Interactive Desktop Study Buddy Robot: Stubie

Jongwon Lee
Indiana University
leejojo@iu.edu

Colette Clouse
Indiana University
coleclou@iu.edu

Ayesha Kazi
Indiana University
kaziaye@iu.edu

Abstract

An electronic device while studying is a double-edged sword in the aspect that it helps student study but it can distract the student as well. In this research, we design and create a robot study mate Stubie (Study + Buddy) using Arduino that implements the Pomodoro method and interactive emotions and rewarding system. Our research reveals that students demand functional features from a study buddy robot and believes a robot can be their study buddy if the robot provides relevant features. Regarding ethical concerns, our prototype of Stubie does not store the data that can be generated with the sensor to reduce any privacy concerns such as feeling that they are under surveillance for how long and what time they study.

***Keywords*—** Human Robot Interaction, Robot Ethics

1 Background

Studying with electronic devices such as a laptop and a smartphone can be helpful because it provides technological functions such as timers and search functions. However, electronics can be more distracting than beneficial. For students that prefer to study with a companion, but sometimes get distracted, a robot study mate could be helpful. Moreover, students can quickly lose motivation when studying or doing classwork, leading to burnout. We want to design a robot that can help students focus. We are also interested in the effects of social settings on studying efficiency and how a desktop robot can embody the characteristics of social studying. Lu et al. adopt the self-determination theory (SDT), which emphasizes the importance of the user's innate psychological needs such as relatedness as the design principle for their study partner robot. They claim that satisfying such psychological needs will motivate learners and improve the learning output (Lu, 2018). Thus, we designed a robot that is friendly, interactive, motivating, and rewarding to fulfill their psychological needs. We were also interested in how we can design the robot to familiarize students and derive affordance so students will use the robot more often. Moreover, Michaelis and Mutlu emphasize that face design is the key to motivating users and connecting socially with their robot (Michaelis, 2017). Thus, we focused on the digital facial design to make our robot serve as a better companion.

We are interested in the following questions:

- What motivates students to study?
- How can students study more efficiently?
- Why do people like to study with friends?
- What kinds of tasks can be automated with a desktop assistant to ensure students have effective study sessions?

2 Context of Use

We wanted our robot to be a companion for students, helping pace studying, and completion of assignments. We wanted our robot to interactively provide reminders, and motivation, and track the progress of the study on top of simpler functions such as a desk light, a timer, and a clock. We are studying college-aged students to build a desktop study companion robot that helps them stay motivated. We would need to study students working in public areas like the Union to see how they pace their homework. The companion is meant for desks at home, to keep students company when they're alone. The robot needs to be appealing and somewhat customizable so users can connect with it. This could be accessories or a light that changes colors. We know that many students like to study in groups based on experience and observations

around campus. We want to mimic social studying with a robot that actually helps keep you on track. Students will be able to keep track of how long they study and achieve desired study hours through a studying method called the Pomodoro method. The robot will be able to detect students with a sensor. The robot will know if the student sits or leaves the desk. This will let students focus on studying and motivate them to study. The robot will reward the students in multiple ways. For example, Stubie will give emotional rewards with the digital screen that expresses the positive emotions of the robot.

(Mubin, 2013)

3 Ethical Statement

Privacy is a primary ethical concern when adopting a robot as a service provider. Usage of the information collected by robots should meet the informed privacy policy. Calo argues robots can infringe on privacy by robots serving as direct surveillance, new points of access, and social agents (Calo, 2011). Stubie does not use a camera for the version we are working on, but it uses a proximity sensor to sense if the student is sitting at a desk. We will only be using that information to know if the student is on the desk or not and will not store the data that can be generated with the sensor and inform this policy to the users. This is because users may have privacy concerns such as feeling that they are under surveillance for how long and what time they study.

We believe robots can provide objective welfare such as respect and recognition if they are designed to do so. However, Sparrow makes an argument that the introduction of robot aged care will lead to a dystopian future because robots cannot provide objective welfare (Sparrow, 2016). Rather, we believe human caretakers could have negative sides such as disrespect such as treating the aged just as a client. On the other hand, well-designed robot caretakers will not have those attitudes and can show positivity, respect, and motivation. Objective welfare such as respect and recognition can be expressed by Stubie as well by showing positive facial expressions whenever it recognizes the student completing their study hours. However, friend studying mates or parents may not be providing this recognition and rather be indifferent or negative about the student's studying progress. We believe we need to take objective welfare into account to improve the result of a service robot project because people will design the robot to have more interactivity and motivation. Moreover, service provider robots do not necessarily replace human service providers but rather help them. In this sense, Stubie can be part of the study group instead of conceiving as a replacement for a human studying mate.

We apply Riek and Howard's HRI principles that aim to address ethical concerns regarding human dignity (Howard, 2014):

- The emotional needs of humans are always to be respected.
- The human's right to privacy shall always be respected to the greatest extent consistent with reasonable design objectives.
- Human frailty is always to be respected, both physical and psychological.

We are concerned with our robot being misused as a surveillance and a time tracker. We address this by designing our robot as friendly as possible and having interactive facial expressions so that students will treat the robot as a companion instead of a tool. We respect users' privacy. We will not be storing or using data that may be invasive to students' privacy. There will be no pressure if the student feels frailty. We address this by our robot only having reward systems and no punishment related to students' study progress.

4 Design Research Methods and Findings

In our empirical research, we found that outer appearance is one of the most important aspects of robotic design. Faces, round edges, soft materials, and animal-like forms build trust and connection in an HRI system (Michaelis, 2017). In terms of studying, working on different subjects in a study session is helpful enhances study outcomes (Winerman, 2011). We planned to design Stubie to be able to suggest study topics.

4.1 Survey on Emotion and Motivation

We asked four questions to 11 university student subjects (N = 11) through Google Forms to understand the motivation to study and how people conceive the emotions of a robot. We wanted to understand whether emotional or functional features would motivate students more and what features

students are expecting from a Study Mate Buddy Robot. Also, we wanted to learn what forms of rewards are expected and preferred to motivate them. The results will be guiding which function of the robot the group should prioritize.

The survey results revealed what students believe motivates them to study. Out of five scales of answer choices, 45.5% of the students believed that emotions by digital facial expressions or sounds of s a study buddy robot will somewhat motivate them to study, 27.3% neutral, and 27.3% negative. We plan to show facial emotion through an Arduino screen. Since more students believe emotion will motivate them, we plan to create this emotional screen that shows positive emotions such as when students come to sit at the desk to study and complete the study. 54.5% of the students preferred physical or virtual quantitative rewards would motivate them to study and 45.5% of the students preferred qualitative verbal or visual praise. This implies that both quantitative and qualitative features are both worth designing. After the completion of the 25-minute study, we plan to reward students and encourage them to take a short break. For physical quantitative rewards, we plan on giving a candy, for virtual quantitative rewards, we plan to display how many total hours they have studied in a day and a week. For qualitative verbal or visual praise, we plan to record and play a sound welcoming and praising students that study and show digital faces. Next, we asked if a Studying Buddy Robot assuming it fulfills your desired features of a studying buddy can replace a human studying buddy. Out of five scales of answer choices, 63.6% of the students believed it will depend on the features, 27.3% believed it will somewhat replace, and 9.1% believed it will unlikely replace. These results showed that most students were positive about studying with a robot instead of a human study mate. Also, students care significantly about the feature the robot can provide. We asked what features students prioritize from a Studying Buddy Robot among 3 choices: a companion for psychological reasons (27.3%), motivation by rewards (27.3%), and functional purposes such as task and time management (45.5%). We can expect students are expecting functional purposes more than other features. We will be applying the Pomodoro technique and using the Arduino screen to visualize it.

4.2 Survey on Behavior and Design

We sent out two surveys to learn about college students' study habits and their feelings toward robots. We surveyed 10 students to see how they like to study, how long they study, and whether they use/know about the Pomodoro technique. She also presented images of four social robots (Kuri, Keepon, Blossom, and Vector) and asked what the students liked and disliked about them (Appendix Figure 5-8). Respondents generally did not like Kuri's high-tech look. They said it was "mainstream" and a "stereotypical" robot, with one respondent saying "Looks like it will take over". For Keepon, students said it was cute, they liked the color, and it reminded them of a duck. When asked what they disliked, the most common comments were they did not know what it did, and the black cylinder is bulky. Comments about Blossom included, students saying it looks cute and cuddly, and they liked its knit material and ears. Respondents did not like the "ambiguity" of it with many people saying it needs eyes or a face. Lastly, students liked Vector's form because it has wheels, green eyes, and looks like it can perform tasks. When asked what they disliked about Vector, respondents said it looked scary, bulky, and one person said it looked complex to repair. The last survey question was "If you had a desktop study robot, what features would you want it to have?". As for functionality, respondents wanted a study robot with a timer, a reminder system with a to-do list, and sounds or gestures to keep them motivated. Other respondents were more focused on the form of the robot. Some said they wanted it to be cute and soft, one person said it needs to be "non-distracting", and one person said it should have calming lights/colors.

The survey results were aligned with what we know about social robot design. Survey respondents generally liked the softer shapes/textures of Keepon and Blossom and disliked the faceless aspect of some forms. Students disliked the high tech look of Kuri because it looks mainstream and cheap. Our form will reflect the responses by including a cartoon-like face so users connect with it without falling into the negative part of the Uncanny Valley. The robot is intended to accompany students on their desk while working, so it will need to relatively small in size. Because of the size constraints, we will have to limit bulky hardware components and only include necessary fea-

tures. According to our design survey, students want Alexa capabilities (timer, to-do list, and ability to answer general questions) housed in a cute body. Based on the students' wants we will design the robot with an emphasis on pacing work sessions through timer intervals. When asked about familiarity with the Pomodoro technique, 71% of surveyed students had never heard of it, and 21% had used it. Though many students don't practice a structured study method with timed sessions and breaks, it is proven to help remember information and avoid burnout. We will implement the Pomodoro method through structured study and break intervals, because the goal of the robot is to improve study habits. We are looking into using an Arduino connected Bluetooth component so users can connect their phone and access the assistant capabilities many respondents wanted.

5 Appendix

Emotion and Motivation Survey Questions

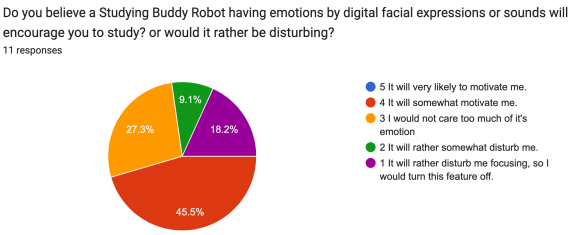

Figure 1: Emotions

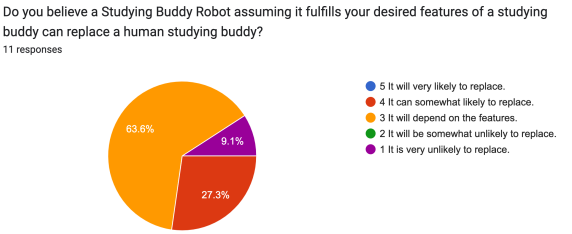

Figure 2: Replace

Behavior and Design Questions

- How many hours a day do you spend on schoolwork outside of class?
- What do you like about X? What do you dislike about X? (X being the pictured robot)

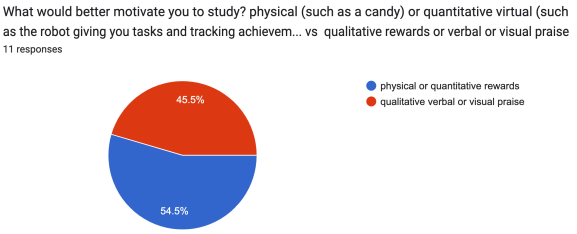

Figure 3: Motivation

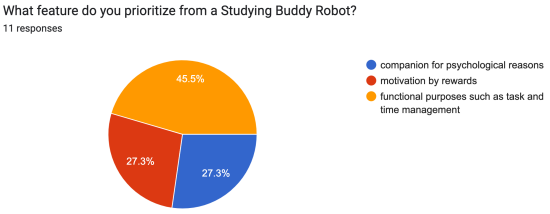

Figure 4: Features

- If you had a desktop study robot, what features would you want it to have?
- Do you have anything to add on the subject of studying or social robots? Explain

Behavior and Design Images

Figure 5: Keepon

Figure 6: Kuri

Figure 7: Vector

Figure 8: Blossom

References

M. R. Calo. 2011. Robots and privacy. *Robot Ethics: The Ethical and Social Implications of Robotics 187*.

Riek L. Howard, D. 2014. A code of ethics for the human-robot interaction profession. *In We Robot*.

Chen C. Chen P. Chen X. Zhuang Z. Lu, Y. 2018. Smart learning partner: An interactive robot for education. *Artificial Intelligence in Education*, 10948.

Mutlu B. Michaelis, J. E. 2017. Someone to read with: Design of and experiences with an in-home learning companion robot for reading. *Ser. Telepresence and Robots*, page 301–312.

Stevens C. J. Shahid S. Mahmud A. A. Dong J.J. Mubin, O. 2013. A review of the applicability of robots in education. technology for education and learning.

R. Sparrow. 2016. Robots in aged care: a dystopian future? *AI Soc 31*, page 445–454.

Lea Winerman. 2011. Study smart: Make the most of your study time with these drawn-from-the-research tips. *gradPSYCH*, page 25.