Abstract—This paper explores the use of webcams in virtual classrooms and how it affects students’ behavior. We utilize the survey strategy with a questionnaire as the data generation method. The respondents were 31 Norwegian students in tertiary education. Respondents were asked questions about their webcam usage habits when attending virtual classrooms and if using a webcam affects their decision to do certain activities. Our findings indicate that students are less likely to perform "distracting" activities while in a virtual classroom when their webcams are turned on as opposed to off. The findings are relevant for those who host virtual classrooms as they will have a better understanding of how webcams affect their students.

Index terms—Virtual classroom, webcam, students, lectures, behavior

I. INTRODUCTION

The usage of virtual classrooms has become more common the last year due to the recommendations from FHI[1][2], with a report from UiO stating that only 30% had prior experience with online teaching before March 2020, to 80% using Zoom during the lockdown [3]. Many of these classes were in the form of physical lectures before the Covid-19 pandemic, but are now replaced by virtual classrooms. In these virtual classrooms, the lecturer and participating students may use their webcams. This allows the teacher and the other students to see each other. The purpose of this paper is to understand how students perceive their behavior to change in virtual classroom settings when their webcam is on, based on the following research question:

• RQ1: How do students in a virtual classroom perceive their behavior to change as a consequence of having their webcam turned on?

In the context of our research, 'students' is defined as Norwegian students in tertiary education. 'Behaviour' is measured as actions that the student performs during or prior to a virtual classroom session. Examples of actions can be using a smartphone or dressing up.

Virtual classrooms are defined as a virtual space where the students can interact with the teacher in real time through text chat, voice chat and video streams. Students can also interact with other students in the virtual space. These virtual classrooms can be accessed via the Internet.

II. BACKGROUND

The background for this research follows the explosive use and adoption of virtual classrooms as a substitute for traditional lectures in higher education [3]. Earlier research [4] lament a lack of research in the field. The same paper gives reasons for students to keep their webcams turned off, the main ones being shyness and ensuring the privacy of their home or personal space. Paper [5] suggests that visual communication, in this case webcams, offer a higher degree of social presence, meaning that they allow for greater communication through social cues. However, this research was conducted on middle schoolers and was more focused on communication and the social aspect of webcam usage.

A research of virtual teams – as in group meetings conducted online through voice and video chat – found that participants increase their focus at the cost of decreased multitasking [6]. However, we could not find research of this kind specifically regarding a virtual classroom setting, whose different nature of interaction between participants warrants research of its own.

After having experienced many hours in virtual classrooms we were curious about how different aspects of the lecture affect the students. More specifically, we looked at the webcam to see how it affects students’ focus. We were curious about differences in attitudes towards mandatory webcam usage in lectures, as well as how its usage impacts behavior and focus on the contents of the lecture.

Our intention for this article is to give more clarity around how camera use in virtual classrooms affect students, and to give a better idea of possible benefits and how they are perceived. Lecturers should be able to make a more informed decision about whether or not to require webcam in their lectures, when they have information on how it can affect student behavior.

III. METHODS

A. Research Strategy

Due to the COVID-19 pandemic, choosing a research strategy that could be conducted effectively, safely and lawfully was a necessity. For this reason, our research group chose to use the survey research strategy. Since a survey is something
that can be conducted without the physical presence of the respondents, this was an appropriate choice given the situation. While a case study or an experiment would have been great choices for research strategies given the subject of our research, creating a realistic setting to explore the research question was deemed to be too much of a problem to overcome. If users knew they were being monitored, their behavior would likely be impacted as a result, spoiling the results of the research. In addition, COVID-19-related restrictions meant we would be greatly limited in the number of research subjects/participants that we would have the opportunity to be physically present with. Digitally monitoring an eventual experiment or case study was deemed unfeasible due to the hardware requirements (cameras, microphones) and set-up time that would be required by such an approach.

By using a survey, we can obtain the same kinds of data from a large group of people in a standardized and systematic way, and then look for patterns in said data that can be generalized to a larger population[7]. A survey also allows us to collect of a significant number of responses in the relatively short time frame that we have to conduct our research. Because a survey cannot directly establish a cause and effect relationship, our research question regards only how webcam usage is perceived to impact the respondent’s behavior.

B. Data Generation

We chose to use a questionnaire as our data generation method. This allowed us to gather quantitative data from respondents, meaning the numeric and categorical data gathered could be analyzed using statistical techniques later on. Our questionnaire was created and hosted on the Google Forms service, which allowed to create, edit and distribute the survey quickly and efficiently.

The sampling frame for our survey is Norwegians who are enrolled in tertiary education. Respondents were sampled in a non-probabilistic fashion using a combination of self-selection and convenience sampling. The questionnaire is self-administered, meaning no researchers were present during the individual completions of the questionnaire.

The various questions were formulated to follow Peterson’s criteria for good questionnaire questions. To ensure that the questions would be understandable and unambiguous to readers, we piloted the questionnaire on a few test respondents and as a result re-phrased a few of them based on the feedback we received.

The questionnaire is structured as such:

- Part 1 asks mainly categorical questions regarding whether the respondent has a webcam on the device they typically use for lectures, for what reasons they have avoided using their webcam during a lecture (if at all), and if they have ever avoided a lecture because of a webcam requirement. It also asks some ordinal scale questions (on a five-point Likert scale) regarding whether the respondent thinks webcams are a benefit during lectures, and how likely the respondent is to use their webcam during a lecture.
- Part 2 asks categorical questions about specific “distracting” activities that the respondent could possibly engage in when in a virtual classroom, and whether the respondent may do these things when their webcam is turned off as well as when it is turned on. In addition, it asks some Likert scale questions regarding whether the respondent tries to improve their appearance when they are to appear in virtual lectures, and how the amount of participants in the lecture influences their decision to use their webcam.
- Part 3 is for factual data about the respondent: their age, gender, field of study and year of study.

C. Data Analysis

All the questions produce either nominal data (yes/no or multiple choice questions) or ordinal data (Likert scale questions) and thus necessitate quantitative data analysis. Using Google Forms to create our questionnaire later allowed us to export a spreadsheet containing all the responses. We could thus use the values in the spreadsheet to conduct quantitative data analysis on the data, as well as generate graphs presenting answers to various questions presented in the questionnaire.

For Likert scale questions, we used the median of the responses to summarize the answers since using the mean does not provide very useful answers.

IV. FINDINGS

The questionnaire had a total of 31 respondents. 23 respondents were male, 7 were female while one respondent preferred not to state their gender. The data attained from the questionnaire presented various findings.

Figure 1 shows a tendency for students to refrain from enabling their webcam if this is not explicitly instructed by the lecturer. However, if the lecturer asks for webcams to be turned on, the data indicates that students tend to do so.

![Fig. 1. Median response to questions regarding respondents’ tendencies to enable their webcam for virtual lectures. The data is on a 5-point likert scale.](image)

One of the main questions asked by the survey was asking respondents whether they found themselves doing various distracting activities that may take the subject’s attention away
from the ongoing lecture, such as looking at their phone or eating. This was asked in the context of the subject’s webcam being turned either on or off.

As shown in figure 2, there are more people doing activities during lectures while their webcam is turned off compared to having it switched on. The figure represents each activity with a keyword for brevity. Table I shows which keyword represents which question that users were asked during the survey for context. Figure 2 further reveals that there is a varying degree of how much having a webcam turned on impacts the likelihood of doing certain activities. For instance, there is a big difference in how many people move away from their device when their camera is on as opposed to off, while there is not as great difference when it comes to phone usage. The rightmost bar shows that 7 people do none of the activities during lectures when their webcam is on, while nobody stated that this is the case with their camera turned off. In other words, when their webcam is turned off, they would engage in at least one of the activities listed.

Table I: Keywords Present in Figure 2 and Which Question They Represent.

<table>
<thead>
<tr>
<th>Question keyword</th>
<th>Full question</th>
</tr>
</thead>
<tbody>
<tr>
<td>Move away</td>
<td>I sometimes move away from my computer mid-lecture to temporarily do something else</td>
</tr>
<tr>
<td>Eat</td>
<td>I sometimes eat during the lecture.</td>
</tr>
<tr>
<td>Work</td>
<td>I sometimes work on things not related to the ongoing lecture (assignments/answering emails etc.)</td>
</tr>
<tr>
<td>Games</td>
<td>I sometimes play games during lectures (that are not related to lecture)</td>
</tr>
<tr>
<td>Videos</td>
<td>I sometimes watch videos (Netflix/Youtube) unrelated to the lecture.</td>
</tr>
<tr>
<td>Phone</td>
<td>I sometimes use my phone during lectures</td>
</tr>
<tr>
<td>None</td>
<td>None of the above</td>
</tr>
</tbody>
</table>

When asked whether they have ever avoided a lecture due to a webcam requirement, 13% of students responded yes.

Figure 3 shows the median values for responses to various questions regarding factors that may motivate or discourage students to turn on their webcam during lectures. The median response to whether students felt more motivated to turn on their webcams if a virtual classroom has more than 30 participants was 1, a value representing strong disagreement. Meanwhile, the median response to whether students felt more motivated to turn on their webcams if a virtual classroom had fewer than 15 attendants was 4, a value indicating agreement. There was agreement that if friends of the student are using their webcams, this motivates the student to turn on their webcam as well. The same figure also shows that respondents hesitate to be the first student to turn on their webcam in virtual classrooms.

When asked if they would forgo changing their appearance if they knew webcams would not be a factor during a virtual lecture, the median response indicated agreement.

Figure 4 shows how respondents felt when it comes to taking measures to better their appearance before appearing in a virtual lecture. The median response indicate that students to some degree do make efforts to look representable before appearing on webcam during lectures. When asked if they would forgo changing their appearance if they knew webcams would not be a factor during a virtual lecture, the median response indicated agreement.
V. DISCUSSION

Our study shows that webcam usage in virtual classrooms makes a difference in student behaviour. Students tend to multitask by doing activities that are unrelated to the ongoing class when their webcams are turned off. All participants engaged in at least one of the potentially distracting activities when their webcam was turned off. When their webcams are turned on, there is a reduction in the amount of students that engage in these activities. A virtual classroom with a webcam has many similarities to virtual team meetings when it comes to staying focused. Similarly to what was found regarding virtual team participants in paper [6], webcam usage seems to reduce the amount of multitasking done by participants in a virtual classroom as well.

As suggested by paper [5], having a visual component in a meeting, requires some degree of focus on what is being seen through the webcam, in turn making you more aware of how you are being presented to the others present. This could explain the reasoning for students engaging less in the distracting activities when their webcams are turned on.

Many of the students answered that they take the extra step of making themselves look presentable when they know they are going to use their webcam. The opposite is true when they know they are not going to use their webcam. This indicates that students care about their appearance and they will make an effort to be presentable in situations where they will be seen by others, even if it is only on a digital platform.

VI. CONCLUSION

As presented in the earlier sections, students perceive that their behavior changes when using a webcam in a virtual classroom. They are less likely to do potentially distracting activities when their webcams are turned on.

A. Limitations

Nearly three quarters of the respondents to the survey were male, leading to a significant gender bias in our sample size. This means the gender balance in our sample size is not representative of the intended population – Norwegian students in tertiary education – since 60% of Norwegian students are female [9].

Likewise, our population is not a representative sample of various higher education institutions in Norway. Because the survey was distributed to individuals known by the researchers to attend tertiary education, there is a significant likelihood that many of these individuals belong to the same institution (NTNU in this case), which may result in our dataset being biased towards representing students at NTNU. Overall, relatively few institutions out of all the ones existing in Norway were represented in this study due to the low sample size. It is likely that requirements for webcam usage vary from institution to institution.

Because we used a self-administered questionnaire as our data generation method, the data presented in this paper is the result of the respondents’ self-assessments and is therefore affected by some amount of subjectivity.

The overview represented in figure [4] is incomplete since there are alternatives to the situation that are not covered by the questionnaire. Respondents do not necessarily have to identify with any of the alternatives. For instance, they might not make an effort to look representable and still use their webcam.

B. Future work

While this paper associates webcam usage in virtual lectures with behavioral changes, it inherently cannot draw any conclusions when it comes to changes in concentration levels on the ongoing lecture. Research that assesses the connection between webcam usage and concentration levels could be interesting to conduct in an experiment or case study.

Another area of potential further research is whether webcam usage has a beneficial academic affect on students in their ability to retain information. Do students miss out on a significant amount of information as a result of doing the activities mentioned in our findings section, or are students still able to retain the course-related information that is provided during the lecture?

REFERENCES