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Supporting Inclusive Learning Using Chatbots? A Chatbot-Led Interview Study

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ABSTRACT

Supporting student academic success has been one of the major goals for higher education. However, low teacher-to-student ratio makes it difficult for students to receive sufficient and personalized support that they might want to. The advancement of artificial intelligence (AI) and conversational agents, such as chatbots, has provided opportunities for assisting learning for different types of students. This research aims at investigating the opportunities and requirements of chatbots as an intelligent helper to facilitate equity in learning. We developed a chatbot as an experimental platform to investigate the design opportunities of using chatbots to support inclusive learning. Through a chatbot-led user study with 215 undergraduate students, we found chatbots provide the opportunity to support students who are disadvantaged, with diverse life environments, and with varied learning styles. This could be achieved through an accessible, interactive, and confidential way.

Keywords: Chatbot, Learning, IS education, Artificial intelligence, Inclusive learning

1. INTRODUCTION

Supporting student academic and professional success has been one of the major goals for higher education. Education research has shown that positive social interaction between students and teachers enhances student learning (Cole et al., 2019; Luo et al., 2017; Muir et al., 2019; Wallace, 2003). However, understaffing and a low mentor-to-students ratio make it difficult for students to receive sufficient support and guidance that they might want. This is further strained with students not having similar resources as others, making education exclusive for some groups (Ortagus, 2017), which leads to an urgent question of how to provide a *personalized* learning environment at scale.

The advancement of artificial intelligent (AI) and conversational agents (Luger & Sellen, 2016), such as chatbots (Grudin & Jacques, 2019), has provided promising opportunities for assisting student life in higher education (Goel & Polepeddi, 2016). The term “chatbot,” coined from “chatting robot,” refers to intelligent machines that can conduct text-based conversations with users. Chatbots were initially studied in the early 1980s but did not receive much attention until the past decade with the development of natural language processing and deep learning. Starting from chatbots that are integrated in messaging applications (e.g., Facebook and Slack) and used for customer services, researchers have also leveraged chatbots in answering basic questions, providing information, and offering interactive support in various domains (Avula et al., 2018; Jain et al., 2018; Tallyn et al., 2018). In particular,

researchers have started to discuss the scenarios in teaching and learning where chatbots might be adopted, as shown in a recent workshop (Gonda et al., 2018). However, to the best of our knowledge, there lacks an empirical study to investigate the capabilities of chatbots in inclusive learning.

This research project aims at investigating the opportunities, requirements, and limitations of chatbots as intelligent tutors to support personalized student learning. As part of the project, this paper reports the findings that are related with how chatbots could support inclusive learning – a personalized learning environment that meets with different students’ needs at scale. Note that this is an exploratory study that engages potential users to brainstorm design opportunities. Therefore, the chatbot was used as a tool to interview potential users, *not* to offer a one-size-fit-all learning support system.

To this end, we developed a chatbot called “Sammy” as an experimental platform to investigate the design opportunities of using chatbots as an intelligent and inclusive tutor. We conducted a user study with 215 undergraduate students at a large public university in the United States who completed chatbot-led interviews with Sammy. In particular, the chatbot aimed at investigating the main barriers for students to receive help, advice, and coaching from course instructors, the opportunities that a chatbot might help, and benefits and concerns of using chatbots in supporting student learning.

We found that chatbots have the potential to create an inclusive environment for students who are disadvantaged, with varied life environments, as well as different types of learners. Chatbots could have the ability to answer basic questions

regarding courses content, connect students with helpful campus resources for individual needs, provide supplementary materials for advanced learning for different learning styles, and chat about life and wellbeing issues to help various types of students. Such opportunities were mainly supported by three qualities of chatbots: accessibility at anytime and anyplace, interactivity with students, and the possibility to connect with external resources. Participants also expected the enhanced ability for chatbots to understand conversation flow, social-emotional cues, and their specific needs. We conclude by proposing design implications for an intelligent and inclusive tutor.

2. RELATED WORK

Chatbots, as one type of AI technologies, continue to grow in popularity on various industrial platforms. The term “chatbots,” coined from “chatting robots,” refers to intelligent machines that can conduct text-based conversations with users. Chatbots have been widely used for commercial purposes such as customer support (Johannsen et al., 2018; Xu et al., 2017). Recently, researchers also started to extend the value of chatbots from commercial usage to a variety of different areas, such as facilitating collaboration (e.g., SearchBot, Avula et al., 2018), enhancing work performance (e.g., SwitchBot, Williams et al., 2018), conducting recruiting interviews (Zhou et al., 2019), and promoting healthy lifestyles (e.g., Pocket Skills, Schroeder et al., 2018), AI-bot for healthy lifestyle (Fadhil & Gabrielli, 2017), Woebot (Fitzpatrick et al., 2017) and Vincent (Lee et al., 2019) for mental health. Besides that, chatbots are found to be a valuable alternative to collect research data. For example, chatbot-led surveys are likely to elicit higher-quality responses from users than surveys, such as differentiated responses. For another example, the Ethnobot (Tallyn et al., 2018) leverages chatbots to gather ethnographic data for scientific research. Chatbots are also used to deliver services to underserved and vulnerable populations. For example, FarmChat (Jain et al., 2018) was designed to help farmers in rural India better access information; Consejero Automatico (Wong-Villacres et al., 2019) aimed at supporting Latino parents’ educational engagement. Another chatbot usage is virtual assistants (Chattaraman et al., 2019) for older adults providing step-by-step verbal task guidance in an online environment, which was found to deliver diverse positive social, functional, cognitive, and behavioral health benefits for the elderly.

Prior work also explored the benefits of using chatbots in higher education. Currently, chatbots are mainly used in the education of health and wellbeing, language learning, facilitating feedback and metacognitive thinking, and asking students challenging questions (Winkler & Soellner, 2018). A study conducted by Patrick and colleagues (Bii, 2013) revealed that the interactive nature of chatbots provides opportunities for social interaction, which plays a critical role in the development of cognition and contributing to the process of learning. For example, @dawebot trains students in learning through quizzes (Pereira, 2016). During a 15-week study, students considered using the chatbot for a practice test as an engaging way of studying. Fadhil and Villafiorita (2017) presented a chatbot called CiboPoliBot that teaches children about a healthy lifestyle through an interactive social game. Taking it further, Georgia Institute of Technology piloted a chatbot called Jill

Watson that served as a teaching assistant who answers student questions in an online course (Goel & Polepeddi, 2016). Beyond learning, a few universities have deployed chatbots to support student life. Pounce (Daniel Peterson, 2016) helps first-time students transition to and enroll in Georgia State University. The chatbot can answer students’ questions regarding enrollment and financial aid, while also having the capability to remind students who have not finished portions of their enrollment process. Beyond the tutoring function, INDIGO was developed as an intelligent agent to infer students’ personality and facilitate the teaming process and enhance teamwork among college students (Xiao et al., 2019a). This takes the chatbot capabilities to the next level by not only understanding content of a conversation but also the personality of users.

Recently, researchers started to design chatbots for career counseling. For example, Parab et al. (2017) proposed a chatbot career counseling system to help users find potential fields of interest by asking questions to a chatbot that connects to a database. An article by D’Silva et al. (2020) further proposed a more comprehensive chatbot counselor that can conduct a series of psychometric tests to infer users’ personality, which will be used to provide career options matching the corresponding personality traits. Once a user has decided to apply for a specific job, the chatbot will then learn about user’s emotions to understand their interest in the job application and mentor them to learn the skills required in the job description. Finally, the chatbot will build e-portfolios of the users for their own information and/or for the job providers. The chatbot might also provide translation services for users who have language barriers throughout the job application process (D’Silva et al., 2020).

So far, very few projects have studied the equity, diversity, and ethical issues of using chatbots in learning. Among them, the chatbot CiSA (Heo & Lee, 2019) was designed and developed to enhance the equity of information access for international students. An interview study showed that CiSA has great potential to support the communication, information accessibility, and social inclusion of international students. Another study (Eicher et al., 2018) discussed the ethical issue of Jill Watson – the virtual teaching assistant for a course at Georgia Tech – that is not capable of understanding the special conditions for students who are in the minority group or with sensitive backgrounds. This project discusses the limitations of current natural language processing techniques in Jill Watson and how to address such issues in a learning context, especially in STEM (Science, Technology, Engineering, and Mathematics) majors where engaging the minority students are crucial.

In the field of information systems, several studies have focused on human-chatbot interaction and the value of chatbots. In order to design the humanness in chatbots, researchers have demonstrated the importance of considering typing speed, typefaces, emoji of a chatbot during the conversation (Candello et al., 2017; Fadhil et al., 2018). Meanwhile, studies have applied the social presence theory to indicate the importance of relevance, presence, and engagement of chatbot conversations (Schuetzler et al., 2018), as well as to strengthen users’ autonomy, competence, and social relatedness, according to the self-determination theory (Sidorova, 2018). In general, chatbots might make services more accessible, available, and affordable (Følstad et al., 2018).

In sum, prior work has demonstrated the opportunities for using chatbots in various scenarios, including education. However, a systematic study on user needs and expectation of how chatbot might be used for student learning – especially inclusive learning – is understudied.

3. METHODOLOGY

3.1 Experimental Platform: Sammy

To fulfill this goal, we designed and built a chatbot named Sammy (Figure 1) as an experimental platform to conduct chatting-based “interviews” with students, which engaged each student in a one-on-one text-based chat, “interviewing” users by asking questions, eliciting their responses and then automatically providing acknowledgement after receiving their response. We chose to conduct chatbot-led interviews for four reasons: first, chatbot allows us to collect students’ feedback in an efficient way compared with human-led interviews and were found to be effective to perform a human interviewer’s role by applying effective communication strategies (Kim et al., 2019); second, chatbot-led interviews are more conversational and interactive than surveys and more likely to solicit quality and differentiated response input from participants (Kim et al., 2019); third, it helps students experience chatbots, especially for those who have limited knowledge about chatbots; last but not least, being able to participate in the chatbot-led interview at any time any place by themselves, participants are more likely to provide input under their day-to-day context than a human-led interview (Tallyn et al., 2018).

In this chatbot-led interview study, we aimed at understanding participants’ current challenges in learning, and more importantly, brainstorming with student participants on the features, relationship, and interaction modality of chatbot. We designed the chatbot questions after consulting instructors of the Business Systems course, which is typically offered for 15 sections in a semester. After asking students demographic questions such as gender, major, the main interview questions were designed around three aspects: (1) students’ current practices, needs, obstacles, and expectations of learning the Business Systems course, (2) how chatbots might be designed to help with their learning by addressing the respective obstacles and needs they mentioned, and (3) general impression about the chatbot conversation. A full list of questions that the chatbot asks is provided in Table 1. We intentionally use more open-ended questions instead of leading questions to provide space for participants to provide input.

To build the sense of familiarity and rapport with participants, we decided to use college-student friendly language. We designed the chatbot language to be first person to make it more human-like, e.g., “Fasho, I can handle that!” We carefully co-designed the chatbot language with college students to make it colloquial and cheerful by including abbreviations, slangs, emojis that are currently used by the student group.

We developed Sammy using the Juji chatbot platform (juji.io), which allows users to create chatbots for personalized needs, such as conducting interviews. The Juji platform provided a template chatbot for conducting job interviews. We chose to use the Juji platform for two reasons. First, the customization and deployment of a Juji chatbot is very similar to creating a survey. For example, Juji was used to develop chatbots for interviewing job candidates (Xiao et al., 2020) or

interviewing college students for teaming purposes (Xiao et al., 2019a). In particular, the interview chatbot automatically created a set of default capabilities, including handling basic social dialogs (Xiao et al., 2020), such as handling a conversation around an open-ended question and managing the main types of user digression. Juji supports various types of questions that are like mainstream survey tools such as Qualtrics, e.g., choice-based and open-ended questions. Like a Qualtrics survey, the chatbot is also distributed via a URL. When user inputs are too brief, e.g., fewer than three words, the chatbot will ask follow-up statements or questions such as “I’d love to hear more about it,” to encourage users to provide more details. This “minimum words” feature is provided by Juji Studio for us to customize the word number. Second, we wanted a chatbot that can function robustly in the real world and support long conversations. Juji has demonstrated that their chatbots can conduct hourly-long job interviews in the real world (Xiao et al., 2019a, 2019b, 2020). Getting started with Sammy was designed to be quick, simple, and intuitive. Once users clicked on the link to the Sammy chatbot, they were asked to provide a name for Sammy to call them. After greeting users, Sammy started the “interview” by asking users questions, acknowledging their answers depending on users’ answers (e.g., too short, or acknowledging), and continuing with asking the next questions till reaching the end of the interview. We used the premium version of Juji Studio which allows us to distribute the chatbot using a URL link and download collected conversation data.

1. I know we just met, but could you specify your gender? If you have a preferred gender identity, please let me know.
2. So, tell me a bit about yourself. What is your major and do you currently work somewhere?
3. Based on that, how many hours a week to honestly get to study including time to do any assignments?
4. Nice! So, what are some questions/concerns do you frequently have about this course?
5. Alright, I can see how some students could potentially have questions/concerns such as those. Let’s say if I were to be always available to answer your questions about Business Systems, what would be some of the main questions you hope I can help you with?
6. Fasho, I can handle that! So, what kind of course materials do you think I could potentially be capable of presenting to you through chatting like this?
7. Hmm, interesting, I think there could be potentially various ways of presenting things to people since everyone learns in different ways. Do you think I could potentially help you in a few things such as developing critical thinking skills and understanding the course material better so you can get a better grade?
8. Okay makes sense, what do you think is my best strength as a potential course assistant for you?
9. Haha I’ll do my best to live up to that standard, so based on that then what would you say is my greatest weakness as a course assistant specifically to you? Because I would love to know what I could do my best to improve on!
10. Thank you for sharing all these wonderful examples and experiences! Do you have any questions or comments for me before we wrap this up?

Table 1. Interview Questions Used in Sammy

3.2 Participants

We recruited participants by announcing the study in five sections of the Business Systems course. These are business students with a technological understanding, which would be able to offer useful insights as students, and of a successful product in the perception of business majors who would be able to identify current technology limitations. Their task was to participate in a chatbot-led interview with Sammy around the opportunities and challenges of using chatbot in assisting learning. They could participate in the “interview” on their own laptops at a place of their choice. We collected chat responses from 215 students, including 211 from business majors (e.g., MIS, accounting, marketing, finance, entrepreneurship) and 4 from non-Business majors, consisting of 132 males and 83 females. The study was approved by the University’s Institutional Review Board.

3.3 Data Analysis

We conducted a thematic analysis on the chat log data we collected from Sammy (Braun & Clarke, 2006). With the main goal of identifying student learning barriers and the opportunities and challenges of using a chatbot to support student learning, we first performed open coding to generate a list of labels. We then discussed the labels by think-aloud and iteratively refined the labels. Finally, we performed axial coding to find the relationships among the labels. In this iterative process, we have identified opportunities and limitations on how chatbot can support students learning. Part of the findings of this study is reported in another paper (Gupta *et al.*, 2019). In this paper, we focus on reporting findings on how Sammy might help support inclusive learning and meeting students with diverse learning needs. The findings reported in this paper are significantly different from our previously published paper which focus on opportunities and limitations of Sammy in general.

4. FINDINGS

Overall, three themes emerged around how chatbots might support an inclusive learning environment: helping disadvantaged students, supporting students with varied life environments, and facilitating students with varied learning styles.

4.1 Supporting Disadvantaged Students

Participants have indicated the possibility of chatbots to provide support for students who might lack proper learning resources and those with learning disabilities and disorders.

4.1.1 Students Who Lack Proper Resources. One category of disadvantaged students is those who are unable to gain access to proper resources to be successful. Many participants believed that chatbots would be able to help students who are economically impacted and provide them proper educational resources as well as help locate campus resources to use.

Personal tutor. Participants resoundingly asserted that they frequently needed to check basic information, such as course materials, textbook information, due dates, study tips, and office hour information. They also wished chatbot could provide tutoring on course content. For example, one participant wrote: “*I think sometimes it’s hard to pay attention to the lectures in class so I would ask questions from you related to the topics I don’t understand.*” Sometimes they were unable to get sufficient support from course instructors due to the low instructor/student ratio. This situation is worse if the students were too shy to directly communicate with their instructors. Nevertheless, students wished for a tutor that could answer their questions. For example, “*I think it would be great if you can be a platform for studying for a test, like a person to review exam materials with... Basically, it is like reviewing with a friend and test each other out.*” These features would allow students to

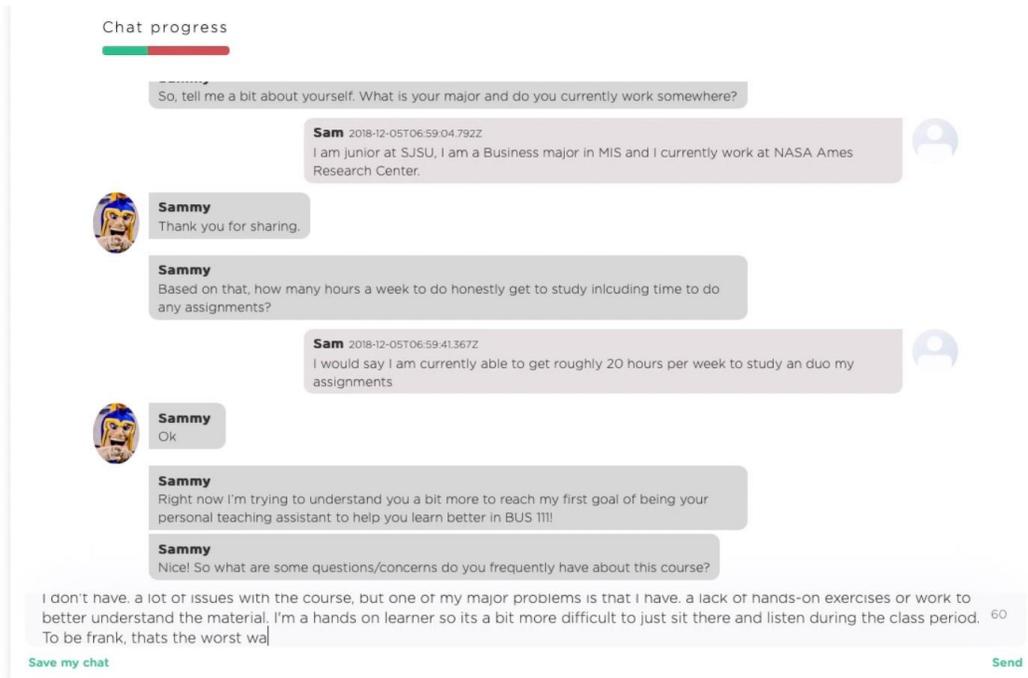


Figure 1. Screenshot of the Interface of the Chatbot Used in the Need Assessment Study

access information in conjunction with the learning management system by answering questions regarding course information and course content.

Connect with campus resources. Some participants indicated that students who lack proper resources need to be able to utilize all resources on campus which many are unaware of. There are various grants and food resources around campus that many students do not know exist or how to find them. Participants wished that the chatbot would be able to help these students by informing them of various resources, who to talk to and the locations for students to visit. As one participant wrote: *“I think one of your best strengths is the resources you can obtain and provide knowledge about to assist someone in need.”* This feature would allow students to maximize their capability of success and ensure their well-being.

4.1.2 Students with Learning Disabilities. Many students supported the opportunities of using chatbot to help students with varied learning abilities by creating a welcoming and tailored learning environment that they can use to supplement their current resources. This has the potential to maximize their ability to be successful and receive the same learning opportunities as other students.

Explain concepts through audio (for visually impaired). Participants noted that there are some students who have visual impairments and are unable to experience school as others. One participant replied: *“There are many possible ways to help people, hearing instructions and being able to talk verbally would be something nice.”* There are various solutions such as braille prints for students to simply read and understand, and chatbots can also be in the form of a voice agent as well. This feature would allow students who are unable to see written instructions or concepts but still be able to understand and learn when they are not in the classroom.

Hold conversations through chat (for hearing impaired). For auditory impaired students, typing or writing is a common method of communication. Many participants emphasized that students in this group would be able to communicate effectively and learn in a way that would help bolster their education. One participant stated: *“One of best strength is that you immediately respond, and it feels like a real-life interaction. I feel like I am talking to a real person. It is also easier to talk this way, in a chat rather than emails.”* By being able to interact with artificial intelligence to learn, students would be able to maximize their educational resources and keep up with the pace of their peers.

Create a safe space without judgement. To create an inclusive environment, it needs to be judgement free and welcoming. A few participants supported how chatbots can be a great resource that offers this advantage as it would be opinion free for students and help them based on their difficulties. One participant emphasized: *“I think you could potentially have the ability to not be subjective.”* By having this advantage, more students would feel welcomed and would be more inclined to engage with the chatbot as they are not being judged.

4.1.3 Students with Learning Disorders. Students who have learning disorders may need a specialized way to learn, as many students emphasized and a chatbot could help provide the needed tools for them understand the materials they need to learn as well as adapt to methods that work best for each student.

Simplistic design for accessibility. Participants stated that chatbots have the potential and need to be simplistic in design. By being simple and easy to access it would allow students who have learning disorders to be able to utilize the resource. As one participant replied: *“Your best strength would be the ease of accessibility.”* By making the chatbot design simple to understand and use, students will be able to easily understand how to use it right away and receive the help that they may not necessarily always get.

Provide immediate feedback. Chatbots also have the potential to interact with students to help them learn key concepts through conversations compared with learning by themselves outside of the classroom. Our participants mentioned the lack of social interactivity in learning outside the classroom, such as standard learning through the textbook or through Canvas. Our subjects also promoted the use of conversational bots as a type of interactive and engaging learning tool to provide resources for students to learn and receive feedback. As a participant mentioned: *“I like how you can provide meaningful feedback immediately, so I know what I need to improve on or focus on more through our conversations.”* For students with learning disorders, this tool might help them understand what they are struggling with efficiently.

Keeping learning short and concise. Some participants insisted that sessions with the chatbot be short and concise where time isn't wasted. This would allow students to simply state difficulties they are having and receive the proper help immediately, ultimately helping students with learning disorders to get as much help instead of delaying their learning process. One participant stated: *“Your quick response. Being able to ask a question and get a fast reply is beneficial since it will save time looking for additional materials online.”* By having quick replies to students who have forgotten information could retrieve quickly what they are missing, making sure they do not lose their attention with other information.

4.2 Supporting Students with Varied Life Environments

Many students have varied life environments besides their coursework and need help balancing their academic life and personal life. Our participants were asked what areas they believed chatbots could assist them with additional responsibilities. Students commented on how chatbots could help students who have other things in their lives and mainly proposed the following functionalities.

4.2.1 Commuter Students. To increase inclusivity among students, the group of students who commute to school are less likely to create friends and enjoy a similar social life as students who live near the school. Many students noted how chatbots can help these students with learning but also enhance inclusivity within the student community.

Access resources anywhere. Our subjects indicated the ease of access to the chatbot as it could be available online and can provide information about courses easily. Thus, students could learn and understand the material outside of the class time at any place. The accessibility also comes from the short response time, making it much faster than communications with a teacher. As one participant mentioned: *“Your best strength as a potential course assistant is that you can answer my questions quickly and at any time, unlike a human, so I won't have to wait for someone to help me.”* Additionally, participants supported

the specific information provided by the chatbot to be a key strength of the chatbot.

Help find social events to make friends. Commuting students are unable to socialize as students who live on or around campus. Some participants emphasized that through a chatbot, campus resources can be made known of such as social events which would allow students to make more friends. By socializing and networking, students can grow as people and take a break from student life and have leisure time. One participant replied: *"I feel like this could potentially help people find out about social events to meet new people."* Socializing also creates a stronger community within the school as more students can share ideas and work together, and commuter students can benefit most by becoming part of the community.

Mental health support. Besides academic needs, a few participants asserted the need for mental health assistance from chatbots. Through interacting with the chatbots, students would be able to talk about their current issues without worrying about confidentiality and connect with professionals on campus who would be capable of interacting with students more and assist by addressing issues. As a student chatted: *"Would you be available for counseling students? I feel like you would be very useful to students who have depression or anxiety and don't have people to talk to."* Participants consider health, daily life, and self-development as essential supportive elements for their academic success.

4.2.2 Students with Family Responsibilities. Students who have family responsibilities face different challenges compared to other students and need tools that will help manage school and life easier, and our participants supported the use of chatbots to provide these tools.

Study aid. Students with children have many additional responsibilities besides school and are usually short on time. A few participants noted that through a chatbot, students like this can utilize this resource by using it as an efficient study aid and seeing what areas they need to study and track progress. One student noted: *"Yes, yes! As you would be able to study my habits and times I am possibly online to study and use resources, as well as tracking my progress."* Using a chatbot to understand and track a student's progress introduces a dynamic method of learning by allowing students with caregiving responsibilities to study effectively with limited time.

Connect with financial resources. Many students need financial assistance and can find different ways to receive them, but there are many students who are unable to find these resources easily. Some students emphasized that financial aid is not as accessible as other students may perceive it to be and by allowing chatbots to be integrated with connecting students to the right financial aid resources, it would be helpful. As one student replied: *"I think it might be useful to be able to connect those who need financial assistance to know where to go online or on campus as it's not easily accessible."* By having resources such as financial aid information available online, students such as those with children would have an easier time locating and using them if needed, allowing them to continue their education.

Help manage schedules. For a parent, schedules can be extremely busy especially if they are a student as well. To support student success and help students in all types of situations including those with children means understanding their schedules. There are numerous deadlines and assignments

that have different requirements and dates which might keep changing; keeping track of them with a busy schedule is never an easy task. Some students pointed out: *"I would like for you to help me with keeping track of scheduled assignments."* Keeping track of various assignments and their requirements as well as the due dates will help students who have children be an included part of the community by staying up to date with any potential changes and have the same chance as other students to succeed.

4.2.3 Non-Native Students. Students who struggle from a language barrier are unable to understand and communicate easily, creating an environment that limits their ability.

Help understand material in different languages. A few students noted a need for course material to be available in different languages as they were having a hard time understanding. Being able to fully understand what is being taught is an important concern for student inclusivity especially if it is in a language that students are not fluent in. One student said: *"There is no Spanish; it's hard to understand the material."* By being able to include students like this through chatbots in different languages, it allows students to be able to focus on simply understanding the concept instead of both the language and the concept which adds another layer of difficulty.

Help learn English. Building upon the struggles of students who are unable to understand English, those same participants stated that chatbots could help them learn English. One student noted: *"This could help me speak English better, by practicing with it."* This potential leap in capability would allow students to be able to communicate more effectively in the classroom setting, making a more connected community compared to having a language barrier. This could also allow students to understand what is being taught in the classroom and the materials much better as they could before. While this would be a great addition to a chatbot system such as Sammy, there would be a need to incorporate an advanced Natural Language Processing model, such as to understand typographical errors as well as misspellings to function effectively in this role.

Connection to peer tutoring. To be a truly helpful tool, some students explained how the ability to connect to various peers on campus who would be available to help reduce the language barrier and tutor students could be an important tool. By connecting students with peers, it would allow them to communicate more easily and understand the material and create inclusivity through networking. One student mentioned: *"I would like help on where to find tutoring and what times are available; I also wanted to know if there are any other resources available if I needed more aid in studying for the class and to reduce the language barrier."* Peer tutoring would allow students to make more friends and bring the community closer through learning, growing, and accepting each other. One method of connecting the user to peer tutoring is by providing the proper web addresses for the school's tutoring resources webpage to book appointments through. While booking appointments through a chatbot can be done as well, the added complexity in design outweighs the time required to establish such a task.

4.3 Facilitating Different Types of Learners

We identified three themes from the chat log regarding different types of learning that a chatbot could support: visual, kinesthetic, and auditory learning which we elaborate below.

4.3.1 Visual Learning. Visual learners need to visualize concepts and while listening to lectures. Participants emphasized the need for chatbots to connect these types of learners with visual friendly resources and to help organize notes.

Videos. Some students prefer to learn visually by watching videos rather than simply reading text. This method allows them to visualize key concepts according to some participants. A few participants stated that chatbots could help them with their type of learning by providing video resources to follow along that cover the same material as in class to be able to stay on the same pace as other students. One participant insisted: *“Just a visual learner so I would appreciate videos and labs to be able to understand the material better and this chatbot might be a good platform for that.”* By utilizing video resources, students will be able to understand diagrams in a way that enhances their learning.

Visual representation of concepts. Building upon using videos through chatbots, being able to provide visual representations of concepts is also an important tool for students. Participants emphasized the need for more than just video links and blocks of text conversations with a chatbot, but also providing images in the chat and explaining what it meant would allow students to understand in a different way that they may not have before. A participant replied: *“Yes, it can visualize the course materials in ways that it can make sense and I can understand.”* By allowing students a visual structure of concepts, it helps visual learners understand content better than simply reading or listening.

Color coded information. To be an effective study tool for visual learners, chatbots could help them improve by highlighting important information while chatting with them, according to participants. This highlighting feature through chatbots would allow students to focus on specific information that is necessary for understanding key concepts. A participant emphasized: *“I learn better visually; I need people to show me how something works by highlighting it rather than just explaining it with a bunch of words.”* Through this method, visual learners would be able to maximize their efforts of paying attention in combination with other methods that chatbots can help them with. This might be done by having professors or teaching assistants entering key information that the student needs to pay attention to, such as uploading photos of notes or specific presentation slides under the specific topic categories in the chatbot’s scripting.

4.3.2 Kinesthetic Learning. Students who are kinesthetic learners need to be engaged to learn, some participants stated the possibilities of helping these types of learners by introducing activity based learning games, testing by quizzing each other and connecting concepts in real life to engage these learners in an inclusive environment.

Engage in activity-based learning. Students stated a need for more activity-based learning that would allow them to learn by doing compared to simply reading or hearing about it. Some students prefer to learn this way as it allows them to connect textbook knowledge with practical learning examples to better

understand material. As one student stated: *“It would be great to have more hands-on experience such as labs to help better understand the concept and I think the chatbot would be able to provide that to me or link me to online resources.”* Experiential learning such as games makes learning fun and enjoyable for students and easier to remember concepts covered.

Chatbot asks students to give feedback. Participants stated that chatbot could help them repeat the material numerous times so they themselves can know it better and are more prepared; and chatbots can help correct any misinformation during this practice. One student emphasized: *“It would be lovely if the chatbot could provide feedback on an answer I would have that is course related.”* Allowing students to be corrected is extremely important, so they do not understand wrong concepts and are able to continue learning as well as prevent other students being told wrong information as well. To engage students who are oriented towards hands-on learning, being able to clarify concepts and even teach others allows them to understand the material even better.

Connect concepts with real life. Participants emphasized the wish for chatbots in support of advanced learning beyond just understanding course content. This included responses for how students require an intelligent tutor to provide real-world applications to enhance learning. As one participant mentioned: *“It would be beneficial in providing real-world examples to certain applications and terms described in the textbook.”* According to our participants, chatbots might provide unique ways for different types of learners as intelligent tutors by providing supplementary materials for course content. For example, students could be questioned about the material to ensure their understanding. Participants also wished they could further help them develop soft skills through interacting with the chatbot tutor, e.g., *“You could help me develop critical thinking skills by asking meaningful questions that provoke critical thought.”* This shows the opportunities where chatbot might address different levels of learning goals, such as applying and critically thinking about course material. This can be accomplished by a teaching assistant writing custom questions and examples under the specific topic categories in the chatbot’s scripting.

4.3.3 Auditory Learning. Auditory learners can learn best when listening to lectures or others. Despite chatbots being a text-based agent, integrating with a voice agent to listen to and speak with students builds upon previous suggestions from our participants and allows chatbots to help these learners with audio resource such as music, podcasts, and conversation.

Music based learning activities. Auditory learners have different processes compared to other types of learners, as they require more music or vocal learning methods. To incorporate this type of learning a few students suggested ways that chatbots might be able to help through finding resources that relate to music. While the opportunities are limited due to the various contexts this method can be used for, chatbots can instead ask students to create their own music as an assignment to spark their creativity and to encourage learning about the concepts in focus. One of our participants stated: *“It could offer help and listen to what I have to say through various creative assignments.”* Creative assignments such as this would help auditory inclined students learn in a method they prefer. Despite being a unique and helpful tool, it might be difficult to implement depending on technical capabilities.

Provide podcast-based resources. As video resources for visual learners, there could also be podcasts for auditory learners. Students emphasized the need to have podcast-based learning tools to be able to learn on the go and allow them to simply focus on taking notes from what they are listening. One student mentioned: *"I think having a podcast type resource would be helpful for me to just listen to."* While there is a limitation on what concepts can be explained through this format as some concepts require visuals as well, there is a category of students whom this could help. This can be achieved through connecting the user to the proper web addresses of podcasts available through streaming services, video-sharing platforms or even recorded lectures that help explain the topic in chatbot scripting.

Conversational flashcard games. The most supported method from auditory learners was the use of a voice agent option in chatbots that quiz students with a flashcard game. Students believed this method would offer a similar studying style to Quizlet. However, through incorporating a voice agent where the students do not necessarily need to type, it could be a similar experience as studying with a friend or a tutor. While a chatbot is a text-based agent, it would only require the capability of voice to hold a conversation with a student. One student stated: *"It could make a summary of each chapter with flash cards over voice."* This feature would be beneficial to visually impaired students as well and create an inclusive environment for various types of learners. This can be achieved through connecting the user to the proper external resources with flashcard sets through a service such as Quizlet Inc, which offers vocal flashcard practice and can help students practice knowledge under the specific topic categories in chatbot scripting.

5. DISCUSSION

As presented in the related work section, chatbots have been receiving an increasing amount of attention for opportunities to augment human tasks in various areas and have the potential to make services more accessible, available, and affordable (Følstad et al., 2018). In particular, a few studies started investigating the role of chatbots for education, such as offering multiple-choice quizzes (Pereira, 2016) and answering frequently asked questions as an online teaching assistant (Goel & Polepeddi, 2016). Through a chatbot-led need assessment interview study among undergraduate students in a business college, we found that students saw the opportunities of chatbots in creating inclusive learning environments for disadvantaged students, those with varied life environments, and of different types of learners. This can be achieved through answering course and content information, providing supplementary course materials, asking in-depth questions, tailoring learning to individual needs, as well as offering support for student life and wellbeing. Chatbots were reported to offer accessibility, interactivity, and confidentiality, while needing improvement in machine learning as well as emotional communication. We therefore derived the following design implications.

Design chatbots that support holistic academic success. Our findings show that students expect opportunities to support an inclusive learning environment by gaining a deeper understanding of course material and cultivating a broader set

of skills using chatbots while creating an environment that includes all types of learners.

Students come from diverse backgrounds in terms of their learning abilities, learning styles, and life environments. This imposes a crucial need for supporting students beyond passing content in the classroom, but more importantly, understanding the context of the individuality of students. Current online learning resources provide abundant content that students can digest; however, an inclusive learning environment also considers the context of students. While delivering course content can be scaled easily, understanding the learning context of each student could be a challenging task. Artificial intelligence, however, might be a complementary tool to provide personalized service at scale. Chatbots might be helpful to give students immediate feedback, enable students to learn content with different modalities, such as audio, visual, as well as creating a space for them to learn without feeling judged.

As an emerging field of study, chatbots were currently used in answering student basic and frequently asked questions. Our studies highlighted the importance of a holistic view of academic success and student life, which includes personalized learning, study-life balance, wellbeing, and inclusivity. For example, chatbots might connect commuter students to local social communities, provide information to those with limited access to resources and proper web addresses for the specific school and government resources, help students with family responsibilities manage their schedule through connecting with email service or a smart calendar service, and support non-native speaker by connecting with AI language translator. The above are just a few examples of opportunities of chatbots supporting inclusive learning based on the findings, but educators could find the most needed feature to consider integrating into their system.

Meanwhile, one issue that some participants pointed out is the ability for chatbots to be more "intelligent" in understanding dialog flows and learning each individual student over time. This requires further advances in natural language processing and deep learning to enhance the "IQ" of the chatbot.

Design chatbots to support interactive learning. From the findings, we repeatedly observed students support the use of chatbots to serve as an inclusive intelligent tutor and campus resource who works 24/7. Meanwhile, instead of reading or studying alone, participants prefer an interactive way, which mimics and extends the classroom setting. Surprisingly, we also found that students sometimes wished for social interaction (i.e., chatting) for professional support but without revealing their own identities.

While it is impossible for educators to be always available to answer student questions, chatbots might provide answers and resources for certain basic requests. This can be especially useful for students with varied learning abilities, varied learning styles, and those with family responsibilities. For example, chatbots might provide additional materials by searching for and embedding relevant video tutorials, visual diagrams, or images. To take it further, chatbots might be able to encourage students to learn by teaching the content to a chatbot; while this might be a unique and helpful resource, it will be difficult to implement depending on how the chatbot's neural network is trained regarding how information is worded and described.

On the other hand, chatbots could not replace the role of an educator. Since conversational agents are still in the early stage of its development, there are many ethical issues that chatbots

are unable to handle, as presented in the case of Jill Watson that was unable to recognize the individual needs of a pregnant student. This shows the opportunities of developing more emotionally inclusive intelligent chatbots for higher education. Emotions play a significant role in inclusive human-human interaction, and our findings indicate such demand in human-chatbot interaction. While a chatbot might have the ability to potentially detect and help students with special conditions, such as mental health scenarios, it is not advisable for use due to licensing and liability concerns.

6. CONCLUSIONS

This research aims to understand the opportunities and challenges in using chatbots to support an inclusive online environment. We created a chatbot to interview student participants around these questions. Through a study of 215 students at a large public university, we found out that chatbots might have potential in creating inclusive learning environments for disadvantaged students, those with varied life environments, and different types of learners. Benefits of using chatbots as intelligent tutors in an inclusive environment include the ability in answering course and content information, providing supplementary course materials, asking in-depth questions, tailoring learning to individual needs, as well as offering support for student life and wellbeing. Chatbots provide opportunities to help disadvantaged students, those with family responsibilities, and different types of learners through various methods including connecting to campus resources. Meanwhile, potential technical limitations include the time needed for training and the lack of interpersonal emotional understanding.

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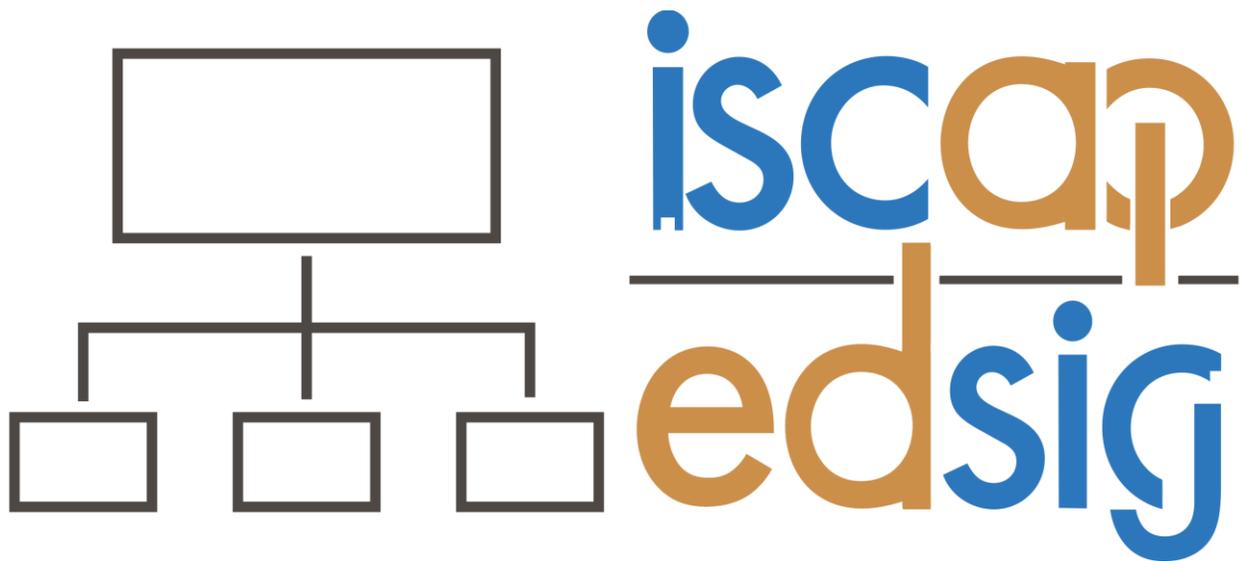
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