OcuClass - Enhance focus and learning through augmented reality

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ABSTRACT

This paper describes some of the problems of the current way of teaching and learning in regular classrooms. The main issue this project aims to solve is the tendency for students to lose focus during class. The time during which a student can manage to stay focused without a break is one of the main factors that has to be considered in order to provide an efficient and functional learning environment. Through the use of movement and a teaching method inspired by museum visits, we are introducing a new teaching tool for the classroom of the future: OcuClass.

OcuClass aims to increase the attention level of students during class through a more immersive experience and by physically moving between the different information. The teachers guide students through a dynamic and engaging tour in order to improve their learning experience.

AUTHOR KEYWORDS

Augmented reality, dynamic learning, learning and technology, interactive class.

ACM CLASSIFICATION KEYWORDS

H.5.1 [Information Interfaces and Presentation]: Multimedia information systems.

INTRODUCTION

There are many important lessons to be learned in high school; amongst other things it provides the foundation of knowledge that you are supposed to stand on during university, or the rest of your life if you aim to start working after high school. Despite the importance of what is being taught, many students struggle with staying focused during class. They must then either learn all the material on their own time instead or fail to learn it all. Imagine how much time and effort could be saved if there was some way to help students concentrate more during

class. If this solution could also engage students and potentially spark an interest in what is being taught, it could very well be a teaching tool for the classroom of the future.

BACKGROUND

Attention

From a partner school that collaborated for the project, some information on student's behaviours had been gathered, the main concern is that concentration difficulties, together with learning specific subjects that are connected to abstract ideas and concepts, are what students tend to struggle with. With this in mind, the project had been defined around the difficulty to focus. Observations, interviews, and questionnaires were carried out, in order to identify the relevant design questions that needed to be solved. Confirmation on the first informations gathered on struggles to pay attention for long time, were clear from a visit and observation of an high school class. Students were observed in two environments: during a typical classroom physics lecture and during a biology lecture at a museum.
In both cases students were attentive for approximately the first 20 minutes, before starting to lose concentration, and in some cases starting to exhibit distracting behaviors. This idea is supported by the Pomodoro Technique [1], a productivity method which proposes that tasks are completed in 25 minute intervals, followed by a short break. This method also prevents procrastination, by encouraging people to write down any procrastination tasks on a piece of paper. By both allowing people to take frequent breaks and not accepting unrelated tasks to be completed, the Pomodoro Technique allows for work to be completed more efficiently [1].

Although students seemed to struggle to pay attention for longer than 20 or 30 minutes, it appeared that when there is a sudden change in the pace of the lecture, students seemed to start paying attention again. This could happen for example when the teacher was handing out supplementary

class material, or changing from projected material to whiteboard writing. This change acts as a short break between two sections of informational input, and helps students regain and reorient their focus [5[. Sitting still during long periods of time is not ideal while trying to keep alert. Inspiration from learning environments where sitting still is not a requirement was a great input for the project, museum were taken as an inspiration for the concept development.

Museums

A survey of a high school physics class shows that over 70% of the students enjoy field trips to museums, and view them as useful in the learning process. The social aspect of going to museums is important; students have more control over their learning when learning together with or from their peers [2]. Furthermore, the variation in learning environment that occurs when visiting museums is a welcome change for many students, and can add many benefits that cannot be gained in a classroom. Museums allow for a deeper understanding of concepts through visual displays and interactive artifacts, combined with theoretical input in the form of speech or written text. They offer opportunities to absorb information in two different ways: through a guided tour, or by free exploration. Guided tours enable the visitor to learn more, but may not be as engaging as free exploration [2] as it often doesn't leave enough time for students to absorb and reflect on the information gained at their own pace. It is therefore suggested that a combination of both be used, to provide both learning and enthusiasm.

An interview with a biology teacher revealed that since museum exhibitions are less information-dense and theory-heavy than lectures, students are able to be more attentive during their visit than in a lecture. Input from both teachers and a student suggests that information learned at museums can be retained for a longer time than that learned in a classroom, perhaps because it is different from a regular classroom lecture or because of the change in environment. Beyond these advantages, a key component of a museum environment is the movement aspect.

Movement

Studies have shown that movement aids attention and learning. Importantly, moving around stimulates the flow of blood and oxygen to the brain, facilitating ways to maintain attention and increase learning [4]. Another advantage of movement in learning is that moving away from a seated position, students "experience the curriculum through their bodies, … [helping] them make deeper emotional, interpersonal, and kinesthetic connections to academic subjects" [5]. A study from the University of central Florida, in Orlando [5] found that when facing complicated cognitive tasks, children need to move in order to succeed.

RESEARCH METHODS

The research phase consisted of ethnographic studies, interviews, literature studies, role playing and bodystorming. Bodystorming was carried out in order to empathize with how a student or teacher might feel or act while in class, and combined with the results of other methods, helped identify users' needs. Literature studies gave solid background knowledge on movement and learning that could be used for both ideating new design ideas and features as well as validating the ones created during the ideation phase. Observation of a high school biology lecture at a museum and observation of a high school physics class in a classroom gave direct contact with the target users and made it possible to see behaviour that could not have been acknowledged through literature studies alone.

Aside from using these research methods in the beginning of the project, results from the secondary research studies and observations throughout the whole project were used in order to find weak points in the concept and to validate aspects of it. During the school and museum visit, interviews with teachers and questionnaires from both students and teachers helped in gathering material to base design decisions on.

RESULTS

The concept

OcuClass is an augmented reality service which integrates virtual class material with the real world. Three different components are used to create a mixed reality learning environment: the OcuClass app, Google Cardboard eyewear, and markers to store information. The teacher uses a special teacher version of the app to assign class material to the different markers and a smartwatch to control the presentation. This material can include presentation slides, 3D models, images, animations, video, or anything else that the teacher believes will enhance the learning experience. Once the material is linked to the markers, the teacher is free to place the markers anywhere, either inside the classroom or outside.

Students all have access to one Google Cardboard each, and each have an account in the OcuClass app. After logging in, students place their phone in the cardboard, where it is automatically synced with the specific cardboard through Near Field Communication (NFC), since the cardboard has an NFC tag. It is then possible to use the marker on the outside of the cardboard to identify the student, which comes in handy for the teacher who is able to see which cardboard belongs to which student. The tour must be started from the teacher's app before the augmented information is visible to students. The teacher's version of the app allows the teacher to view all connected users, so they can see which students are following the tour. The teacher's app also has the possibility of showing notes. With these, the teacher can talk to the students without

turning to look at the slides, and can thus face them at all times.

Once the teacher has started the tour on the app, he or she will be able to guide the students through the exhibition. The students gather around the first marker, where the teacher holds a presentation of the material that is visible there. The students will be able to see the presentation slides, 3D models and other available material through cardboard when the app scans the marker and displays the information that is stored in it. It will then look as though the material is actually displayed in the real world.

There can also be an opportunity for students to freely explore the exhibition on their own, without a guided tour. Here, they are free to explore the things that they most want or need to learn about. Discussion with classmates is encouraged during free exploration. This is also a good time to introduce any worksheet or tasks to students.

The values of OcuClass
One of the biggest problems in school these days is that students struggle to stay focused during classes. They have trouble paying attention to the same thing for an extended period of time when sitting still, and need a break in the action to bring their alertness back. OcuClass's main goal is to address this issue, and create a learning environment that helps students to focus better and for longer periods of time.

OcuClass aims to help students stay focused through its use of movement and small "mini breaks." Physically progressing through the lecture by walking between slides ensures that a limited amount of time is spent in the same place during a lecture. Students should have an easier time staying focused during these short time spans when compared to attending an entire sedentary lecture. Movement helps students become more alert, and the breaks that accompany the movement helps to bring alertness back when it has temporarily faded.

An important aspect of OcuClass is its ability to eliminate distraction through immersion. If students are standing close enough to the marker that they only see the augmented material, they are not as likely to be distracted by their classmates or other sights around the environment, and are thus better able to focus on the information at hand. Further, having a student place their smartphone in the cardboard ensures that the phone will not be used for procrastination purposes, like it might easily be during a regular class.

OcuClass is designed to act as a complement to a regular theoretical lecture, much like museum visits would complement school teaching. Something that is appreciated about museums that has been carried over to OcuClass is that there is not too much information to take in, but rather the focus is on a fun and varied experience that shows information from a new perspective.

Another suggestion of how to use OcuClass is to combine guided tours with free exploration. This ensures that students will gain benefits from both methods: learning from the guided tour, and enthusiasm from free exploration [2]. The free exploration phase allows students to decide what they spend their time focusing on. Normal lectures do not usually accommodate students who learn at different paces. Free exploration with OcuClass, on the other hand, allows students to take the time they need in order to learn the available information. This is also an excellent opportunity for students to discuss with each other, which should help them gain more control over their own learning [2].

DISCUSSION
The design of OcuClass
One concern with OcuClass might be its lack of integrated note taking opportunities. Previous observation studies showed that taking notes actually keeps students from being distracted by technology or social activities to some extent; therefore, integrating some form of note taking would have been beneficial in order to keep students focused. However, since OcuClass would often be coupled with a normal lecture, and students might not take the same notes twice, it would be far more beneficial for students to take their notes during the normal lecture rather than during the OcuClass session. OcuClass already contains features that aim to prevent concentration loss. Furthermore, note taking during an OcuClass session might prove difficult due to technology interaction possibilities, and could lead to motion sickness or cause the session to be perceived as less fun. Some lighter notes should still be possible to take with a regular pen and paper, and students can be handed exercises to complete during the session.

Another possible negative effect of an intense use of OcuClass system is the potential risk that there will be some difficulty and time loss while moving furniture around the class. If moving furniture is a big issue for classes, the OcuClass session can be moved to an empty room, the hallway, or even outside the school since OcuClass is highly adaptable. If the session needs to be held in the classroom, markers could be put on card holders and placed on the desks, so that the class can walk around the classroom and gather around the desks.

One technical issue that might occur with the OcuClass system is lighting problems. Care therefore needs to be taken while placing the markers, taking into account the available lighting at the location. If there is too much direct lighting on the marker, the app may have trouble detecting it. Another issue is that if a person is blocking the marker from someone's view, then the class material will not be available to them. However, this can easily be fixed by having either person move slightly to accommodate the other.

The original concept is that Ocuclass can be used after a regular theory-based class. Teachers lecture about the subject before holding an OcuClass tour for the students, so that students have some previous knowledge of the domain and can use the tour as a repetition. One student explained that information takes longer to learn at a museum, but once it is learned it can be remembered for longer. If students have already heard the information beforehand, it will be easier and faster to learn it during the tour. However, OcuClass is a complementary tool; whether using it before or after regular class would be most beneficial to students remains to be seen and depends on the context. This would probably need to be tested and evaluated by teachers; the usage would most likely vary depending on the subject and other deciding factors such as how they plan to use it and what facilities they have available.

The design process
First hand information from the partner school was given without further opportunities to carry out user research with them, in order to fully understand the matter or prove its real presence before ideating for possible solutions. This might have lead to a solution that doesn't solve a properly identified problem. Later, research was carried out, with the aim to understand the real needs of the students and to evaluate the current concepts, in order to change them or implement them accordingly. The gathered data was also used to decide on ways in which the system could be used. Proper user research prior to ideation would have made sure that a purposeful design question was formulated and answered. A long Implementation time required an early start on designing the final product; therefore, the first phase of sketching, wireframing and prototyping was reduced to the minimum.

Future Work
OcuClass has not yet been tested in a real class environment. The next step in creating a successful OcuClass system would then be to hold user tests examining the usability and user experience of the system. The feedback will then be used for improving the system to make it more intuitive and relate better to the needs and desires of students and teachers.
From the museum visit, was observed the difficulty for a guided tour, to accompany as many as 30 students, which is usually a regular class size. Therefore, for OcuClass sessions, it might be preferable to divide classes into smaller groups, studies could be done on different sized groups to assess the preferable size for OcuClass usage, so that a recommendation can be made to teachers. Dividing a class into smaller groups though could potentially be an issue with scheduling, since more time would be needed for all groups to use OcuClass.

The concept got feedback from the partner school, regarding how social interaction might to some extent be suppressed by the OcuClass eyewear as it occludes people's eyes from others' sights. Further input challenged that since social interaction has been suggested to be very useful for learning [2], it would be a beneficial feature to embrace social interaction more intensively. Future work should be done to evaluate whether social interaction really is inhibited by the cardboard, or if this is not seen as an obstacle. If it turns out to be an issue, more effort could be given to finding a way for social interaction to be better supported by the eyewear. Further research needs to be done on whether this would feel like a natural interaction between people.

Since OcuClass is such a versatile system that is not tied to any subject or any usage, there are more possibilities for its use than have been explored during the scope of this project. In the future, other opportunities for its use may be considered. Further possibilities include incorporating a quiz into the OcuClass app, to ensure that students are paying attention during the class. Students could interact with the app through the volume control buttons on their hands free, and the teacher has easy access to all their answers through their personal accounts.

An important aspect of the OcuClass system that needs to be further considered and implemented is user interaction. Currently, the teacher interacts with the app through a smart watch. The interface can be improved further to include feedback to the teacher on the actions taken. Interaction between students and material could be considered, this could be particularly useful during free exploration, where the teacher does not control the focus of the class material. Work also needs to be done on a simple user interface for the teacher to upload class content to markers. This should be possible to do through a tablet or computer, and should be intuitive and easy.

CONCLUSION
In this project, augmented reality is used to create an innovative solution to improve both the learning experience of students and the quality of the material provided by the teacher. The OcuClass system is meant to ease the difficulty of explaining abstract phenomena and help students remain focused throughout a lecture. It also allows students to acquire knowledge with the aid of three dimensional objects and multimedia. OcuClass serves as a complementary tool to regular lectures, turning passive learning into engaging exploration.

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