Let's FOCUS: Location-based Intervention Tool to Mitigate Phone Use in College Classrooms

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Abstract
Many studies have shown that smartphone activities, such as Facebook, text messaging, during the class are irrelevant to learning, and lead to a negative influence on students' academic performance and the flow of the class. In this paper, we present Let's FOCUS, an application that helps college students concentrate on the class. For each class, Let's FOCUS offers context-aware reminders and a virtual limiting space in which students limit their smartphone use. We conducted a campus-wide campaign for six weeks to evaluate the usefulness of Let's FOCUS. A total of 379 students were engaged in 9,335 hours of limiting behaviors over the campaign period. We found that many students continued to use Let's FOCUS after the campaign without any external rewards.

Author Keywords
Software-based intervention; context awareness; smartphone usage; college student

ACM Classification Keywords
H.5.m [Information interfaces and presentation (e.g., HCI)]: Miscellaneous.

Introduction
Personal digital devices such as smartphones allow users to access wider information with ease. As the use of

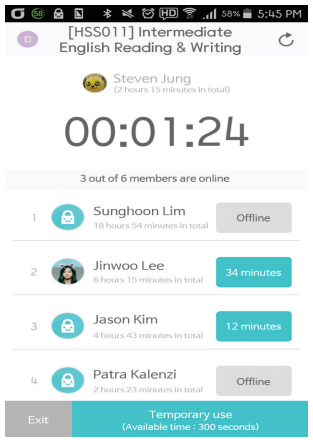


Figure 1: The virtual limiting room (focus mode)

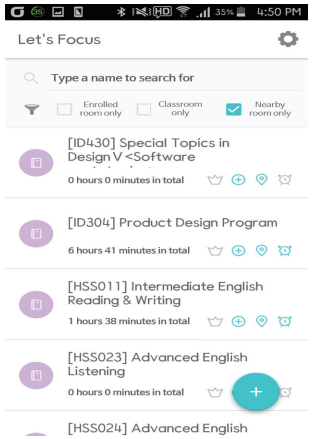


Figure 2: Searching a room

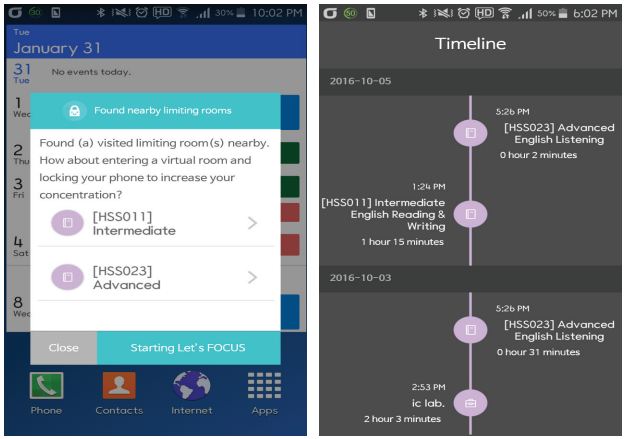
smartphones has become pervasive, it has been natural for students to utilize their smartphones as a learning tool in the classroom (e.g., searching for information etc.) [4]. However, when the smartphone is used for non-class purposes, it may become a distraction in the classroom.

According to our preliminary survey (n=283), 79% of college students use a smartphone during class and 74.9% agreed that smartphone activities that are irrelevant to the class (e.g., social network services, text messages, etc.) are problematic. Many studies have shown that off-task multitasking, such as using Facebook and text messaging during the class, leads to a negative influence on learning performance [1]. In addition, instructors may have difficulties with managing students' smartphone use, since it requires considerable effort, especially in large or crowded lecture halls, and may interrupt the lecture flow.

Many software-based products and research prototypes were suggested to help users self-regulate smartphone use [3, 2]. However, there was no attempt to help students regulate smartphone use in the context of the class. In this work, we developed Let's FOCUS, an application that helps college students concentrate on the class. Let's FOCUS supports virtual limiting spaces, context-aware reminders (location-based and time-based), and a timeline of limiting behaviors. Our evaluation of an intervention was in the form of a campaign at a large university.

The Application Design

The key idea of Let's FOCUS is to help students self-regulate their smartphone use and to guide them to use a smartphone as an assistive learning tool. Let's FOCUS has three main features: (1) a virtual limiting room, (2) context-aware reminders, and (3) a timeline.



(a) The reminder **(b)** The timeline

Figure 3: Context-aware reminder and the timeline

Virtual limiting room
During the class, Let's FOCUS provides virtual limiting spaces to help users avoid smartphone distractions. It is done by locking their phones while the user resides in those spaces. Each virtual space is associated with a corresponding physical space (e.g., a classroom). For a given classroom, the physical presence of a user can be detected by scanning Wi-Fi fingerprints (i.e., the unique MAC addresses of Wi-Fi APs) near the classroom. These fingerprints are predefined on the server, so that only users who are near the physical classroom can enter the corresponding virtual rooms.

User interactions for a virtual limiting room: If a student enters a virtual limiting room, the execution of any applications is blocked and all notifications (e.g., messenger, SNS etc.) are muted. We refer to this smartphone state as the "focus mode". During the focus mode, the student

Figure 4: The main poster

Figure 5: The main poster

can identify the title of a virtual room (e.g., class name), the accumulated time of limiting, the amount of time spent in a given focus mode, and a list of users taking the same course who have previously entered the virtual room (Fig. 1). By touching the "temporary use" button, students can temporarily leave the virtual room up to five minutes for occasional use (e.g., information searches or personal contacts).

Creating a virtual limiting room: Before deploying Let's FOCUS, we created virtual limiting rooms for every class. In addition, we allowed students to generate a new virtual room for their individual study or other work. The creator of a new room can set an option for its location restriction. When this option is enabled, a virtual room are associated with a physical space, and students can enter the room only if they are near the corresponding location.

Searching for a virtual limiting room: Basically, a student can search for rooms they want to enter by typing the class name. In addition, We offered checkbox UIs for students' convenience. Checkbox UIs allow a student to easily filter the virtual rooms by listing only (1) the virtual rooms the student has previously entered, (2) the virtual rooms associated with classrooms, and (3) the virtual rooms located near the student (Fig. 2).

Context-Aware Reminders
When a user joins a virtual limiting room, Let's FOCUS allows the student to set a context-aware reminder for the given virtual room. Once a student accepts a reminder and enters a virtual limiting room, their smartphone use is limited. There are two types of context-aware reminders: (1) a location-based reminder, and (2) a time-based reminder. Students can choose the reminder option depending on their preference.

Regarding the location-based reminder, when the student approaches a classroom, the application checks nearby Wi-Fi fingerprints, and automatically sends the student a notification with a short vibration and a popup message that displays a list of nearby classrooms (Fig. 3a). If the student decline the popup message, the alarm is snoozed for an hour to prevent disturbance from the alarm. Students also can set timers for when they would like to receive notification. Hence, students can receive timely reminders that they should focus on the class.

Timeline of Limiting Behaviors
Let's FOCUS records all of user's limiting activities and displays them (Fig. 3b). The timeline can remind users of recent limiting activities such as which virtual limiting room they entered, when they started the focus mode, and how long their limit lasted in a time sequence. By doing so, the users can reflect on their limiting behavior as well as improve their self-regulation, as also shown in another study [3].

The Real-world Campaign

Technical environment setup
We conducted software-based intervention in the form of a campaign at a large university. We identified 137 classrooms and 1,003 lectures that are held in the semester. We collected every Wi-Fi fingerprints of APs near the classrooms. We stored all lectures' information (e.g., class name, instructor, time for the class, locations of the classroom, Wi-Fi fingerprints of APs near the classrooms etc.) on the server, and we generated 1,003 virtual limiting rooms for all lectures.

Campaign procedure
We produced promotional posters and distributed them throughout the campus to encourage the students to

participate in the campaign (Fig. 4 and Fig. 5). We uploaded Let's FOCUS to the App Store so that students could easily download and install it. The campaign lasted for six weeks, and every student who achieved 20 hours in the focus mode was rewarded with a mobile gift voucher worth about 5 USD. After the campaign, we collected all users' usage logs with timestamps, and we conducted an exit survey (n=177), and an interview (n=19) to understand students' general user experience of Let's FOCUS.

Evaluation of the intervention

Deployment summary

A total of 379 students were engaged in 9,335 hours (2,082 hours in class, and 7,253 hours in their individual studies) of limiting behaviors over the campaign period. Students limited their smartphone usage on average 64.2 minutes (SD=149.6) for a given focus mode during the class. For students' individual studies or other work, they limited their usage on average 80.7 minutes (SD=175.2).

User experiences of the key features

71.9% of students reported that they could focus better on the classes using Let's FOCUS, since they could stay away from smartphone distractions. 96.3% reported that they utilized the five-minute allowance for occasional use (e.g., searching or personal contacts). Students preferred the location-based reminder to the time-based reminder.

Let's FOCUS use after the campaign

74% of the students responded that they are willing to continue to use the app after the campaign. We continued to monitor students' Let's FOCUS usage till the end of the semester and found that there were still 177 active users, limiting additional 1,224 hours after the campaign ended although there was no longer any external reward.

Conclusion

We presented Let's FOCUS, a software-based intervention tool for college classrooms that helps students regulate their smartphone use and focus on the class. To our knowledge, our work is the first large-scale trial of software-based intervention in a college.

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