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6-6-2020

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Abstract

Instructor-student interaction is an important element of a course design, but office hours can be challenging to attend based on students' commitments. They have time and space limitations that prevent students from getting the help they need and often garner poor attendance. Virtual office hours can address issues related to low attendance and provide a low stakes environment where unhindered learning can happen. Virtual office hours are flexible, yield productive interactions, and all enrolled students can participate. This study reports on three engineering instructors' perspectives on the efficacy of virtual office hours compared to the traditional face-to-face interactions with the confines of an office room. These classes ranged from sophomore to junior level covering two classes in mechanical engineering and one in electrical and computer engineering, taught over a period of at least a semester and impacting about 150 students across these disciplines. These sessions were held in the evening, twice a week. Information on the logistics of the implementation of the virtual office hours and key details, such as how instructors selected the best time for these sessions, content presentation, and the type of interactions that occurred during the virtual office hours are discussed in this paper. This study's goals were to find out how virtual office hours impacted engineering student's learning, whether such an exercise is an efficient use of the students' and the instructor's time, and the differences between traditional and virtual office hours. The instructors' perspectives were gathered via interview after implementing virtual office hours for at least a semester. Analysis of the interviews concluded that the implementation of virtual office hours was mutually beneficial to both the instructors and the students.

Introduction

A longitudinal study concluded that interactions between faculty and students outside of lectures is minimal, a trend that has remained consistent over time [1]. Most interactions between students and faculty are short, irregular, and are encouraged only by specific concerns [1]. Students have to make the initiative to meet with their instructors. Considering these findings, it seems that increasing student participation in office hours is out of the professor's control. However, there is an alternative that can boost attendance by tackling grievances that students and professors have. Virtual office hours (VOH) allow faculty to conduct student-led meetings online. This platform is more convenient for both parties for a number of reasons – (1) They can be attended from anywhere students and professors have access to an internet enabled device, (2) They are typically held in the evening of the day after lecture lasting 1 hour twice a week (starts between 7 pm to 9 pm), giving students time to attempt problems and in identifying what they understood, and (3) VOH makes interacting with the instructor more attainable and manageable.

Our study aims to understand the benefits of virtual office hours for engineering courses. Most engineering majors are math intensive and information is solidified by practicing problems outside of lecture. Traditional office hours are often utilized for assistance with the solving process. Although important, this one-on-one interaction is inefficient. One-to-one environment

can be replicated with demonstrative VOH, using video chatting software to hold office hours. The professor can write out problems and show diagrams to the students. Instructors can interact with every student simultaneously. With multiple students are able to participate, others can benefit from passive participation and professors only have to answer questions once. Recording the sessions has additional benefits. First, students who were unable to attend the online meeting could still gain knowledge from watching the videos. Secondly, students can watch the session and follow the concepts at their own pace. Lastly, instructors can refer students to the recordings so that they don't have to explain concepts again.

Three engineering professors were interviewed to gather their perspectives on VOH. ZOOM was used as their platform for communication with the students online. The instructor could share their screen, display documents, and write out problems using Microsoft Surface or iPad with an Apple Pencil. A headset with a microphone enhanced the quality of the recordings. This is a particularly useful feature for mathematics and diagrams. Students have a comments section to type responses or questions. There is also an option for the students to raise a hand to gain the attention of the instructor, so that they can enable their microphone to speak a question or response. This approach was enough in soliciting student questions and providing adequate responses. If additional assistance was needed the students always had the option to schedule an in-person consultation. Since, instructors do not have to see each student individually, office hours are more productive and easier for faculty and students. Such convenience and productivity make VOH a superior alternative in several ways.

Background

Office hours are often underutilized. Even if they are scheduled for a time that works for the majority of students, most do not attend. Two studies have been conducted to understand what prevents and what motivates students to show up to physical office hours. Students are less likely to attend in-office hours if their professors are unapproachable [1]. Faculty should make it clear to the students that they want to interact and encourage them to attend office hours. Another deterrent is a large class size [2], which often leaves the impression that the instructor is too busy to meet with the individual. Lastly, the time and location weigh heavily on the likelihood of attendance [1]. If either are inconvenient the student is less likely to go out of their way to get help. To increase attendance, one should aim to make office hours accessible and less intimidating. It should be made clear to the student that there is help available for everyone.

VOH addresses the deterrents and possesses the motivators for office hour attendance. Several studies have tried to find out if VOH results in an overall higher attendance rate than traditional ones. A majority used instant messaging (IM) software to conduct meetings. This was unsuccessful for most, because of its similarity to email [3]. IM provides an instantaneous response, which makes it different from email, but it was not favored [4]. VOH has been most successful with video calls and is a superior method because every student can join into one conversation. Video chatting also allows the instructors to verbally and visually demonstrate their response. Video call VOH had more reports of success than IM, but both had demonstrated an increase of student faculty interaction [4, 5].

A study aimed to understand the impact of VOH on student opinions of a course [4]. Some courses provided the option to interact with their professor via Facebook messenger at a specific time throughout the semester. After collecting student surveys, it revealed that the average student satisfaction with the course increased if VOH were offered [4]. This is an interesting result because only a small percentage of students had tried communicating with their instructor via IM. Students also reported on their preferred method of communication. A majority of students ask their questions before or after class or via email [4]. A similar study used student surveys to find out which form of communication students preferred. They also offered IM VOH and had low student usage. Students preferred asking questions before, during or after class the most [6]. However, students preferred VOH and discussion boards over email. Students' last choice for communicating with their professor was in-person office hours. Some students were deterred by office hours because they saw it as being intimidating [6].

Although attendance of VOH of the previous studies were low, another group had success. After introducing IM partway throughout the semester, interaction and office hour attendance increased. From this result, one may conclude that the relationship built through IM encouraged the students to meet in person [7]. However, students may have gone to traditional office hours for different reasons. It is likely that they were more comfortable with professor after communicating informally, or because feedback over IM was not sufficient as the semester was coming to an end.

Most studies utilizing IM for VOH have not had much success with getting students to trying them contrary to the success of VOH via video chatting. In one study, an instructor offered these sessions the evenings before tests. Student were able to ask last minute questions and to see the instructor draw out diagrams and demonstrations [8]. Common responses from students were about the convenience. Another study gathered the student opinion on demonstrative VOH. Students mentioned the benefit from listening to other's questions and engaging with each other and the advantage of anonymity during these interactions [5]. Students could choose to display their name. Being anonymous alleviated anxiety and allowed them to take more risks [5]. Students found it to be more convenient and comfortable. The instructor also reported higher attendance than traditional office hours.

Student faculty interaction is essential for student success. Interacting outside of lecture is important for students because it helps solidify lectures and can improve grades [9]. It also can increase course confidence and retention rates [10]. VOH gives students a chance to meet with instructors outside of class in a low-stakes environment. It is an opportunity to clarify lecture material and practice coursework. Even if the student is not actively participating in the meeting, they are still benefitting from the questions of their peers. The research on the student benefits from VOH has been documented [3 - 8] but understanding the professor's perspective is important. The goal of our study is to understand the faculty perspective on whether VOH is something that instructors will want to implement in their course, and if so, what are the most efficient ways of doing so.

Method

Our exploratory study aims to gain the instructor perspective of VOH implemented within engineering courses. The courses were Heat transfer, Dynamics (2 sections), and Circuit Analysis and Design (Circuits-II). Three instructors were interviewed after they completed at least one semester with VOH. Two of the professors are reporting on their first time offering VOH, while the other professor has been using it for several semesters. The nature of these virtual office hours was clearly explained in the syllabus. The instructors felt that offering these sessions at a time when there is fewer scheduling conflicts for students would increase participation. In all the classes in this study the average participation was between 10-25 students. Based on the frequency of quizzes, exams the student participation was at its peak before assessments. While these sessions happen outside normal business hours the benefits outweigh the inconvenience of doing these sessions in the evening. For example, the instructors and students do not have to commute to campus, any number of students can attend virtually, a wide variety of questions were answered that benefit all students. The VOH were conducted similarly, with minimal differences. Another difference is that one instructor did not offer a recording of the session. One of the instructors did require attendance of VOH, and one offered that attending help sessions as a portion of the grade. As previously stated, ZOOM was the communication software utilized. The instructors sent out problems beforehand for students to attempt before the meeting. During the meetings, the problems are solved by the students and are guided by the instructor. The sessions are student-led to avoid them turning into a lecture, a benefit for the students because it gives them additional practice on course material. To gain the student perspectives, the students completed an evaluation at the end of the semester with questions on how they benefitted from VOH, if they preferred this method over traditional office hours, and any changes they would like to make. These responses affected the instructor's view and their conclusion of the benefits of offering virtual meetings. A manuscript reporting on student perspectives is under preparation.

Our study is exploratory, guided by the phenomenology framework as we seek to understand instructor's experiences. Phenomenology (qualitative research) focuses on the commonality of lived experiences and the goal of the approach is to arrive at a description of the nature of the particular phenomenon. Each instructor was interviewed individually. The interviews were guided by a list of questions so that research objectives could be met. Each interview lasted about 15 to 30 minutes. Once the interviews were transcribed, each question response was analyzed. Thematic coding was performed to determine patterns between the instructors and to establish any themes of the instructor's experiences. The main focus of this study was to understand how VOH affected the course design and student learning. Institutional Review Board (IRB) approval was issued prior to the beginning of the study.

A recording of a session in one of the classes can be viewed here:
https://boisestate.techsmithrelay.com/kJY4

Results

Professor A taught Circuit Analysis and Design in Electrical and Computer Engineering, professor B taught Heat Transfer in Mechanical Engineering, and professor C taught two sections of Dynamics in Mechanical Engineering.

The following section describes the instructor's responses to each of the interview questions.

1. What are your reasons for choosing to offer virtual office hours as compared to traditional face-to-face office hours?

All of the professors offered VOH so that every student could attend. This is a large issue with traditional office hours, because most rooms only have space for three to four students. Other reasons to offer VOH were because they were student-led and students could work at their own pace with the recordings. It was agreed that VOH helped students learn engineering content.

Table 1: Instructor quotes from interview question 1

Professor A	Professor B	Professor C
"instead of having a separate session for each student it would benefit if I just have a virtual office session where everybody could just join in at their own and basically that would be a conversation and they would review the problems at their own pace." "you can be relaxed and not be tense sitting in an office room and maybe hesitate to ask a question." "it added clear value to my course" "There was not one negative thing about the virtual office hours in the overall review. This was a great success."	"When I started teaching classes I found that students didn't come to the office hours. I thought it was because of schedule conflicts and I tried to make different times, but still it was the same case." "I could meet them at a time where a lot of them could make it, and also at the same time it was recorded." "The virtual piece can help enhance the in-person interaction as well, because you interact with them more often."	"I can do it on my time frame in the evening and sometimes things are a little more flexible than during the daytime." "We need to offer students more flexibility, …offer me more flexibility as the instructor." "I think it's beneficial for the students."

2. In what ways do you think attending virtual office hours will impact the learning of engineering content?

This method has made students more likely to ask questions. Other benefits are reviewing concepts, increased student knowledge of content, and passive participation. The professor can also establish how well the students understand the content.

Table 2: Instructor quotes from interview question 2

Professor A	Professor B	Professor C
"being able to go back and look at certain problems and reviewing some concepts is going to help them [students]" "students are free to ask questions." "based on the feedback I received from students they have found this [VOH] to be extremely useful."	"This gives us one hour of practice problems or talking about concepts and that definitely helps everybody see where they are at." "there are people who can now make mistakes in a low stakes environment" "in this scenario people are more likely to ask questions."	"the students can benefit from the questions of others." "We get broader participation because they can both ask questions with chat and they can also ask questions by…speaking through the microphone."

3. What are your observations/perceptions of changes in student learning as a result of attending virtual office hours?

VOH have resulted in better comprehension of subjects, more participation, and higher attendance than office hours. Students repeatedly attended VOH, which led instructors to conclude that students benefitted from them.

Table 3: Instructor quotes from interview question 3

Professor A	Professor B	Professor C
"students who are normally quite in the class actually participated when I offered virtual office hours. They were comfortable asking questions and they were hesitant to even raise their hands during the regular class hours" "attendance was usually pretty high, which basically meant that the students wanted to come back for more." "Students who missed the concepts during the regular class hour got a chance to look at it again" "there were more participants here [VOH] then in my actual office hours"	"for many students that barrier is removed where they are now more comfortable to talk even in the class or at least interact."	"I value what they appreciate, everything that a student thinks helps them learn, I have to believe that they think it's better." "I had very good attendance, so I know that they thought it was helpful." "Homework participation and homework scores both were higher with VOH, especially in the latter half of the semester."

4. What are your perceptions on whether and/how attending virtual office hours is an efficient use of the instructor and the students' use of time?

VOH are a productive use of time because no one needs to commute, and it is time devoted to helping students. This means that there is no waiting for students to arrive. The recordings and the fact that many can attend can make it less stressful for the instructor. VOH eliminate redundancy, because the professor does not need to repeat themselves multiple times.

Table 4: Instructor quotes from interview question 4

Professor A	Professor B	Professor C
"I think it is extremely efficient" "they [students] really saw the value in having virtual office hours" "Virtual office hours I know for sure that that is an hour that I have set aside and people are either free to join or not join and they have the recorded version available after the session." "it [VOH] is a win win for both, where I'm not wasting my time and they are not wasting their time." "once that virtual office hour was done if somebody came in to ask a quick question about a certain concept, I just referred them to that video"	"they know that they are going to look at these problems and they are covering these topics that they are supposed to learn." "if I see that the majority could not answer then I could step in a make that clear to everybody what that concept is." "since this [VOH] is recorded those who missed can also have access to that discussion."	"… by virtue of their attendance I'm assuming they figured it [VOH] was an efficient use of time." "the nice thing about them [VOH] is that nobody has to travel, nobody has to come to the office, nobody has to get out of bed if they're if they're--nobody has to get off the couch if they just want to be a couch potato you know, call it up on their iPad if they want they can do that." "virtual hours are more efficient because it requires me to be prepared for them ahead of time."

5. What are some ways in which you changed your course design to make the most efficient use of virtual office hours?

The only change that one of the instructors would make to their course design is reducing traditional office hours, because VOH are sufficient. The others will not make any changes.

Table 5: Instructor quotes from interview question 5

Professor A	Professor B	Professor C
"I did not make any specific-- any changes to my course design whatsoever."	"I've never found a disadvantage with this setup"	"reducing my face-to-face or in my office hours."

6. Based on your experience of teaching using virtual office hours, what are some lessons you have learned regarding the most efficient use of virtual office hours?

To make VOH timely, it is beneficial for the instructors to be able to use the technology proficiently. One professor finds that the student-led problem solving helps efficiency. The students are given set problems to solve and have the professor to guide them.

Table 6: Instructor quotes from interview question 6

Professor A	Professor B	Professor C
"I think I would say that the first time offering went very well. I was kind of surprised looking at how many people came back again and again for this virtual office hour." "they [students] were pretty happy with the use of virtual office hours"	"you get a quick pulse of the majority of the class, how they are doing. Versus if you only have the physical office hours you only know about one or two students."	"I did not lecture. I just let the students ask questions. Just like I would if it was regular office hours." "the efficiency is not having to commute."

7. What is the difference between virtual office hours and traditional ones?

The difference between the two meetings are that VOH are more productive. Every student can attend, they are less intimidating, and more can be accomplished in this time. The professors do not have to answer questions multiple times, because they can refer students to the recordings. The instructors found VOH to be beneficial to students and themselves. They believe students are more likely to ask questions and that it has the potential to enhance in-person interaction. One even believed that students had learned better than in the previous semesters.

Table 7: Instructor quotes from interview question 7

Professor A	Professor B	Professor C
"sometimes it [traditional office hour] is overwhelming because I am going over the concept again and again and it's tiring because I am doing the same stuff all over again." "it [VOH] was a better utilization of my time"	"In a traditional office hour, I can have two or three people at best in the office room. Whereas in a virtual office hour, I can have any number of students, like the number of students in the class for example." "when they can type it removes a big barrier."	"virtual office hours were pretty much down to business from the start." "virtual hours are more efficient because it requires me to be prepared for them ahead of time."

"once that virtual office hour was done if somebody came in to ask a quick question about a certain concept, I just referred them to that video"		

Discussion and Conclusion

In summary, there was an agreement that VOH were beneficial to the students. From the feedback instructors received from course evaluations, it confirmed that the students had a better understanding of the course information. The benefits to the instructors were not having to repeat material, being able to accommodate more students, a more constructive meeting, and increased student participation. Students also benefitted from being able to do office hours from home. All professors plan on continuing to use VOH and found it to be an effective solution to their needs and wouldn't change anything about it.

Out study indicates that the student faculty interaction can be increased with VOH. However, no instructor felt that VOH increased office hour attendance, which was a finding result of another study mentioned in our review of the literature. As previously stated, instant messaging did increase this interaction for one professor. The professors did however find that there was more interaction with students than in previous semesters. All three agreed that there was more student involvement. One study indicated that anonymity was a positive aspect for students, however in this study, two professors offered credit for attendance, therefore eliminating the option for anonymity. Overall, this new perspective helped gain an understanding of the professor's view as opposed to the more commonly seen, student one. Every instructor plan to continue to utilize VOH within their course design because of the benefits to the students and themselves.

Finally, we need to acknowledge as a limitation the exploratory nature of our study with only three participants. In future work we plan to design a study understanding the VOH experiences with larger pool of instructors across colleges and across institutions.

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