a result, where the larger it is the more reliable it is as it holds greater statistical power (Roni et al., 2020c). Sample size also affects the generalizability of the result which is part of the external validity (Roni et al., 2020c). There is however no definite number that dictates what an adequate sample size is (Drew et al., 2008c). Some researchers present numbers such as 12-14 respondents as a rule of thumb when comparing groups (Drew et al., 2008c) whilst others define 30 respondents per group as the suitable minimum (Strunk & Mwavita, 2020). This indicates that there is no agreed upon minimum that can be applied in every study, but rather researchers should when deciding a sample size “use their best judgment and consultation resources” (Drew et al., 2008c, p. 310). In other studies where the CoI survey has been employed for data collection, there has been a wide range of sample sizes. In the systematic review conducted by Stenbom (2018), the sample sizes vary from five respondents as the lowest number to 64,781 respondents as the highest, with a median value of 158. The sample size of this study, being 34 participants, places itself on the lower end of the spectrum. In total 25 respondents filled

out the survey, out of which 10 students participated in the experimental group and 15 in the control group. We find it to be a realistic sample size that also can be considered reliable in relation to the scope of this study and the context in which it is performed. The context, compared to tertiary levels of education, means that each class group is smaller and it would have been necessary to recruit more teachers, in order to gain a larger sample size. Although larger sample sizes are preferred in regards to generalizability, small studies can also yield valuable results particularly when they are part of early research within a specific area (Slavin & Smith, 2009).

### **2.6.2 Internal validity**

Despite the CoI survey being a reliable measurement tool according to previous research (Arbaugh et al., 2008; Bangert, 2009; Kovanović et al., 2018; Swan et al., 2008), there are still some possible errors that can occur in the measurements. According to Lund Research Ltd (n.d.a), errors emerge due to some circumstances affecting the true value of the measurable component. These errors could arise as a result of factors like respondents' current mood, degree of tiredness, overall wellbeing, ability to focus or distracting environments (Lund Research Ltd, n.d.a). The impact of these errors may result in students' evaluations to not be precise representations of their actual experiences in group discussions which might decrease the internal validity of the experiment. In this study, the students' responses could therefore in some cases be a combination of their true evaluation with some degree of error. Although the errors specific to this study are not possible to control by the researchers, it is important to acknowledge the chance they have of impacting the results.

In order to establish internal validity, it is important to eliminate common threats and ensure that there is a causal relationship between variable A, the cause, and variable B, the outcome (Martin & Bridgmon, 2012). When a study cannot ensure internal validity, the results are most likely deriving from another cause than the one intended to be investigated (Slack & Draugalis, 2001).

To ensure that the causal relationship between the two variables is direct, a potential third, uncontrollable variable needs to be minimized as that otherwise can lead to impacting the result and the appearance of the relationship between the two variables (Salkind, 2010c). The potential confounding variables in a study like this could have been for example the possible different ages of the respondents, differences in instructions from the teachers and differences of subjects discussed. Eliminating these potential differences and making the intervention the key difference between the experimental group and control group will support arguments that the outcomes are attributable to the intervention (Capraro et al., 2019; Roni et al., 2020a). Our aim was therefore to diminish the effects of the external factors that we could control by ensuring that both control and experimental groups were placed under the same conditions. This was achieved by comparing online group discussions that took place in grade 7 among the students of the same age, 13, and within the same subject group. Furthermore, both the control group and experimental group can be assumed to have received similar instructions and guidance through the discussions as they were given by the same teacher. There are numerous participant-led determinants that may influence the outcome of the study yet are impossible to control by researchers (Lund Research Ltd, n.d.a). According to Donnon (2012)

“by randomizing learners ... the researcher strives to anticipate confounding factors that may influence the internal validity concerns related to doing quantitative studies” (p. e82). Taking this into consideration, we made sure to avoid selection bias by randomly assigning students to control and experimental groups instead of assembling these groups based on some common characteristics that students might share.

Another potential threat that could reduce internal validity is experimental mortality which has to do with participant drop-outs. This type of threat is only critical when the dropout rates are significantly different between the groups that are being compared (Lund Research, n.d.b). As a general observation, Lund Research (n.d.b) notes that the longer the study lasts the higher are the chances of participant withdrawals. Loss of participants can cause misleading conclusions since it is difficult to state that the findings of the experiment are due to the intervention and not the drop-outs (Lund Research, n.d.b). One measure that was undertaken, in regards to minimizing the chances of participant drop-outs in our study, was asking students to fill out the survey while the lesson was still ongoing. As opposed to doing it in their free time intended for the break between classes, giving them the chance to do it during the lesson might increase the probability of them filling it out. Other measures that were taken concerned the survey design. By adjusting the survey to accommodate them we had the intention to lessen the required effort of the respondents and their perceived difficulty.

Another aspect that could lead to deceptive interpretations of the conducted study is the possibility that those students who partake in group discussion without integration of digital collaborative tools might still utilize these tools on their own initiative, without realizing that this decision could interrupt the purpose of the study. In order to track these behaviours we decided to add a question at the beginning of the survey, asking the students if they used any digital collaborative tool during the group discussion. They could choose an option from a predefined list but also write the name of the tool in an open ended option labelled “Other”. An answer to this question would inform us if and how many students from both control and experimental groups used any supplementary digital tools. This knowledge allowed us to make credible judgements about relationships between students’ experiences and any interventions that affect them.

### **2.6.3 External validity**

The sample for this study is assumed to include students with different characteristics: boys and girls, students with different types of interests, students with varying grades, and from different family backgrounds. Including a broader variety of participants helps avoid sampling bias, which is when a sample is prevented from being representative of the overall population (Bhandari, 2020).

Due to practical concerns, most studies prioritise either internal or external validity, since they can have a tendency to impact each other’s effect (Drew et al., 2008d; Henry, 2009). Generalizability of the result, which is part of external validity, tends to be prioritised in later dimensions of research within the chosen field and when larger studies are conducted (Drew et al., 2008d; Slavin & Smith, 2009). By opting for a sample of groups that are more homogenous we exclude some confounding variables, which is beneficial for internal validity, but also sacrifice more generalizable results. This can be justified with the fact that this study

has a relatively small scope and time frame, but also as it is in early stages of the research program within this area. Druckman et al. (2011) also describe how “external validity results primarily from replication of particular experiments across diverse populations and different settings using a variety of methods and measures” (p. 34). Therein, external validity is not prioritized over internal validity in this study. Despite this not being the focus, there are still some circumstances of this study that contribute to the generalizability and external validity. For example, by reporting the calculated effect size, which is done in this study, the results become more generalizable (Grissom & Kim, 2011). The effect size allows researchers to compare across several studies (Fritz et al., 2012).

The ecological validity is high in this study due to the fact that the experiment was incorporated into an actual lesson instead of being conducted outside of school context for example in a lab setting with minimized extraneous variables. This increases the generalizability of the findings and makes them more applicable to real-life cases (Bhandari, 2020). Since the ecological validity is high, the findings of this study would not be able to be generalized to other settings outside of education, as there would most likely be different end goals of having a group discussion.

A threat to external validity is the Hawthorne effect which, according to McCambridge et al. (2014), is a change in behaviours of study participants caused by awareness of being observed. In our study, there was a slight possibility that students might have changed their behaviour and perhaps made more or less effort when participating in the group discussions. Such behavioral changes might root from students being informed of the experiment taking place as they work on the task within group discussions. Some other reasons could be a teacher joining the group discussions to listen in and check on students as well as the researchers observing the students as they work on the task. To reduce chances of the Hawthorne effect taking place and affecting the outcomes of this study, we refrained from attending the online lessons and discouraged the teacher to interrupt the flow of the group discussions unless absolutely necessary.

## **2.7 Considerations**

Several aspects were necessary to consider at the different stages of this research. Ethical, methodological and practical considerations are further addressed in the following sections of this chapter. These are relevant to reflect on prior to thorough development of the methodology and data collection.

### **2.7.1 Consent**

Getting consent means that potential respondents through an explicit act, such as verbal confirmation or written agreement, accept to take part (Gallagher, 2009). However, consent can only be given if the participant is informed about and understands certain factors of the research such as the purpose, structure and possible outcome (Gallagher, 2009). Valid consent also means that the participants are properly informed about their rights both during the study but also in the process of giving or refusing consent (Alderson & Morrow, 2011). Younger participants are vulnerable in their relation to adults due to the unequal social status and subsequent existent power imbalance (Gallagher, 2009; Roni et al., 2020b). This vulnerability can lead to the students feeling obliged to participate or coerced to do so (Gallagher, 2009).



This is strongly connected to consent, as valid consent is given freely “without pressures such as coercion, threats or persuasion” (Alderson & Morrow, 2011, p. 101). Therefore, it was necessary in this study to not only provide the option of giving or refusing consent, but also to provide information about this study and the rights that the participants had. As the participants of this study are of a younger age, the information that was presented needed to be easily understandable for that age group. Roni et al. (2020b) explain how considerations must be taken into account regarding both literacy and cognitive development of the respondents. Throughout the study the participants also had to have the possibility to withdraw their consent and be able to stop participating in the research (Alderson & Morrow, 2011; Gallagher, 2009). In order to conform with the above mentioned standards, students who were recruited to participate in our study were verbally informed about the experiment taking place by the teacher who was conducting the lessons. Furthermore, the survey that the students were offered to fill in started with highlighting the right of students to choose if they want to partake as well as their right to drop out at any time.

### **2.7.2 Anonymity and confidentiality**

Ethical considerations regarding confidentiality and anonymity are also relevant to include in our study. Anonymity can be seen as one form of confidentiality, concerning the act of maintaining the identity of participants secret (Saunders et al., 2015), where confidentiality concerns avoiding to disclose any information that has been provided by a participant which may identify them (ESRC, 2015). In research, the participants should be made aware of the extent of their anonymity and confidentiality (BSA, 2017). In this study, data that might identify the participants individually were not deemed necessary. For example, personal information such as gender or name was not collected, but rather the survey was restricted to identifying which group they belonged to (control group or experimental group) and prompting them to evaluate their experience. As explained by Saunders et al. (2015) “true anonymity is by definition never achievable, i.e. there will always be at least one person with access to participant information” (p. 617). However, by not documenting any information that identifies the participants, the classes or the school the aim is to ensure the anonymity of the individuals to the largest extent.

### **2.7.3 Young survey respondents**

Young respondents are generally more inclined to satisficing, where they tend to give answers they believe to be correct or expected by the researcher (Roni et al., 2020b). This is a factor that also had to be considered when setting up and conducting this type of study, in order to ensure honest answers that reflect the true experiences of the respondents.

When a respondent is satisficing, it means that they are giving superficial responses that they believe are reasonable or acceptable (Omrani et al., 2019). The satisficing theory developed by Krosnick describes how the combination of respondent and question characteristics has an effect on the reliability of the response (Omrani et al., 2019). This theory also describes a “strong relationship between the respondent’s cognitive ability and the reliability of responses” (Omrani et al., 2019, p. 330). Therein, this had to be considered in our research design, as the cognitive ability of younger respondents is different to the ability of adults. When designing a survey for young respondents some things to consider are that at the age of

12-16, the respondents are at risk of getting bored easily and lose motivation as well as being context sensitive and literal (Omrani et al., 2019). Aspects such as question type, response options, ambiguity and difficulty should then be handled with this in mind (Omrani et al., 2019). However, it is important to remark that the respondents of this study were at the age of 13 and there is an improved cognitive functioning of adolescents of this age compared to even younger kids, which means subsequently there is an increased reliability of their responses (Omrani et al., 2019).

#### **2.7.4 Communication with the school**

Other relevant considerations in the initial stages of the study were related to the communication with the school. Aspects such as flexibility, minimizing stress for the teacher and communicating benefits of the study needed to be considered. In order to ensure good relationships with a school, it is important to understand the characteristics of that specific school and have knowledge about the school system (Svirydzenka et al., 2016). It is especially important to understand and respect the primary objective of schools, which is to educate children, and the probability of them being busy and concerned with other matters than hosting a research project (Svirydzenka et al., 2016). Apart from being aware of it, the researchers can also take further measures by discussing the study with teachers to minimize disruptions and receive input as well as communicate the flexibility of the research in favour of the school's methods (Alibali & Nathan, 2010; Roni et al., 2020b). Furthermore, the researchers need to manage their own responsibilities in the research and through that minimize the burden of the school, the teachers and the students (Roni et al., 2020b). In the initial stages of the study, when contacting the school to seek approval of the study, the expectations of them as well as the connection between the study and beneficial outcomes for them as an educational institution should be clearly communicated (Roni et al., 2020b; Svirydzenka et al., 2016).

#### **2.7.5 Personal connection**

One of the researchers of this study has a personal connection to the school that was sampled, as it was the comprehensive school she studied at. This should not have had an impact on the data collection but was rather beneficial for the recruitment process.

This study had the aim to investigate students at the age of 12-16, but there were no specifications in regards to sampling a school. Therefore, the school was not chosen based upon any of its characteristics and could be replaced by any other school if the study were to be replicated. However, regarding the communication process with the school, the personal connection was influential, which means it is an important aspect to acknowledge. As it is estimated to have had a relatively large impact on the success of recruiting a teacher, the research process can be assumed to have had other issues or even results if there was no personal connection.

When determining which school to contact, instead of doing this randomly, this school was selected as it would simplify certain aspects when reaching out and communicating with them. As explained by Bartlett et al. (2017), getting access to a school for conducting research is time consuming and is often helped by an established and collaborative connection. If there would not have been a personal connection to the school, this would have been difficult to

achieve considering the time frame and scope of this study. Therein, selecting a school with which there was already a personal connection we hoped to balance the shortage of time. For example, the prior knowledge of the school that we had allowed us to focus on learning about details more closely related to the study itself. It also made the search process for contact details easier, as we knew how to navigate to that information.

Furthermore, as the process of recruiting teachers proved to be more challenging and time consuming than expected, the personal connection to the school was advantageous. In the initial stages of recruitment, we pursued a formal approach before recognising a need for direct and perhaps more informal communication in order to succeed. We acknowledge that this might have been more difficult or even impossible to do in a study where there is no personal connection to the school and teachers.

#### **2.7.6 Recruitment process**

The recruitment of participants is a critical part of the research process. This is further demonstrated by Salkind (2010b) who states that “the success of any human subject research project is usually only as good as the researcher’s ability to recruit the proper participants.” (p. 1226). The potential failure or success of a study can be determined by limitations that are related to the recruitment process, such as small sample sizes or that the sample fails to represent the population (Salkind, 2010b).

Every study is met by different types of challenges in the process of recruitment which can be related to the topic of the study and time frame (Voyer et al., 2008). Lack of participation in the study can be a result of for example the chosen recruitment methodology, participants misunderstanding the presented materials or the researchers not successfully convincing participants of the relevance of their research (Salkind, 2010b). These potential issues as well as the difference of each study needs to be acknowledged and addressed in the recruitment strategy. In this study, certain considerations needed to be taken into account specifically when recruiting. For example, the study required assistance and implementation from teachers which meant that recruitment of participants needed to be done in two stages: recruiting teachers for the experiment and thereafter recruiting students to answer the survey. Another consideration was related to the shorter time period of the study, as the recruitment process needed to be confined in the specific time frame. The recruitment process was just one of the stages in the research process and time was also required for other stages, such as the experiment. One underlying aspect that needed to be considered was the COVID-19 pandemic and its impact on the recruitment process.

#### **2.7.7 Pandemic**

This study was initiated as a result of education being transferred online, which in turn was due to the COVID-19 pandemic. However, the pandemic also affects most aspects of the research process and therefore the study cannot be regarded as typical research in a school. Some considerations that are normally important in research conducted with children or in schools may be invalid in this case due to the current circumstances. Similarly, other considerations that are necessary in this situation may typically not be regarded in comparable studies. Therein, when designing the research method of this study, related studies and their

considerations might have been applicable as references but greater consideration might have been needed for other certain aspects.

Furthermore, each school has implemented different solutions of how to conduct online education during the pandemic. The individuality of each school's strategy needs to be considered in a study similar to this, as it also may affect the research implementation. For example, their general structure of online education, digital platforms and tools that they use as well as adaptations or changes they have implemented since transferring online.

### **3 Theoretical framework**

In this chapter we introduce a theoretical foundation that is necessary to become familiar with in order to address our research questions. Concepts such as collaborative learning, group discussions and Community of Inquiry are covered.

#### **3.1 Collaborative learning and group discussions**

Several studies have illustrated the beneficial consequences of collaborative learning and group discussions. Group discussions have been shown to enable learners to improve their conceptual understanding, support high levels of analytical skills and strengthen the learners' critical-thinking (Ku et al., 2013; Pollock et al., 2011). According to Jung and Brady (2020), interpersonal communication that occurs within a class offers a possibility to digest and analyze ideas expressed by other students and apply their interpretations to one's own understanding of a concept in order to make sense of things. Collaboration has also been shown to be helpful in, and have a positive impact on, problem-solving activities (Ku et al., 2013). Research suggests that social interaction is an essential element that leads to productive learning (Center for Advancing Teaching and Learning Through Research, n.d.).

#### **3.2 Collaborative learning in a digital context**

With a growing number of technological developments, there is an opportunity for teachers to become more creative and experimental with the structure of the lessons and their levels of engagement, which digital tools offer a variety of options to achieve (Akbar, 2016). Research suggests that “designing an interactive and participatory online learning environment is important for fostering positive learning experiences” (Brown et al., 2016, p. 52). Online collaborative learning and the use of technological tools in general have been connected to enhanced means of communication (Hernández-Sellés et al., 2019; Jones, 2016). Specifically synchronous discussions provide possibilities for participants to feel more group-belongingness and remain focused on the task at hand (Jones, 2016). An important factor to ensure effective and more extensive learning in a digital context is to plan and thoughtfully implement the online courses (Clark, 2014). Brown et al. (2016) emphasize the importance of clear instructions provided by the teacher, open-ended questions that encourage critical thinking, and creation of an atmosphere that feels safe and therefore stimulates productive exchange of opinions and ideas in online discussions. Online learning has been shown to have the potential to offer the same, or even slightly higher, levels of efficiency as traditional face-to-face programs have, provided that the curriculum materials and instructional methods are accommodated to the chosen context (Clark, 2014).

According to Shea and Bidjerano (2012), past meta-analytic research found that appropriate choice and use of instruments and methods to conduct online education have a small but positive effect on learning. As expressed by Reimann and Aditomo (2019), “more than 60 meta-analyses have appeared since 1980, covering thousands of individual comparative studies” (p. 303) that try to answer the question of whether digital instruments change education and make a difference in learning patterns. The same authors refer to a review that is compiled of 25 meta-analyses which consist of 1055 studies, more than 100 000 students and cover 40 years of research. It was found that “technology had a positive but relatively

small effect ( $d = 0.35$ ) on student achievement” as well as that “the effect was larger for K–12 ( $d = 0.40$ ) than for post secondary classrooms ( $d = 0.29$ )” (Reimann & Aditomo, 2019, p. 304). Similarly, the findings of Chen et al. (2018) show a medium effect size on group task performance and social interaction when extra learning environments or tools are being used. These consist of basic and enhanced online discussions, visual representation tools, group awareness tools, graphs or multimedia for instruction, adaptive or intelligent systems and virtual environments (Chen et al., 2018). The enhanced online discussion is described as a situation where “some extra electronic communication tools are provided for learners in the experimental condition, though learners in both the experimental and control conditions use the same learning platform” (Chen et al., 2018, p. 809). For this learning activity, the obtained effect size, in regards to students’ perceptions, also reached medium level. The effect size of another type of learning activity is presented in the synthesis of over 800 meta analyses from educational research, done by Hattie (2009). When incorporating concept mapping as a learning activity in the education, the mean effect size resulted in  $d = 0.57$ . The definition of concept mapping, provided by Hattie (2009), is an activity that involves creating “graphical representations of the conceptual structure of the content to be learnt” (p. 168).

Additionally, when investigating **how** digital tools were utilized, in the same review it was discovered that digital tools “had a larger effect when used to support instruction ( $d = 0.42$ ) than when used to deliver content ( $d = 0.31$ )” (Reimann & Aditomo, 2019, p. 304). Another meta-analysis that was based on nine studies which included a total of 419 students explored effects that technology has on second language learning. The identified average effect size across those studies was large with  $d = 1.12$  (Reimann & Aditomo, 2019). From these past studies it is clear that technology has a positive influence on both students and learning processes. According to Reimann and Aditomo (2019), its effect size values are different, but within the small to medium range, depending on the type of digital tool that was used, the age and previous experience of students as well as the learning area and subject being taught. The key message presented in the analyses by Reimann and Aditomo (2019) is that technology “will more likely be supporting learning if it is employed for the purpose of students interacting with content and interacting with peers rather than solely distributing and presenting content” (p. 307). Altogether, when implementing technology in education, the tools should be evaluated on their ability to support “student interaction, confidence, motivation and learning” (Jaggars & Xu, 2016, p. 281).

### **3.3 Community of Inquiry**

#### **3.3.1 Framework**

Community of Inquiry is a framework developed by Garrison et al. (1999), intended to identify important factors that ensure successful educational experiences in online environments. Teachers and students form a Community of Inquiry that is constructed of three interrelated core elements, namely cognitive presence, social presence and teaching presence (Garrison et al., 1999). According to Garrison et al. (1999), the cognitive presence entails the ability of CoI participants to construct meaning through stable communication. This presence also functions as the most underlying element in the CoI model in regards to ensuring success in higher education (Garrison et al., 1999). The second element, social presence, is defined as

the ability to display personal characteristics to the other participants within the CoI and primarily it supports the cognitive presence in regards to promotion of critical thinking (Garrison et al., 1999). Teaching presence constitutes the third element of the model and has two general functions, one being how the educational experience is designed in terms of course content, learning activities and assessments (Garrison et al., 1999). The second function is facilitation of the presence, which in comparison to the first function can be a responsibility of both teacher and participating students (Garrison et al., 1999). Teaching presence as a whole intends to support and enhance the other two elements in the model in order to enable learning outcomes (Garrison et al., 1999).

### **3.3.2 Survey**

In order to measure the Community of Inquiry framework, Arbaugh et al. (2008) developed an instrument called the Community of Inquiry Survey consisting of 34 items, where each of them reflects an element from the CoI framework (Stenbom, 2018). The instrument has been encouraged by Arbaugh et al. (2008) to be used in studies that investigate, for example, course outcomes, course characteristics' relation to the framework elements, comparison of courses and the implementation of technologies in courses. Furthermore, Arbaugh et al. (2008) mention both measuring "the impact of specific strategies and technologies" (p. 136) and finding definitions of best practices as possible objectives for using the CoI survey. As identified through a systematic review of studies using the CoI survey, conducted by Stenbom (2018), the most common area in which the instrument is implemented is e-learning. The studies reviewed were primarily focused on post-secondary level (Stenbom, 2018).

According to Watts (2017), the Community of Inquiry model is especially helpful when it comes to evaluating online courses because it was originally developed with a strong focus on computer-based interactions. The CoI survey incorporates digital environments, where the learning is taking place, into the process of course evaluation and this is what makes it different from many other course assessment tools and strategies (Watts, 2017). Surveys that are based on the CoI model and are designed to evaluate learning in an online context take into account all kinds of student- and instructor-initiated actions and their experiences (Watts, 2017). Constructive feedback gathered through the use of surveys and assessment tools based on the CoI is widely used by instructors and other staff within education in order to adapt courses and implement improved learning activities (Bangert, 2009).

## 4 Results

When reviewing the collected data, one case showed extreme tendencies by having the majority of the values invariable. It is inevitably difficult to determine what causes extreme tendencies (Meade & Craig, 2012; Mertens et al., 2017), in this case it could reflect a loss of interest from the respondent or, for example, be caused by environmental distraction. The decision to exclude this particular case from this study is motivated by the fact that more than half of the values were the same, namely 14 of the 20 responses. The repeated value was 0, which represents the opt-out option which further motivates the removal of this case, as it reflects that the items were considered non-applicable and this “no answer”-answer was given instead. Furthermore, if this case would be kept and included in the data analysis, there is a possibility that it would have distorted the final results to a certain degree, which we aimed to avoid. Therefore, the total number of respondents from which data is displayed in this section is 24.

The initial question of the survey was used to track whether the students took initiative to use another digital collaborative tool, separate from what was instructed in the experiment, as it could impact the results. However, the given answers for this question do not indicate that anyone did. The responses consisted of either Google Meet, Padlet or Google Docs which is how the text material for the task was distributed. Therein, we can exclude that the students used other extra digital tools that would foster collaboration or visualisation in a similar way that Padlet does.

		Mean values		
	Survey item	Experimental (n = 9)	Control (n = 15)	Difference
Teaching	Item 1	4.00	4.67	-0.67
	Item 2	4.33	4.33	0.00
	Item 3	3.56	4.13	-0.57
	Item 4	2.44	3.13	-0.69
	Item 5	3.56	3.87	-0.31
	Item 6	3.89	3.33	0.56
Social	Item 7	3.44	2.87	0.57
	Item 8	3.78	3.07	0.71
	Item 9	3.67	3.47	0.20
	Item 10	3.78	3.47	0.31
	Item 11	3.78	3.40	0.38
	Item 12	4.00	3.47	0.53
	Item 13	3.89	3.33	0.56
	Item 14	4.00	3.00	1.00
Cognitive	Item 15	3.67	3.20	0.47
	Item 16	3.78	2.47	1.31
	Item 17	3.44	3.07	0.37
	Item 18	4.22	3.13	1.09
	Item 19	3.78	3.20	0.58
	Item 20	3.67	3.53	0.14
<b>Total</b>		<b>3.73</b>	<b>3.41</b>	<b>0.32</b>



*Table 1. The mean values for each item from the survey calculated for each group, together with a number indicating the difference between them. The value n represents the number of respondents.*

Firstly, we constructed a table that displays mean values calculated for every item in the survey. These are shown separately for each group, where experimental represents nine students who partook in group discussions with the use of a digital collaborative tool, and control stands for 15 students who were placed in groups without an intervention. The total mean values reflect the overall Community of Inquiry observed in the two groups. The column on the right-hand side showcases the differences in the results between the experimental and control group. The numerical values in the table are based on the verbally labelled response options from the survey where 0 = “Not applicable”, 1 = “Strongly disagree”, 2 = “Disagree”, 3 = “Neutral”, 4 = “Agree” and 5 = “Strongly agree”.

When calculating the mean values for each survey item, several results were represented by numbers with a large scale, meaning that there were nine digits to the right of the decimal point. In order to maintain consistency when presenting the data and allow for clear calculations we rounded the values to the nearest hundredth so there are only two digits after the point.

As visualized in Table 1, mean values for each survey item vary between the groups, with the difference ranging from 0 to 1.31 points. The majority of mean values are higher for the experimental group with one survey item demonstrating identical average values and only four values being higher for the control group. Additionally, the table illustrates that those four survey items that were ranked higher by the students from the control group concern the teaching presence.

The largest differences between the groups regarding social presence are present within items 7, 8 and 14. They address, respectively, if the students consider communication online as a favorable method for working together, if they are comfortable communicating through the online medium, and if the task helped increase their overall interest in the subject. The mean values of the experimental group were larger on all of these items compared to the control group. The items with the smallest difference measured if the students were comfortable, both in regards to discussing and interacting with the other students as well as participating in the group discussion in general. The lowest mean values observed in the social presence are connected to item 7, which is the case for both groups. The overall highest values in the social presence from the experimental group are connected to items 12 and 14.

The two survey items with the largest difference overall are observed within the cognitive presence part of the survey. The first one concerned if the students used different sources during their discussion and the second one concerned if they found that the group discussion helped them understand how other students are thinking. The items 17 and 20 are where the two groups have the least difference between the mean values in the cognitive presence.

At first glance when looking at the total means in Table 1, the difference between the two groups appears as rather minor. In the following figures we look at the dynamics of the control and experimental group and how they compare. Examining these survey items, which

had the largest difference values, allows for a better understanding of what made the results the way they are. The response options are placed along the horizontal axis and the number of students along the vertical axis.

Figure 1 represents the 4th survey item and refers to the assistance of the teacher in regards to making students interested in the group discussion and encouraging active exchange of opinions. Almost half of the control group (~47%) expressed an agreeing attitude towards the statement, while only one third of the experimental group (~33%) was of the same opinion. Equal number of students from both groups reported their disagreement with the survey item, however their level of disagreement differs.

The teacher helped me to feel interested in the group discussion and to actively share my thoughts.

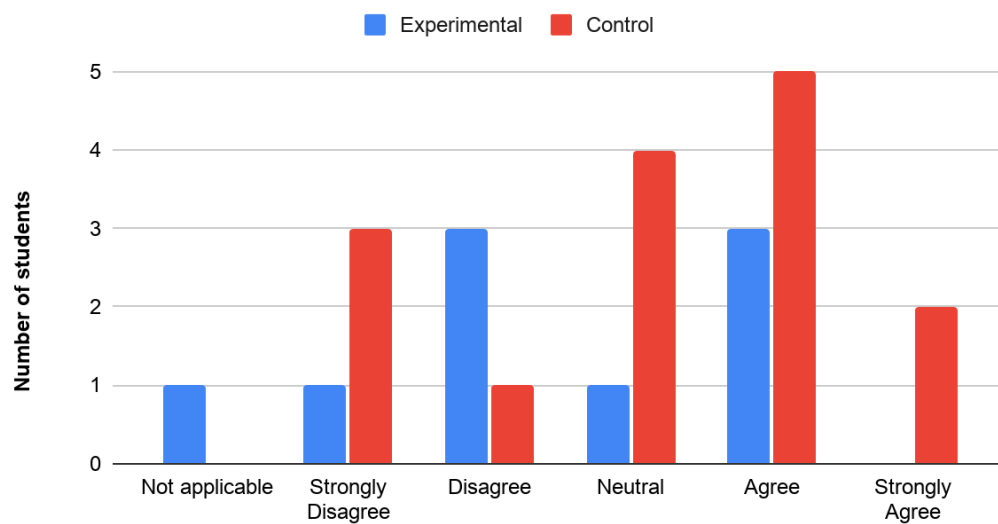


Figure 1. The distribution of answers given to Item 4.

When examining Figure 2 which concerns the first item of the survey and asks about the clarity of the teacher's instruction, we notice that all students in the control group demonstrated an agreeing attitude towards the statement. However, it is important to note the different degrees of their agreement, with 10 students choosing the “Strongly agree” option and 5 opting for the “Agree” response. The answers of the students from the experimental group are not as homogeneous. Nevertheless, it is clear from the graph that six students from the experimental group (~67%) also have an agreeing standpoint, with only a single person (~11%) indicating their disagreement.

The teacher clearly told us about the topic of the task and what we should do in the group discussion.

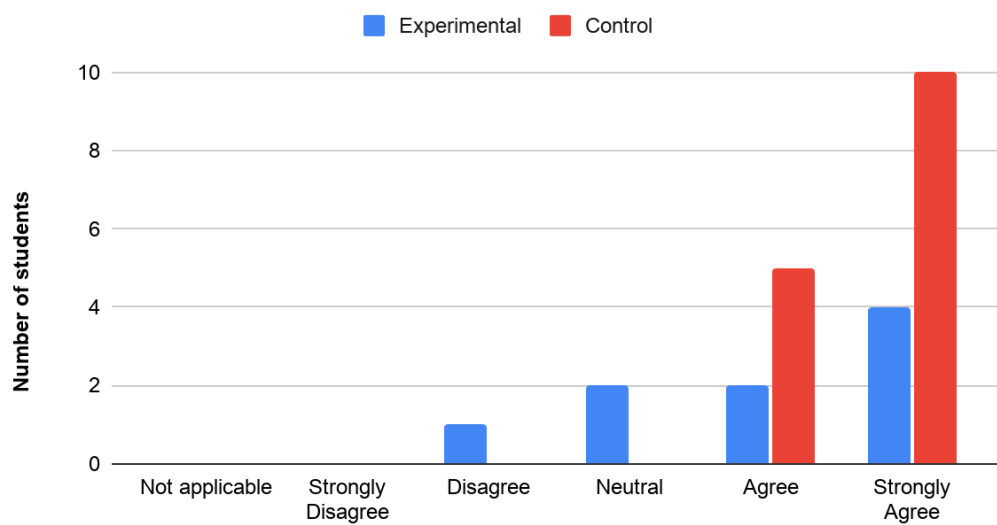


Figure 2. The distribution of answers given to Item 1.

Figure 3 corresponds to the survey item 8 and shows the distribution of students' attitudes regarding the convenience of communication via Google Meet. While there is only one person in the experimental group (~11%) who did not feel comfortable talking through Google Meet, the corresponding number is over a quarter (~27%) for the control group. Equal number of students from both groups expressed their neutral position in regards to the video conference platform. Six students from the experimental group (~67%) and eight students from the control group (~53%) indicated their positive standpoint when asked about the level of comfort provided by using Google Meet.

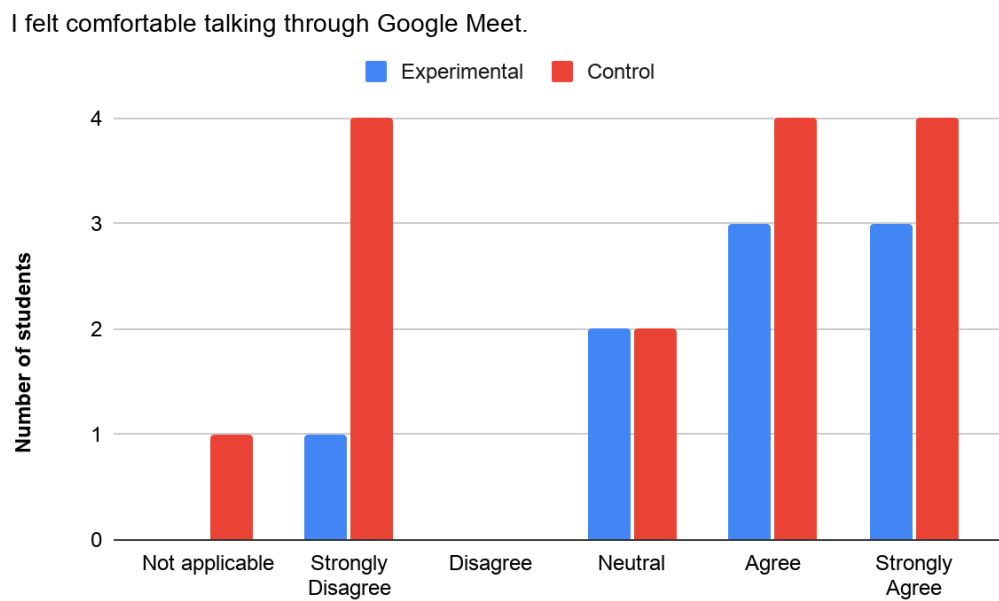


Figure 3. The distribution of answers given to Item 8.

Figure 4 represents the 14th survey item which concerns the respondents' agreement to whether the task created a further interest in the subject overall. The mean values between the groups differ with 1 point, where the experimental group has the higher one. Approximately 66% of the experimental group's values were above 3 (neutral) which indicates an agreeing attitude whilst the corresponding share in the control group was approximately 53%. The values that indicate a disagreeing attitude were fairly similar, representing 11% of the experimental group and 13% of the control group. However, these responses from the control group were represented by the value "Strongly disagree" whilst it was represented by "Disagree" in the experimental group.

The task that we had to discuss in a group made me more interested in the subject overall.

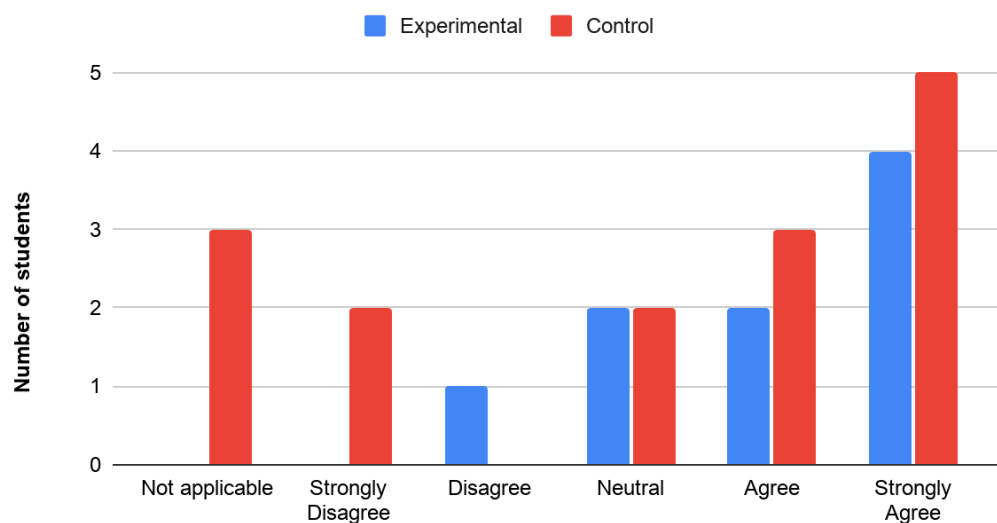


Figure 4. The distribution of answers given to Item 14.

Figure 5 displays the answers to the 18th item of the survey, which concerns how the group discussion contributed to the understanding of other students' views. As seen in the figure the experimental group has no values below neutral and approximately 78% of the respondents were above neutral, which indicates an agreeing attitude. The control group displays more scattered values where 60% are on the agreeing side, 13% are neutral and 13% are showing a disagreeing attitude to the statement.

Being in an online group discussion was valuable because it helped me get to know and understand the views of other students.

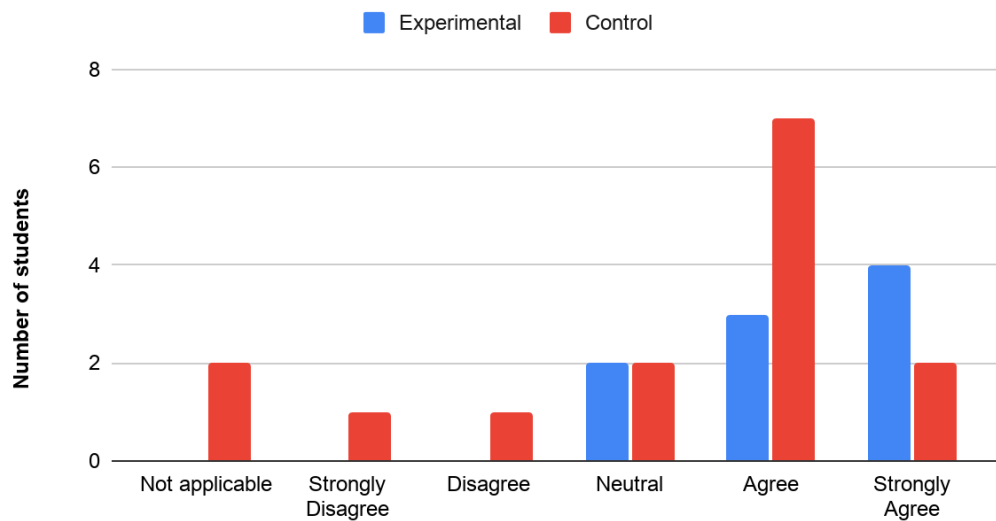


Figure 5. The distribution of answers given to Item 18.

Figure 6 shows the answers to item 16, indicating if the students used several sources during the discussion. This is the item that resulted in the largest difference, where the experimental group had a mean value 1.31 points larger than the control group. As visible in the graph, the values from the experimental group are mainly neutral or above neutral, whilst the responses from the control group are scattered across all options. The values from the control group that were below neutral, implying disagreement, represented 33% of the responses and 20% of the responses belonged to the category “Not applicable”. The experimental group had one response representing disagreement, which represented 11% of all responses.

I used several different sources when I was working on the task that we discussed in the group.

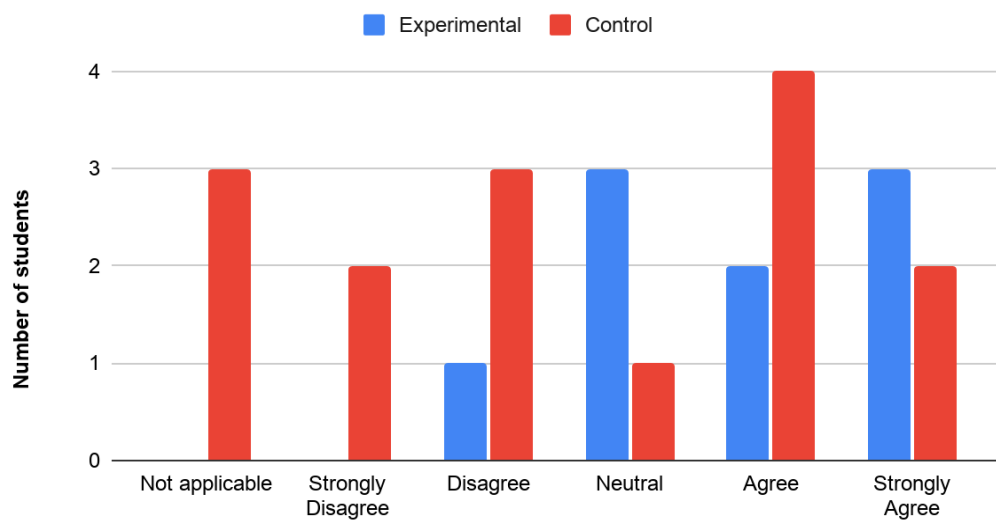


Figure 6. The distribution of answers given to Item 16.

When analysing the difference between the two groups more closely, the obtained U value of 94.5 from the Mann Whitney U test showed to be smaller than the critical U of 127 which indicates that it is statistically significant. Therein, we reject the null hypothesis. This suggests that the difference is real and was not obtained by chance. When calculating the effect size  $r$ , the obtained value was 0.45 which, according to the guidance provided by Cohen (1988), indicates an effect size that is between medium (0.3) and large (0.5). Converting the  $r$ -value to Cohen’s  $d$ , results in a value of 1.01. The A statistic represents the probability of superiority and in this study it equals 0.76 which means that when randomly selecting a student from the experimental group there is a 76% chance that their obtained CoI will be higher than the one of a student who is picked at random from the control group.

## 5 Discussion

In this section we discuss the findings of this research and place them in the context of previously conducted relevant studies. We analyse the results and the methodology, and then evaluate them in regards to the purpose of this study. Additionally, we provide answers to the research questions posed.

### 5.1 Result discussion

#### 5.1.1 Size of the impact

The first research question of this study intended to determine to what extent a digital collaborative tool can impact the students' experiences. As presented in the results, we can see that all items except one display a difference in mean values between the groups. The observed difference between the groups is further strengthened as true since the null hypothesis was rejected by calculating the statistical significance. The standardized effect size calculation illustrates in a more generalizable manner the extent of the difference and therein the impact of the digital collaborative tool, which makes it easier to contextualize and assign meaning to the results. With the obtained  $r$  value being 0.45, the effect size can according to Cohen (1988) be described as medium, but being closely adjacent to large which in a more explanatory way can, as described by Fritz et al. (2012), be labelled as a "subtle" effect (medium), close to an "obvious" effect (large). Although easily understandable and effectively descriptive, the interpretation of the effect sizes expressed through these labels varies based on the research area (Fritz et al., 2012). The labels are also not advised to be used as the exclusive indicator of the study's practical importance (Fritz et al., 2012). Therein, further discussion regarding the effect size as well as comparison to other studies within this area of research is needed to better understand the weight of the results. For example, the probability of superiority value clarifies the impact further in a more comprehensible manner, where the obtained 76% shows that the result from the experimental group displays a pronounced superiority compared to the result of the control group.

Complementary to the guidelines provided by Cohen (1988) on how to interpret the obtained effect size value, Hattie (2009) suggested a barometer, with values of Cohen's  $d$  as the scale, to indicate if a teaching method is worthwhile in relation to other alternatives. With this barometer as measurement we can determine that the effect size of this study is within the range labelled *zone of desired effects* (Hattie, 2009). This points to the usage of digital collaborative tools being in the same area as the "influences that have the greatest impact on student achievement outcomes" (Hattie, 2009, p. 19). We can therefore, by evaluating the effect size of this study, determine that the implementation of digital collaborative tools can be seen as worthwhile. The effort that is required in order to incorporate the tools functionally is through these results assured to have the potential to ultimately bring valuable and effective results. Although a potential implementation is inevitably an assessment that needs to be made by each individual teacher, taking into consideration the circumstances regarding their group, these results serve as a guidance within that decision.

Examining the reported effect size estimates of other studies within similar research areas and comparing them to the obtained effect size of this study also makes it possible to understand



and more easily convey the magnitude of the results. As described by Durlak (2009), “the best comparisons occur when the designs, types of outcomes, and methods of calculating effects are the same across studies” (p. 924). However, due to the novelty of the researched subject in this study, it is difficult to find research that is highly resembling in all aspects, from research design to outcomes. However, by comparing our findings with research which involves testing the use and effect of digital tools in various learning environments we can still gain a useful insight in the typical influence of this phenomena and therefore put the result of this study into context.

The findings presented by Chen et al. (2018) correlate with this study with the obtained medium effect sizes for group task performance, social interaction and partially students' perception. Both the use of extra tools and sometimes the learning activity, for example with the enhanced discussion, are resembling closely to the situation of the experiment in this study. The comparison of the effect sizes is therefore particularly suitable since the novelty of this study makes it more difficult to find highly resembling studies, as previously discussed. It further strengthens the meaning of the similar outcomes, which can be interpreted more literally than comparisons with other studies that need to be viewed more as indications.

Furthermore, the findings from the synthesis by Hattie (2009) concerning concept mapping are, similarly to the research from Chen et al. (2018), relevant for comparison to this study. Their findings align with how the digital collaborative tool was used in this study and what aspects of the learning activity it influenced. Both of the estimated effect sizes, from Hattie (2009) and this study, place themselves in the *zone of desired effects*. This is despite the different contexts, as in comparison to the studies synthesized by Hattie (2009), which were from face-to-face classrooms, this research covered online learning. This indicates that digital collaborative tools are especially useful for facilitating concept mapping, and they can be expected to have an impact on the students in more than just face-to-face learning. Therein, this research continues to confirm this observed effect from previous findings, although expands it to pertain to online education as well.

The different reported effect sizes that have been mentioned all have a similar positive direction and the majority are within the *zone of desired effects*, or as defined by Cohen (1988) between medium and large. However, the values are varying widely in size within this range and the calculated effect size of this study,  $d = 1.01$ , is located on the higher end. This large effect size indicates that digital collaborative tools impact students' experiences to a greater extent when the group discussion is held online. This is further supported when looking at the review presented by Reimann and Aditomo (2019), which had a smaller effect size ( $d = 0.35$ ) for technology and its impact on students' achievements, but was measured in face-to-face education. The relatively large effect size of this study also aligns with the other findings discussed by Reimann and Aditomo (2019) where the technology had a larger impact on younger students compared to older. Therein we can conclude, as it is more impactful, it is also more advantageous to implement the use of technology and digital collaborative tools to enhance the learning experience for younger students than for older students.

Why the effect size of this study is rather large compared to the other studies can possibly also be explained by the tendency of estimated effect sizes to be larger in studies with small

sample sizes compared to larger sample sizes (Bakker et al., 2019; Durlak, 2009). The notable difference is also likely caused by variance in research design of the other studies, such as the duration of the data collection and other methodological aspects which influences the results and therein the effect size. Furthermore, the other effect size values, that are addressed for comparison, are retrieved from meta-analyses and therefore they are mean values of several studies. Therefore, the effect size of this single study cannot be interpreted as fully comparable to them, but rather is used as an estimate to put the findings in perspective and allow for discussion. With this in mind, the smaller sample size of this study needs to be acknowledged before any strict generalizations or comparisons of the effect size is made in other future, relevant studies.

This experiment was conducted with students that had not previously used digital collaborative tools in group discussions and still yielded this relatively large effect size. This suggests that the implementation of such technology naturally creates a difference between the groups, regardless of previous or habitual usage. We can then speculate that the difference would be even larger if both teachers and students were more accommodated to the method and tools. This is aligned with what is emphasized by Clark (2014) and Brown et al. (2016) in regards to planned and deliberate implementation of digital technologies as well as clear instructions and engaging atmosphere. This further strengthens the argument that, when aiming to improve group discussions, making the effort to incorporate digital collaborative tools is a relevant strategy. When putting our findings in the context of the prior relevant studies (Reimann & Aditomo, 2019; Shea & Bidjerano, 2012), the effect size obtained in this research yields a noticeable evidence of change in the students' attitudes towards group discussions. This might suggest that the format of group discussions, shaped by the implementation or absence of digital collaborative tools, is one of the key contributing factors affecting students' experiences.

### **5.1.2 Nature of the impact**

By asking the second research question the intention was to examine **how** a digital collaborative tool impacts the experiences of the students. The results indicate that a digital collaborative tool affects the students' experiences in a positive manner overall, particularly in regards to the items connected to the social presence and cognitive presence. One out of the three largest differences between mean values within the social presence suggests that the implementation of a digital collaborative tool made the students more comfortable with the usage of the online medium Google Meet as an environment for group discussion. This indicates similar notions to previous research that the use of technological tools can result in enhanced communication (Hernández-Sellés et al., 2019; Jones, 2016) and that "collaboration depends not only upon the skill of the user but also upon the tools used" (Garrison et al., 1999, p. 92). In this study, we can interpret that the usage of the digital collaborative tool functions complementary to the video conference platform in order to enhance the experienced comfort of the students in regards to communication and collaboration within that medium.

The items that concerned how comfortable the students were when participating in the discussion and working together with the other students yielded the most similar results

between the two groups. From this, it is evident that the digital collaborative tool did not have a substantial impact on the students' comfort levels. Although the experimental group's answers did result in higher mean values on these items, compared to the control group, there is no strong indication that we could expect the implementation of such a tool would increase the comfort levels of the students. This is important to remark since the results of this study, as previously addressed, can function as guidance for teachers and when determining if incorporating digital collaborative tools is worthwhile. Nevertheless, the results from these specific items cannot be seen as reason to completely dismiss the potential that digital collaborative tools have in regards to increasing comfort levels. Other features of the context in which this study was conducted might have influenced the results more prominently than the digital aspects. The students might still have experienced discomfort through the discussion and group task regardless of the chosen methods and environment, since it might derive from factors relating to the members of the group, its dynamic or the individual's confidence in the subject. The result of this single study is shaped by its circumstances, which means that the digital collaborative tool can potentially still be beneficial for comfort levels when evaluated from a broader perspective.

The lowest mean value reported from the experimental group in the social presence is connected to the item that states: "Communicating online is a great way to interact with others". This is also the item that yielded the third lowest mean value over all presences and groups, but it is from the control groups' scores. With a moderate difference between the groups' mean values for this item, the implementation of a digital collaborative tool can be seen as beneficial when aiming to improve the students' attitudes towards online communication. However, with both mean values being on the lower side, there is a general agreement that online communication is not a preferred way of interaction with others. This correlates with the previously discussed difficulties surrounding online education that have been documented and are consequences of the COVID-19 pandemic. Online education has the potential to be effective under the conditions of it being well-planned and being deliberate in the choice of methods and tools (Clark, 2014). The abrupt and forced transition from face-to-face classrooms to online education can be assumed to explain the low mean value of this item, as teachers, schools and students did not have time to prepare for this situation or ensure the potential of technologies would be fulfilled. Furthermore, this is strengthened through the mean values for survey item 1, which regards whether the teacher clearly instructed the group discussion and the topic of the task. The scores from the control group for this item yielded the highest mean value across all results with a noticeable difference in mean values compared to the experimental group. The digital collaborative tool can therein also be assumed to not have been implemented optimally and not produced results to its fullest capacity. This is because the result indicates that the students did not perceive the instructions as clear and therefore it is likely the execution of the task and the use of the tool was affected.

Within the cognitive presence, the digital collaborative tool produced results with similar magnitude as within the items connected to the social presence. The third highest mean value across all collected data is connected to the cognitive presence and is from the experimental group's responses. This item regards if the students deem the group discussion valuable and

helpful in understanding the views of the other students. This result indicates that, in group discussions where a complementary digital collaborative tool is used, there is a potential for the students to also make use of the ideas of their peers. Previous research has also shown how interpersonal communication can contribute to the student's own understanding by applying other students' ideas (Jung & Brady, 2020). Furthermore, the difference between the groups' mean values of this item is the second largest, with 1.09 points, which illustrates that the use of a digital collaborative tool is preferable to a group discussion without it when the desired outcome is for the students to be able to absorb the ideas of their peers. This can be viewed as particularly desirable, since collaboration and group discussions have been proven to have benefits for the individual's skills and understanding (Ku et al., 2013; Pollock et al., 2011).

As previously mentioned, a Community of Inquiry is found to be a valuable and important prerequisite for enabling critical thinking and deep learning to be facilitated in an educational experience (Garrison et al., 1999). When the students show an agreeing attitude towards the items prompted in the CoI survey, it indicates to what extent the characteristics of the group discussion positively affects the development of the three presences: social, teaching and cognitive. Since the experimental group overall showed a more agreeing attitude, compared to the control group, this implies that the use of a digital collaborative tool increased the Community of Inquiry. This in turn suggests that using a digital collaborative tool in a group discussion allows for greater possibilities to facilitate more active analysis and enhance the learning. As found in this study, using a digital collaborative tool as an additional dimension to a video conference platform provides participants with a shared environment which encourages them to actively work with content. This, in turn, allows for more interactivity as opposed to group discussions that are purely conversational. As a result, students, especially younger ones, might find it more engaging to take part in group discussions when there is an element of interactivity present. From this perspective digital collaborative tools can be seen as an intervention that has a potential to increase involvement of students and improve participation rates in group discussions.

The higher mean values for the experimental group also align with the description provided by Garrison et al. (1999) of how collaboration and the different presences of a CoI are influenced by the technology that is used. As expressed by Garrison et al. (1999) "the extent to which cognitive presence is created and sustained in a community of inquiry is partly dependent upon how communication is restricted or encouraged by the medium" (p. 93). The results of this study showcase how digital collaborative tools can function as a characteristic of the group discussion that encourages communication. Since we can see an improved CoI for the groups that are using digital collaborative tools, this concept presented by Garrison et al. (1999) is further confirmed. It also validates the relevance of investigating the role that technology can play in education when aiming to improve the students' experiences through an increased CoI. This relevance applies scientifically for researchers exploring this field further but also practically to teachers and schools seeking useful strategies for online education.

The digital collaborative tool used by the experimental group was an additional dimension to the group discussion which had previously not been implemented in these groups. This can possibly explain why the only mean values from the experimental groups that were lower compared to the control group were documented in teaching presence. The teacher had to introduce a new tool and explain how it would be used specifically for this given task, which might have compromised the overall clarity surrounding the given instructions. We can speculate that the results would have been different if the students already had been familiarised with the tool and could have solely focused on the instructions of the task that was meant to be discussed. Since both groups had the same teacher we can exclude the interpretation that these lower mean values for the experimental group were caused by different instructional approaches from the teacher. This also strengthens the reasoning that the result is actually due to the novelty of the situation and the chosen methods. Furthermore, the survey items regarding if the teacher helped to increase the student's interest and focus could also be assumed to have yielded different results if the procedure of digital group discussions, and specifically with the collaborative tool, was more established for both teacher and students. Once again, it can be assumed that more focus could then have been put on the task and to cultivate the discussion rather than the practical aspects of how to use the technology. As explained by Shea and Bidjerano (2012), the novelty and uniqueness of education in the virtual medium lacks prior well established student-teacher communication patterns which then makes it crucial for the students to attain self-management and discipline in order to achieve success in online classes. This might be an additional reason for the teaching presence being lower among the students in the experimental group. Students might have not had previous experience with certain behavioral strategies like self-control and discipline which could be due to their shorter educational background.

## **5.2 Method discussion**

By investigating how digital collaborative tools affect students' experiences in online lessons, we strived to find out in which ways digital situations might be improved to provide smoother and more enriched educational experiences. Through the preparatory discussion phase with the recruited teacher we realized that the actual digital situation of the school was not as we expected it to be. More specifically, we identified a lack of a shared strategy for the school staff in regards to the usage of the video conference platform Google Meet. Furthermore, the digital situation was restricted by the direct unavailability of break out rooms and the teacher's limited proficiency in using Google Meet as a teaching environment. The initially outlined methodology was ultimately used in this study, however it was designed from a theoretical perspective which indicated a need for adjustments to accommodate the practical reality. Aspects such as digital proficiency, financial situation and access to both software and hardware were, through this study, shown to be highly influential in that process. Suppose another school had been recruited in order to conduct this study and the digital situation could be expected to have looked very different, with other challenges and opportunities. Therein, when conducting an experiment similar to this, which takes place in a realistic setting, the research process is required to be agile as a consequence of the individuality of each school.

When it comes to the choice of the digital collaborative tool that was utilized in this experiment, we had a number of options available. The criteria that were guiding our selection included the tool being easy to learn for the first-time users as well as allowing for a variety of manipulations such as writing textual notes, freely moving created items around the board, uploading documents and having the functionality that permits collaborators to interact. On top of that we sought a solution that would not require a complex registration process. We wanted students to be able to simply join in by following the link, without having to create an account solely for the purpose of participating in our study. This is directly connected with minimizing the burden of the participants during the experiment, as previously discussed in 2.7.4.

The intention was to conduct a study which would enable us to draw conclusions about the defined population and how they are affected by the implementation of digital collaborative tools. With this in mind, our goal was to recruit a number of teachers who could help us to conduct the experiment, which was in order to have a bigger sample size. However, we quickly realised the time consuming nature of the recruitment process as well as an unexpected extent of issues that the teachers experienced by conducting lessons online. When contacting a group of seven teachers who teach the social study subjects, we only received two responses, both declining the offer with the motivation that it would not be feasible for them to conduct the experiment in these times. This led us to get help from one teacher instead of several for the data collection. This had a considerable impact on parameters of the research method and therein also the results. The sample size was, as implied, affected together with other characteristics of the sample. By recruiting one single teacher, the groups who participated in the research studied different subjects, whilst our initial aim was to recruit groups of students studying the same subject. We had this aim, as it would eliminate that aspect as a confounding variable. However, by having the same teacher we eliminated another confounding variable, which is the different experiences for the students that we could expect, since a group of teachers would not conduct the experiment identically. We also had more control over the preparation process since we were able to assist more whenever needed, which could be assumed to have been more difficult if we had recruited several teachers.

Another intention of this study was to explore if and how much online group discussions could be improved with the help of digital collaborative tools. To investigate if there is a relation between these aspects, the methodology of this thesis made use of the CoI framework. Even though the CoI framework is most commonly utilized when assessing learning outcomes and satisfaction with the structure of courses, as previously discussed, we found it to be appropriate to apply the framework to subjective experiences that students have in group discussions. The original CoI survey tool is structured and phrased in a way that helps to contextualize the findings and further investigate them in a quantitative manner. With relevant adjustments made to the survey, we ensured that we received measurable results so that the analysis could be focused on students' perceptions as opposed to their achievements, which is in-line with the aim of this research. This approach enabled us to perform inferential and descriptive statistical analysis in order to process the collected data and present it in a way that would provide clear answers to the research questions posed. Garrison, Anderson and

Archer, who developed and conceptualized the CoI model, discussed how the CoI survey instrument “has made possible a variety of large scale, quantitative studies that use the CoI framework to explore the effects of differing instructional strategies on online learning processes” (Swan & Ice, 2010, p. 1). Therefore, our study can be seen as an extension and contribution to the research field of online learning with the focus on using digital collaborative tools as a strategy to improve online group discussions during the COVID-19 pandemic, which has not been widely investigated before.

One more aspect that has to be addressed is our decision to opt for the use of the survey as the main method of data collection. This is something that was given a lot of thought and consideration, in regards to feasibility and the intended outcome. As mentioned before, to ensure some kind of assessment of the survey prior to its use we consulted a teacher to get feedback regarding the survey and to what extent it would be perceived by the students as straightforward and easy-to-understand. This type of evaluation might not fully substitute full-scale pilot testing of the survey, however we believe that it was reasonable for the scope of this study, especially when taking into account imposed time constraints, which prevented us from organising a fully fledged pre- and post-study. There could be a possibility that some students might have still misunderstood some specific survey items or the survey as a whole. This is why we think that it would have been beneficial to conduct some type of post-study, for example interviews. This would have allowed us to gain further insights into the ways students experienced group discussions, how they found the digital collaborative tool as well as their interpretation of the survey. Since this was not achievable for this study, it is further addressed as a recommendation in section 6.2.

What we consider to be one of the strongest facets of this research is that it was conducted in the context of the COVID-19 pandemic. It was therefore possible for us to make use of this context and conduct the study that features the most accurate and realistic circumstances resulting from the pandemic. We assume that if this study will be replicated in the future, once the pandemic will be over, the context might not be as closely representative and therefore the need to imitate the conditions in an artificial manner will arise. This can be assumed to affect the outcomes of such investigations, because a number of aspects won't be reproducible like the mental state of the participants that is caused by the pandemic. Therein, this study is valuable because it has the possibility to constitute an accurate reference to the full experience of being a student during the pandemic which other coming studies might not. Furthermore, it is likely that many studies will be conducted after the pandemic with the objective to measure the consequences; in other words investigating the post COVID-19 world. The results of this study however portray the reality of the pandemic, yielding in-the-moment reactions that are current reflections of the circumstances. Even though the need and potential to do additional research to establish strong relations between digital collaborative tools and students' experiences will remain, it is important to differentiate investigations based on the context in which they took place. Researching this issue when the classes are conducted online deliberately must differ from when those are forced to be digitalized due to uncontrollable external reasons like global pandemic.

## **6 Conclusions and further research**

### **6.1 Conclusions**

To conclude, digital collaborative tools have the potential to improve group discussions in a positive manner by encouraging students to actively interact with their peers and by enhancing the educational experience. We found that there are several obstacles to achieve this positive impact when introducing digital collaborative tools into online lessons. In order to gain some benefit from the implementation of the digital collaborative tools, it is necessary to allow sufficient time to overcome a number of the obstacles, one of which is familiarizing with the digital collaborative tool and its functionality prior to expecting it to effectively bring any value. Our study further confirms what previous findings have established, that consistent use of reliable and convenient digital means is favourable in the context of online learning.

#### **6.1.1 Practical implications**

The outcomes of this research provide implications for suggested approaches towards implementation of digital collaborative tools into online lessons and group discussions. With a continuously growing need to make use of the technology in the best way possible, without compromising much on the content of the courses nor on the social aspects of the learning, it is crucial to prepare a thought through strategy on how to put those digital tools into practice. From the results we can determine that, as a teacher, special emphasis should be put on understanding the functionalities of the digital collaborative tool to ensure being clear when instructing and guiding the students. Our findings also suggest that it would be preferable to decide a common tool that can be used across several classes instead of each teacher opting for different tools, in order to allow more continuous use and therein a faster learning process for the specific tool. It has to be acknowledged, however, that there is no universal strategy that would be applicable to every situation, but it rather has to be developed for each individual case, considering the goals that one desires to achieve. Aspects such as optimal levels of interaction and fitting technology play an important role in enhancing online education of all levels, but especially at the initial levels among younger students who have shorter educational experience. For example, this study showed how important it is to allocate sufficient time to integrate a digital collaborative tool that is new for both the students and the teacher. Moreover, this study has proven that digital collaborative tools have advantageous effects on online learning and group discussions. This makes it worthwhile for schools and teachers to consider how to deploy these supporting technologies for students to experience higher quality of education.

#### **6.1.2 Scientific implication**

In relation to the previous studies that were conducted within higher education and proved that digital tools could offer support in collaborative learning, our research made an entry into a novel area regarding the impact of digital collaborative tools on younger students in comprehensive schools. Our results suggest that there is a relation between increased CoI and integration of digital collaborative tools in online group discussions. Since available research within the field was limited at the time of conducting this study, it can then be seen as a basis for building up arguments and raising discussions about the topic in question. This would



allow for establishing trends when it comes to the role that digital collaborative tools play in online group discussions. Furthermore, this study serves as a starting ground for exploring how other methods, apart from digital collaborative tools, can optimize online group discussions for younger students. Experimenting with other aspects related to group discussions and altering the context in which they are held allows for better preparation and offers guidance in similar situations that potentially might occur in the future. The ultimate aim of such future investigations would be to define how to conduct education online, whilst maintaining the same standard as when teaching in face-to-face classrooms, both in terms of the students' experiences and their learning outcomes.

## **6.2 Further research**

This study has a prospect for further research that could be focused on a variety of aspects. Since the sample for this study was limited to students aged 13, it might not be fully representative of the broader population. As a consequence, the same study should be conducted on a variety of other age groups to test if the usage of digital collaborative tools within video conference platforms has the same effect on the population as a whole. Moreover, it is recommended to expand the sample size to include more students in order to test if similar results would be obtained and therein confirm or reject the findings of this study.

Since our sample consisted of students that all attend the same school we can assume that other characteristics which are homogenous for this sample are specific to this sample only and not to the entire population, although it is not investigated in this study. As the defined population is large and includes students from every part of the country with presumably different life experiences as a consequence, the generalizability of the results of our study will decrease. This proves the relevance of further studies that include students from a variety of locations within Sweden. Furthermore, there is a need for expanding this study outside of Sweden and replicating it in different countries. This could yield interesting results because of contrasting ways in which education in comprehensive schools is organised across different regions, and because of how access to assets like the Internet, study materials and other commodities might significantly vary from one place to another.

Additionally, a suggestion for further research would be to explore and compare how, if at all, digital collaborative tools utilized within online synchronous group discussions affect students based on the subject of the lesson. An assumption could be made that digital collaborative tools could act either as a beneficial intervention or as an obstacle when learning depending on if the lesson is run within exact sciences, languages or arts, to name a few.

As previously mentioned, students sampled for this study did not have prior experience of utilizing digital collaborative tools while being involved in group discussions. More specifically, participants of our experiment were unfamiliar with Padlet which might have had an effect on the outcome of the study since that was a new tool for them to explore and get accustomed to. Although not feasible in this study, due to the scope and time frame, it would have been interesting to explore what results would emerge if the participants had a habit of using these tools and learning strategies. It could be worth looking into how impactful a

digital collaborative tool can be in the context of a group discussion when partakers are well acquainted with the tool being used and fully aware of its functionality.

Lastly, we are convinced that if the same or similar study is to be repeated, it would benefit greatly from the use of interviews as part of the data collection. This could be helpful in gaining a better understanding of the participants' stance regarding the implementation of the digital collaborative tools together with their impressions from group discussions.

Overall, additional research in this field is necessary in order to establish stronger connections between the usage of digital collaborative tools and their effects on students' experiences, specifically in the context of group discussions within synchronous online classes, which would confirm the findings of this study.

## 7 References

- Akbar, M. (2016). Digital Technology Shaping Teaching Practices in Higher Education. *Frontiers in ICT*, 3, p. 1. DOI=10.3389/fict.2016.00001
- Alderson, P. & Morrow, V. (2011). Consent. In *The ethics of research with children and young people: A practical handbook*. (pp. 100-122). SAGE Publications Ltd.
- Alibali, M.W. & Nathan, M.J. (2010). Conducting Research in Schools: A Practical Guide. *Journal of Cognition and Development*, 11(4), pp. 397-407.  
<https://doi.org/10.1080/15248372.2010.516417>
- Andres, L. (2012). *Designing & doing survey research*. SAGE Publications, Ltd.  
<https://www-doi-org.proxy.library.ju.se/10.4135/9781526402202>
- Arbaugh, J.B., Cleveland-Innes, M., Diaz, S.R., Randy, D.G., Ice, P., Richardson, J.C. & Swan, K.P. (2008). Developing a community of inquiry instrument: Testing a measure of the Community of Inquiry framework using a multi-institutional sample. *The Internet and Higher Education*, 11(3-4), pp. 133-136. <https://doi.org/10.1016/j.iheduc.2008.06.003>
- Bakker, A., Cai, J. English, L., Kaiser, G., Mesa, V. & Van Dooren, W. (2019). Beyond small, medium, or large: points of consideration when interpreting effect sizes. *Educational Studies in Mathematics*, 102, pp. 1-8. <https://doi.org/10.1007/s10649-019-09908-4>
- Bangert, A.W. (2009). Building a validity argument for the community of inquiry survey instrument. *Internet and Higher Education* 12, pp. 104-111. doi:10.1016/j.iheduc.2009.06.001
- Bartlett, R., Wright, T., Olarinde, T., Holmes, T., Beamon, E.R. & Wallace, D. (2017). Schools as Sites for Recruiting Participants and Implementing Research. *Journal of Community Health Nursing*, 34(2), pp. 80-88.  
<https://doi.org/10.1080/07370016.2017.1304146>
- Bevans, R. (2021). *A guide to experimental design*. Scribbr. Retrieved April 13, 2021, from <https://www.scribbr.com/methodology/experimental-design/>
- Bhandari, P. (2020). *Understanding external validity*. Scribbr. Retrieved March 24, 2021, from <https://www.scribbr.com/methodology/external-validity/>
- Bhandari, P. (2021). *What is a between-subjects design?* Scribbr. Retrieved April 5, 2021, from [scribbr.com/methodology/between-subjects-design/](https://www.scribbr.com/methodology/between-subjects-design/)
- Boslaugh, S. (2012). *Statistics in a nutshell : A desktop quick reference*. ProQuest Ebook Central. <https://ebookcentral.proquest.com>
- Brown, B., Schroeder, M., Eaton, S.E. (2016). Designing synchronous online interactions and discussions. *Proceedings of the IDEAS: Designing for Innovation*, pp. 51-60. Calgary, Canada: University of Calgary.

BSA. (2017). *BSA Statement of Ethical Practice*.

[https://www.britsoc.co.uk/media/24310/bsa\\_statement\\_of\\_ethical\\_practice.pdf](https://www.britsoc.co.uk/media/24310/bsa_statement_of_ethical_practice.pdf)

Capraro, R.M, Bicer, A., Lee, Y. & Vela, K. (2019). Putting the Quantitative Pieces Together to Maximize the Possibilities for a Successful Project. In K. Leatham (Ed.), *Designing, Conducting, and Publishing Quality Research in Mathematics Education. Research in Mathematics Education*. (pp. 97-110). Springer, Cham.

Carrig, M.M. & Hoyle, R.H. (2011). Measurement Choices: Reliability, Validity, and Generalizability. In A.T. Panter & S.K. Sterba (Eds.), *Handbook of Ethics in Quantitative Methodology* (pp. 127-157). Routledge, New York.

Caspi, A., Chajut, E. & Saporta, K. (2008). Participation in class and in online discussions: Gender differences. *Computers & Education*, 50(3), pp. 718-724.  
<https://doi.org/10.1016/j.compedu.2006.08.003>

Center for Advancing Teaching and Learning Through Research. (n.d.). *Building a Sense of Belonging and Community into an Online Course Enhance Student Learning Through Class Community*. Retrieved March 4, 2021, from  
<https://learning.northeastern.edu/building-a-sense-of-belonging-and-community-into-an-online-course/>

Chaturvedi, K., Vishwakarma, D.K & Singh, N. (2021). COVID-19 and its impact on education, social life and mental health of students: A survey. *Children and Youth Services Review*, 121, p. 105866. <https://doi.org/10.1016/j.childyouth.2020.105866>

Chen, J., Wang, M., Kirschner, P.A. & Tsai, C-C. (2018). The Role of Collaboration, Computer Use, Learning Environments, and Supporting Strategies in CSCL: A Meta-Analysis. *Review of Educational Research*, 88(6), pp. 799-843. DOI: 10.3102/0034654318791584

Clark, R.C. (2014). 34 – Multimedia Learning in e-Courses. In R.E. Mayer (Ed.), *The Cambridge Handbook of Multimedia Learning*. (pp. 842-882). Cambridge University Press.

Cohen, J. (1988). *Statistical power analysis for the behavioral sciences*. (2. ed.) Hillsdale: L. Erlbaum Associates.

Dhawan, S. (2020). Online Learning: A Panacea in the Time of COVID-19 Crisis. *Journal of Educational Technology Systems*, 49(1), pp. 5-22.  
<https://doi-org.proxy.library.ju.se/10.1177/0047239520934018>

Di Pietro, G., Biagi, F., Costa P., Karpinski Z. & Mazza, J. (2020). The likely impact of COVID-19 on education: Reflections based on the existing literature and recent international datasets (EUR 30275 EN). Publications Office of the European Union, Luxembourg.  
doi:10.2760/126686

Donnon T. (2012). Experimental or RCT research designs: a crisis of nomenclature in medical education. *Canadian medical education journal*, 3(2), pp. e82–e84.  
<https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4563631/>

Drew, C. J., Hardman, M. L. & Hosp, J. L. (2008a). Statistics choices. In *Designing and conducting research in education* (pp. 242-258). SAGE Publications, Inc.  
<https://www-doi-org.proxy.library.ju.se/10.4135/9781483385648>

Drew, C. J., Hardman, M. L. & Hosp, J. L. (2008b). Descriptive statistics. In *Designing and conducting research in education* (pp. 287-304). SAGE Publications, Inc.  
<https://www-doi-org.proxy.library.ju.se/10.4135/9781483385648>

Drew, C. J., Hardman, M. L. & Hosp, J. L. (2008c). Inferential statistics. In *Designing and conducting research in education* (pp. 305-334). SAGE Publications, Inc.  
<https://www-doi-org.proxy.library.ju.se/10.4135/9781483385648>

Drew, C. J., Hardman, M. L. & Hosp, J. L. (2008d). Participant Selection and assignment. In *Designing and conducting research in education* (pp. 81-108). SAGE Publications, Inc.  
<https://www-doi-org.proxy.library.ju.se/10.4135/9781483385648>

Druckman, J.N., Green, D.P., Kuklinski, J.H. & Lupia, A. (eds.) (2011). *Cambridge handbook of experimental political science*. New York: Cambridge University Press.

Durlak, J.A. (2009). How to Select, Calculate, and Interpret Effect Sizes. *Journal of Pediatric Psychology*, 34(9), pp. 917-928. <https://doi-org.proxy.library.ju.se/10.1093/jpepsy/jsp004>

Eddy, S.L., Brownell, S.E., Thummaphan, P., Lan M-C. & Wenderoth, M.P. (2017). Caution, Student Experience May Vary: Social Identities Impact a Student's Experience in Peer Discussions. *CBE—Life Sciences Education*, 14(4), pp. 1-17.  
<https://doi.org/10.1187/cbe.15-05-0108>

ESRC. (2015). *Methodologies*.  
<https://esrc.ukri.org/public-engagement/social-science-for-schools/resources/doing-research-ethically/>

Ezat, A.N. (2019). The impact of earnings quality on the association between readability and cost of capital. *Journal of Accounting in Emerging Economies*, 9(3), pp. 366-385.  
DOI:10.1108/JAEE-12-2018-0136

Fassinger, P.A. (1996). Professors' and Students' Perceptions of Why Students Participate in Class. *Teaching Sociology*, 24(1), pp. 25-33. <https://www.jstor.org/stable/1318895>

Fritz, C.O., Morris, P.E. & Richler, J.J. (2012). Effect size estimates: Current use, calculations, and interpretation. *Journal of Experimental Psychology: General*, 141(1), pp. 2-18. DOI:10.1037/a0024338

- Gallagher, M. (2009). Ethics. In *Researching with children and young people: Research design, methods and analysis*. (pp. 11-64). SAGE Publications Ltd.
- Garrison, D.R., Anderson, T. & Archer, W. (1999). Critical Inquiry in a Text-Based Environment: Computer Conferencing in Higher Education. *The Internet and Higher Education*, 2(2-3), pp. 87-105. [https://doi.org/10.1016/S1096-7516\(00\)00016-6](https://doi.org/10.1016/S1096-7516(00)00016-6)
- Gersten, R., Fuchs, L. S., Compton, D., Coyne, M., Greenwood, C., & Innocenti, M. S. (2005). Quality Indicators for Group Experimental and Quasi-Experimental Research in Special Education. *Exceptional Children*, 71(2), pp. 149–164. <https://doi.org/10.1177/001440290507100202>
- Grissom, R.J. & Kim, J.J. (2011). *Effect Sizes for Research : Univariate and Multivariate Applications, Second Edition*. Taylor & Francis Group.
- Hattie, J. (2009). Visible learning: a synthesis of over 800 meta-analyses relating to achievement. London: Routledge.
- Heilporn, G. & Lakhal, S. (2020). Investigating the reliability and validity of the community of inquiry framework: An analysis of categories within each presence. *Computers & Education*, 145, p. 103712. <https://doi.org/10.1016/j.compedu.2019.103712>
- Henry, G.T. (2009). Practical sampling. In L., Bickman & D.J., Rog *The SAGE handbook of applied social research methods* (pp. 77-105). SAGE Publications, Inc., <https://www-doi-org.proxy.library.ju.se/10.4135/9781483348858>
- Hernández-Sellés, N., Muñoz-Carril, P-B. & González-Sanmamed, M. (2019). Computer-supported collaborative learning: An analysis of the relationship between interaction, emotional support and online collaborative tools. *Computers & Education*, 138, pp. 1-12. <https://doi.org/10.1016/j.compedu.2019.04.012>
- Herzog, M.H., Clarke, A. & Francis, G. (2019). *Understanding Statistics and Experimental Design*. Springer International Publishing.
- Hodges, C., Moore, S., Lockee, B., Trust, T., & Bond, A. (2020). The Difference Between Emergency Remote Teaching and Online Learning. Retrieved February 25, 2021, from <https://er.educause.edu/articles/2020/3/the-difference-between-emergency-remote-teaching-and-online-learning>
- Iversen, G.R. & Norpoth, H. (1987). One-Way Analysis of Variance, All Categories. In *Analysis of variance* (pp. 11-38). SAGE Publications, Inc., <https://www-doi-org.proxy.library.ju.se/10.4135/9781412983327>
- Jaggars, S.S & Xu, D. (2016). How do online course design features influence student performance?. *Computers & Education*, 95, pp. 270-284. <https://doi.org/10.1016/j.compedu.2016.01.014>

- Johnson, D.W., Johnson, R.T. & Smith, K.A. (1998). Cooperative Learning Returns To College What Evidence Is There That It Works?. *Change: The Magazine of Higher Learning*, 30(4), pp. 26-35. <https://doi.org/10.1080/00091389809602629>
- Jones, S.J., EdD. (2016). Multi-purposing Synchronous Web-based Collaboration Tools. *The Community College Enterprise*, 22(2), pp. 55-59.
- Jung, H. & Brady, C. (2020). Maintaining rich dialogic interactions in the transition to synchronous online learning. *Emerald Publishing Limited*. Vol. 121, No. 5/6, pp. 391-400. <https://doi.org/10.1108/ILS-04-2020-0096>
- Kirschner, P.A., Kirschner, F. & Janssen, J. (2014). 23 – The Collaboration Principle in Multimedia Learning. In R.E. Mayer (Ed.), *The Cambridge Handbook of Multimedia Learning*. (pp. 547-575). Cambridge University Press.
- Kovanović, V., Joksimović, S., Poquet, O., Hennis, T., Čukić, I., de Vries, P., Hatala, M., Dawson, S., Siemens, G. & Gašević, D. (2018). Exploring communities of inquiry in Massive Open Online Courses. *Computers & Education*, 119, pp. 44-58. <https://doi.org/10.1016/j.compedu.2017.11.010>
- Ku, H-Y., Tseng, H.W. & Akarasriworn, C. (2013). Collaboration factors, teamwork satisfaction, and student attitudes toward online collaborative learning. *Computers in Human Behavior*, 29(3), pp. 922-929. <https://doi.org/10.1016/j.chb.2012.12.019>
- Lee, J-E. & Recker, M. (2021). The effects of instructors' use of online discussions strategies on student participation and performance in university online introductory mathematics courses. *Computers and education*, 162. <https://doi.org/10.1016/j.compedu.2020.104084>
- LIX. (n.d.) LIX räknare. LIX. Retrieved March 7, 2021, from <http://www.lix.se/index.php>
- Longhurst, R. (2016). Semi-structured Interviews and Focus Groups. Key Methods in Geography. In N., Clifford, M., Cope, T., Gillespie & S., French (Eds.) *Key Methods in Geography* (p. 143). SAGE Publishing.
- Lowenthal, P.R. & Dunlap, J.C. (2014). Problems Measuring Social Presence in a Community of Inquiry. *E-learning and Digital Media*, 11(1), pp. 19-30. <https://doi.org/10.2304/elea.2014.11.1.19>
- Lund Research Ltd. (n.d.a). *Reliability in research*. Retrieved March 28, 2021, from <https://dissertation.laerd.com/reliability-in-research.php>
- Lund Research Ltd. (n.d.b). *Internal validity*. Retrieved April 1, 2021, from <https://dissertation.laerd.com/internal-validity.php>
- Martin, W.E. & Bridgmon, K.D. (2012). *Quantitative and statistical research methods from hypothesis to results*. San Francisco: Jossy-Bass.

- McCambridge, J., Witton, J., & Elbourne, D.R. (2014). Systematic review of the hawthorne effect: New concepts are needed to study research participation effects. *Journal of Clinical Epidemiology*, 67(3), pp. 267-77.  
doi:<http://dx.doi.org.proxy.library.ju.se/10.1016/j.jclinepi.2013.08.015>
- Meade, A.W. & Craig, S.B. (2012). Identifying Careless Responses in Survey Data. *Psychological Methods*, 17(3), pp. 437-455. DOI:10.1037/a0028085
- Mertens W., Pugliese A. & Recker J. (2017) How to Start Analyzing, Test Assumptions and Deal with that Pesky p-value. In *Quantitative Data Analysis*. (pp. 7-19). Springer, Cham.  
[https://doi-org.proxy.library.ju.se/10.1007/978-3-319-42700-3\\_2](https://doi-org.proxy.library.ju.se/10.1007/978-3-319-42700-3_2)
- Ng E.M.W. (2012). Online Collaborative Learning. In Seel N.M. (Eds.), *Encyclopedia of the Sciences of Learning*. (pp. 2497-2499). Springer, Boston, MA.
- Omran, A., Wakefield-Scurr, J., Smith, J. & Brown, N. (2019). Survey Development for Adolescents Aged 11-16 Years: A Developmental Science Based Guide. *Adolescent Research Review*, 4, pp. 329-340. <https://doi.org/10.1007/s40894-018-0089-0>
- Ornellas, A. & Muñoz Carril, P-C. (2014). A methodological approach to support collaborative media creation in an e-learning higher education context. *Open Learning: The Journal of Open, Distance and e-Learning*, 29(1), pp. 59-71.  
<https://doi.org/10.1080/02680513.2014.906916>
- Pollock, P.H., Hamann, K. & Wilson, B.M. (2011). Learning Through Discussions: Comparing the Benefits of Small-Group and Large-Class Settings. *Journal of Political Science Education*, 7(1), pp. 48-64. <https://doi.org/10.1080/15512169.2011.539913>
- Reimann, P. & Aditomo, A. (2019). Technology-supported learning and academic achievement. In Hattie, J. & Anderman E. M. (Eds.), *Visible Learning Guide to Student Achievement: Schools Edition* (pp. 303-309). Milton: Taylor and Francis.  
<https://doi-org.proxy.library.ju.se/10.4324/9781351257848>
- Roni, S.M., Merga, K.M & Morris, J.E. (2020a). Getting Started: What, Where, Why. In *Conducting Quantitative Research in Education*. (pp. 7-23). Springer, Singapore.
- Roni, S.M., Merga, K.M & Morris, J.E. (2020b). Conducting Research with Children and Students. In *Conducting Quantitative Research in Education*. (pp. 25-38). Springer, Singapore.
- Roni, S.M., Merga, K.M & Morris, J.E. (2020c). Analysis: Difference Between Groups. In *Conducting Quantitative Research in Education*. (pp. 7-23). Springer, Singapore.
- Salkind, N.J. (2010a). Survey. *Encyclopedia of Research Design*. Retrieved from <https://www-doi-org.proxy.library.ju.se/10.4135/9781412961288.n449>



- Salkind, N.J. (2010b). *Recruitment. Encyclopedia of Research Design*. Retrieved from <https://www-doi-org.proxy.library.ju.se/10.4135/9781412961288.n449>
- Salkind, N.J. (2010c). *Internal Validity. Encyclopedia of Research Design*. Retrieved from <https://www-doi-org.proxy.library.ju.se/10.4135/9781412961288.n449>
- Santiago I.-P., Ángel H.-G., Julián C.-P. & Prieto J.L. (2021). Emergency Remote Teaching and Students' Academic Performance in Higher Education during the COVID-19 Pandemic: A Case Study. *Computers in Human Behavior*, 119, p. 106713. <https://doi.org/10.1016/j.chb.2021.106713>
- Saunders, B., Kitzinger, J. & Kitzinger, C. (2015). Anonymising interview data: challenges and compromise in practice. *Qualitative Research* 15(5), pp. 616-632.
- Sjögren, A., Engdahl, M., Hall, C., Holmlund, H., Lundin, M., Mühlrad, H. & Öckert, B. (2021). Barn och unga under coronapandemin Lärdomar från forskning om uppväxtmiljö, skolgång, utbildning och arbetsmarknadsinträde (2021:2). Ehof Grafiska AB, Uppsala.
- Shea, P. & Bidjerano, T. (2012). Learning presence as a moderator in the community of inquiry model. *Computers & Education*, Vol. 59(2), pp. 316-326. <https://doi.org/10.1016/j.compedu.2012.01.011>
- Slack, M.K. & Draugalis, J.R. (2001). Establishing the internal and external validity of experimental studies. *American Journal of Health-System Pharmacy*, 58(22), pp. 2173-2181. <https://doi-org.proxy.library.ju.se/10.1093/ajhp/58.22.2173>
- Slavin, R., & Smith, D. (2009). The Relationship between Sample Sizes and Effect Sizes in Systematic Reviews in Education. *Educational Evaluation and Policy Analysis*, 31(4), pp. 500-506. <http://www.jstor.org/stable/25621597>
- Sreejesh, S., Mohapatra, S. & Anusree, M.R. (2013). Data Preparation and Preliminary Analysis. In *Business Research Methods* (pp. 163-181). Springer International Publishing Switzerland 2014.
- Stenbom, S. (2018). A systematic review of the Community of Inquiry survey. *The Internet and Higher Education*, 39, pp. 22-32. <https://doi.org/10.1016/j.iheduc.2018.06.001>
- Stewart, M.K. (2019). The Community of Inquiry Survey: An Assessment Instrument for Online Writing Courses. *Computers and Composition*, 52, pp. 37-52. <https://doi.org/10.1016/j.compcom.2019.01.001>
- StoryToolz. (2016). Readability Statistics. StoryToolz. Retrieved March 7, 2021, from <https://storytoolz.com/readability>
- Strunk, K.K. & Mwavita, M. (2020). Sampling and basic issues in research design. In *Design and Analysis in Educational Research* (pp. 21-34). Routledge.

Skolverket (2018). *Curriculum for the compulsory school, preschool class and school-age educare 2011: revised 2018*. [Stockholm]: Skolverket.

Skolverket (2020). *Elever och skolenheter i grundskolan läsåret 2020/21* (Dnr 5.1.1-2020:1312). Skolverket. <https://www.skolverket.se/getFile?file=7920>

Svirydzenka, N., Aitken, J. & Dogra N. (2016). Research and partnerships with schools. *Social Psychiatry and Psychiatric Epidemiology*, 51, pp. 1203-1209. <https://doi.org/10.1007/s00127-016-1224-5>

Swan, K. & Ice, P. (2010). The community of inquiry framework ten years later: Introduction to the special issue. *The Internet and Higher Education*, Vol. 13(1–2), pp. 1-4. <https://doi.org/10.1016/j.iheduc.2009.11.003>

Swan, K., Shea, P., Richardson, J. C., Ice, P., Garrison, D., Cleveland-Innes, M. & Arbaugh, B. J. (2008). Validating a measurement tool of presence in online communities of inquiry. *E-mentor*, Vol. 2(24), pp. 1-12. Retrieved March 29, 2021, from <http://www.e-mentor.edu.pl/artukul/index/numer/24/id/543>

Tashakkori, A. & Teddlie, C. (2009). Integrating qualitative and quantitative approaches to research. In L. Bickman & D.J. Rog (Eds.) *The SAGE handbook of applied social research methods* (pp. 283-317). SAGE Publications, Inc. <https://www-doi-org.proxy.library.ju.se/10.4135/9781483348858>

Textcompare.org. (2021). SMOG Index Readability Test. Textcompare.org. Retrieved March 16, 2021, from <https://www.textcompare.org/readability/smog-index/#Grade-Conversion>

Thompson, B. (2017). Effect sizes, confidence intervals, and confidence intervals for effect sizes. *Psychology in the Schools*, 44(5), pp. 423-432. DOI: 10.1002/pits.20234

UNESCO. (2020). COVID-19 crisis and curriculum: sustaining quality outcomes in the context of remote learning (UNESCO COVID-19 education response: Education Sector issue notes, 4.2). Retrieved February 15, 2021 from <https://unesdoc.unesco.org/ark:/48223/pf0000373273.locale=en>

UNESCO. (n.d.). Education: From disruption to recovery. Retrieved February 15, 2021 from <https://en.unesco.org/covid19/educationresponse>

Voyer, P., Lauzon, S., Collin, J. & O'Brien, S. (2008). Research method issue: recruiting and retaining subjects in a research study. *Nurse Researcher*, 15(3), pp.12-25. <http://proxy.library.ju.se/login?url=https://www-proquest-com.proxy.library.ju.se/scholarly-journals/research-method-issue-recruiting-retaining/docview/200846621/se-2?accountid=11754>

Watts, J. (2017). Beyond Flexibility and Convenience: Using the Community of Inquiry Framework to Assess the Value of Online Graduate Education in Technical and Professional Communication. *Journal of Business and Technical Communication*, 31(4), pp. 481–519. <https://doi.org/10.1177/1050651917713251>

WebFx. (2021). Readability Test Tool. Web Fx. Retrieved March 13, 2021, from <https://www.webfx.com/tools/read-able/>

Willard, C.A. (2020). *Statistical Methods An Introduction to Basic Statistical Concepts and Analysis*. (Second Edition). London: Routledge.

wordcalc. (2020). Readability Calculator. wordcalc. Retrieved March 13, 2021, from <https://www.wordcalc.com/readability/>

Xu, J. & Zhang, J. (2008). A Survey of Synchronous Collaboration Tools. *Information Technology Journal*. Vol. 7, pp. 1049-1054. doi: 10.3923/itj.2008.1049.1054

## **8 Appendixes**

### **Appendix 1. The adapted Col survey instrument**

#### **Demographic questions**

1. In what subject did you have the group discussion?
2. Did you use any digital tools to collaborate during the group discussion?

#### **Teaching Presence**

1. The teacher clearly told us about the topic of the task and what we should do in the group discussion.
2. The teacher clearly told us about why we are doing the task.
3. The teacher told us clearly about how much time we had for the task.
4. The teacher helped me to feel interested in the group discussion and to actively share my thoughts.
5. The teacher helped us to stay focused on the task and the subject which helped me to learn.
6. The teacher helped us to feel more like a group when we discussed.

#### **Social Presence**

7. Communicating online is a great way to interact with others.
8. I felt comfortable talking through Google Meet.
9. I felt comfortable participating in the group discussion.
10. I felt comfortable interacting with the other group discussion participants.
11. I felt comfortable to disagree with the other group discussion participants and I still felt an accepting atmosphere in the group.
12. I felt that what I said was listened to and taken into account by the other group discussion participants.
13. Online discussions help me to feel part of a team that works together.

#### **Cognitive Presence**

14. The task that we had to discuss in a group made me more interested in the subject overall.
15. The task that we worked on during the group discussion made me curious about the topic.
16. I used several different sources when I was working on the task that we discussed in the group.

17. Brainstorming and looking for relevant information helped me find solutions to the task that we discussed in a group.
18. Being in an online group discussion was valuable because it helped me get to know and understand the views of other students.
19. I can describe the concepts I learned during the group discussion.
20. I can use what I learned during the group discussion in other tasks in this subject or other subjects too.

*Scale: A = "Strongly disagree", B = "Disagree", C = "Neutral", D = "Agree", E = "Strongly agree", F = "Not applicable".*