Educational Research (ISSN: 2141-5161) Vol. 4(10) pp. 710-716, October, 2013
DOI: http:/dx.doi.org/10.14303/er.2013.231
Available online@ http://www.interesjournals.org/ER

Full Length Research Paper

An investigation of student's attitude towards use of chatbot technology in Instruction: the case of Knowie in a selected high school

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ABSTRACT

A chatbot named Knowie was implemented on a platform based on the open source software Ubuntu, Python, JDK, and PyAIML. A class of students was then given an opportunity to ask questions of and chat with the bot on a topic they were being taught in class over a period of four weeks. They then completed a questionnaire after the intervention with items designed to determine their attitude towards their experience and to elicit their suggestions on how the chatbot could better be improved and used to suit their requirements.

Keywords: Chatbot Technology, Integration, Constructivist teaching and learning, ICT, Student Attitude.

INTRODUCTION

A chatbot is a computer program that is created to simulate intelligent human language interaction through text or speech and whose purpose is to engage in conversation or to emulate informal chat communication between a human user and a computer using natural language (Dryden, 2008; Abushawar and Atwell, 2007; Wang 2008). Chatbots can be created using various computer programming languages such as PHP, XML, JAVA, C++, Python and AIML (Cenelia, 2013). A common approach used in developing a chatbot is to have the chatterbot creator or botmaster program the chatbot's knowledge database so that it has preprogrammed questions, phrases or words and how it is to respond to each question, phrase or word (Kerly, Hall and Bull, 2006; Dohrmann, et. al., 2010). Another approach is to start with an empty database to which content is automatically added as it is used (Abu Shawar and Atwell, 2007). In both approaches, chat-logs created during interaction sessions additionally serve as sources to the botmaster for chatbot response improvement (Kowalski, Pavlovska and Goldstein, 2013; Batista, et. al., 2010; Wallace, 2009; Abushawar and Atwell, 2007; Knill, Carlson, Chi and Lezama, 2004).

Various studies indicates that the benefits of chatbot technology use in instructional contexts includes improved learning, provision of an alternative means of content delivery, increased student motivation, and increased student interest (Burbules, Blanken-Webb, Herrera, Shipman, and Stewart, 2013; Kowalski, Hoffmann, Jain and Mumtaz, 2011; Kerfoot et. al. 2006; Knill, Carlson, Chi and Lezama, 2004; Jia and Chen, 2009). Chatbot use in instructional contexts is emergent in developing countries, hence the interest of what students think and feel about such use of the technology since the one who interacts directly with the chatbot and who is the hoped beneficiary is the student. Thus their view of the technology, their attitude towards it, their experience of it, and their expectations about it are of importance (Murithi and Indoshi, 2011; Osodo, Indoshi, and Ongati, 2010). The current study was designed to elicit information from a randomly selected group of high school students that would be indicative of their attitude towards use of a chatbot called Knowie in their instruction and also to elicit their suggestions on how instructional bots may be improved to better suit their needs. With student acceptance of chatbot technology will come the opportunity of implementation of constructivist teaching and learning environments exploiting interactive,

collaborative, and social dimensions facilitated through chatbot technology use (Can, 2009; Chan, 2006; Tam, 2000; Henze, and Nejdl1997: Murphy, 1997).

Introduction of chatbot use in instruction in schools amounts to the introduction of an innovation in schools. The theoretical basis for the current study (summarized in Table 1) was therefore innovation diffusion theory, specifically Rogers' Innovation Decision Process Theory and Russell's Learning to Use Technology Theory. Rogers' (1995) Innovation Decision Process theory states that diffusion is a process that occurs over time and has five distinct stages.

These five stages are Knowledge (the person becomes aware of an innovation and has some idea of how it functions), Persuasion (the person forms a favourable or unfavourable attitude towards the innovation), Decision (the person engages in activities that leads to a choice to adopt or reject the innovation), Implementation (the person puts an innovation into use), and Confirmation (the person evaluates the results of an innovation – decision already made). According to this theory, "potential adopters of an innovation must learn about the innovation, be persuaded as to the merits of the innovation, decide to adopt, implement the innovation, and confirm (reaffirm or reject) the decision to adopt the innovation" (Surry, 1997:3).

Russell (1996) identifies six stages that learners move through as they learn to use technology: Awareness (that the technology exists), Learning the process (time-consuming assimilation of new information as new skills are mastered), Understanding and application of the process (learners have 'hands-on' experience and they can accommodate new instructions within their basic understanding), Familiarity and confidence (problems become 'hiccups' rather than major distracters), Adaptation to other contexts (new understandings and experiences are transferred to other contexts), and Creative application to new contexts (technological processes become invisible and are used to extend educational environments appropriately). The framework by Russell was developed in the context of email use, but is extensible to other contexts as she writes 'In the future the technological processes may not be electronic mail, but another technological innovation which needs learning through coaching and support with frustrating and time consuming focus on the processes before the technology invisibly becomes incorporated within an environment. Only then can creative and worthwhile uses be applied in a variety of contexts" (Russell, 1996:11).

The current study was specifically directed towards the first two stages of Knowledge (Awareness) and Persuasion (Learning the process) since these are the initial stages of the use of the technology by students. Attitude is critical, as it can either lead to wider acceptance of the innovation, or to the rejection of the innovation (Murithi and Indoshi, 2011; Osodo, Indoshi, and Ongati, 2010). The purpose of the study was to determine the attitude of students towards use of chatbots in their instruction and to elicit their suggestions on how chatbots can be improved to better suit their needs.

The study addressed the following two questions:

1. What attitude do students have towards the use of chatbots in their instruction?
2. What suggested improvements do students have about chatbots to be used in their instruction?

The study was a one-shot case study design in which a group was exposed to an event (chatbot use) and a variable subsequently measured (attitude to chatbot use in instruction) in order to assess the dependent variable.

RESEARCH METHODOLOGY

Venue and Sample

The target population of the eight-week intervention was form two students at a school offering computer studies to all students in a given form, with the school being purposively selected on the basis of its having an adequately equipped computer lab. The rationale for this was homogeneity in student knowledge about computers and the need for a large population of students from which to draw a random sample in the light of the fact that computers available in schools are usually of a limited number. The students were from a five-streamed Girls school located in Kericho County, Kenya. The total number of students in form two was 186. The number of computers that were set up in the computer laboratory for the study was 11. Thirty students were randomly drawn from the stream to form an overall sample of 30 students using simple random sampling procedure. This gave an average of about three students per computer.

Instruments

The primary research instrument for the study was a questionnaire developed by the researchers. The questionnaire contained items from questionnaire instruments that have been used in related computer technology use studies and selected for being relevant to the investigation at hand (Osodo, Indoshi and Ongati, 2010; Heller, et. al., 2005; Kerly, Hall, and Bull, 2006; Newhouse, 2002). The questionnaire had a total of twenty items correspondingly numbered from 1 to 20. Seventeen items [1 to 5; 7 to 18] were designed to determine student attitude to chatbot use in their instruction using a 5-point Likert scale (e.g. Chatbot use in learning should be expanded to include other topics in a given subject of study in school; 1 – Strongly Disagree, 2 – Disagree, 3 – Uncertain, 4 – Agree, 5 – Strongly Agree). Item six sought to determine when students feel is the best time to use the chatbot, i.e. at regular lesson

Table 1. Summary of Pertinent Features of Theoretical Framework of the Study

Stage/ Dimension	Rogers Innovation Decision Process	Russell Learning To Use Technology
1	**Knowledge** *Person becomes aware of an innovation and has some idea of how it functions*	**Awareness** *That the technology exists*
2	**Persuasion** *Person forms a favourable or unfavourable attitude towards the innovation*	**Learning the process** *Time- consuming assimilation of new information as new skills are mastered*
3	**Decision** *Person engages in activities that lead to a choice to adopt or reject the innovation*	**Understanding and application of the process** *Learners have 'hands-on' experience and they can accommodate new instructions within their basic understanding*
4	**Implementation** *Person puts an innovation into use*	**Familiarity and confidence** *Problems become 'hiccups' rather than major distracters*
5	**Confirmation** *Person evaluates the results of an innovation – decision already made*	**Adaptation to other contexts** *New understandings and experiences are transferred to other contexts*
6		**Creative application to new contexts** *Technological processes become invisible and are used to extend educational environments appropriately*

* After Toledo (2005)

time or outside regular lesson time (A chatbot should be used for learning during regular lesson time allocated on the time table and not after classes: SA [ ] A [ ] U [ ] D [ ] SD [ ]). Item nineteen sought to determine the willingness of the student to chat again with the chatbot (Are you willing to continue learning using the chatbot in your continuing learning in school?: No [ ] Yes [ ]). The twentieth item in the questionnaire was open ended and sought improvement suggestions from students for the chatbot and also invited them to make any other additional comments.

Validity and reliability of the instruments

The instrument was validated through consulting peer experts for suggestions and improvement which were effected to come up with the final instrument. (Osodo, Indoshi and Ongati, 2010). The questionnaire was also piloted in a similar school in a four-day intervention session spanning four weeks in which 30 students were randomly selected from a population of 152 students as the piloting sample (Mukoma, et. al., 2009; Bashir, Muhammad and Muhammad, 2008; Kimberlin and Winterstein2008; Yount, 2006).

Intervention and Data Collection

The researcher met the students outside formal lesson time together with the teacher who was facilitating the intervention, after due consultation with the school administration, to introduce the intervention to the student participants and to train them on how to interact with and program the chatbot. All the 30 student participants underwent this prior training. The researcher had on the previous day conducted a similar training session for the participant teacher. The students with their teacher then interacted with the chatbot once a week for eight weeks, each interaction session taking place from 4.45 to 5.45 p.m. on the chosen treatment administration day as per school timetabling constraints. This time was chosen to avoid undue disruption of the school routine, as this is a major consideration in schools (Hennessy, Harrison and Wamakote, 2010; Kozma, 2005; Seyoum, 2004). After the eighth and last intervention session, a day was set apart when the

questionnaire was administered to the student participants in a 20-minute session.

Data analysis procedure

Each of the first eighteen items of the questionnaire was given a rating ranging from 1 to 5. The average rating of the seventeen items that served as an indicator of student attitude towards use of chatbots in their instruction was obtained. A mean score above 3 was interpreted as denoting a positive attitude; a mean score of 3 as denoting a neutral attitude; and a mean score of less than 3 a negative attitude. The average rating of the sixth item that sought to determine when students feel is the best time to use the chatbot was also obtained in order to ascertain student preferred time of use. For the nineteenth item, the percentage of students who indicated they were willing to chat again with the bot was obtained. The twentieth item was open ended and requested the student to offer chatbot improvement suggestions. The suggestions given by students were listed and analyzed into categories, and the frequency of mention of each category obtained.

RESULTS AND DISCUSSION

The number of students selected randomly for the study were 30. A total of 30 students interacted with the chatbot during their allotted time and responded to the questionnaire, thus the response rate for the questionnaire was 100%.

The average attitude rating score for each of the seventeen items of the questionnaire designed to measure student attitude to chatbot use in their instruction is presented in Table 2.

The question for which an answer was being sought here was: What attitude do students have towards the use of chatbots in their instruction? The overall average rating score for the sample respondents of 4.1196 is above the neutral value of 3; hence the attitude of students towards the use of chatbots in their instruction is positive. This finding is in line with other findings that indicates students have a positive attitude to the use of computer technology in instruction (Murithi and Indoshi, 2011; Mwei, Too and Wando, 2011; Osodo, Indoshi and Ongati, 2010). With reference to chatbots, the result indicates that students would welcome their use for instructional purposes in schools.

The average rating score for the sixth item of the questionnaire is presented in Table 3.

This item sought to determine when students feel is the best time to use the chatbot, i.e. at regular lesson time or outside regular lesson time [Item6: A chatbot should be used for learning during regular lesson time allocated on the time table and not after classes]. The overall average score of 2.5 indicates overall disagreement by the students with the statement. This indicates that students prefer chatbots to be used outside regular lesson time. However, time of use of a given technology within a school is a challenge to all players within the school setting, as school routine constraints are practical and real to teachers, students and researchers (Earle, 2002).

The nineteenth item asked the students whether or not they were willing to chat again with the chatbot. Table 4 shows their overall response.

The majority of students (86.7%) indicated that they were willing to chat again with the chatbot. This underscores the indication that the students are positively disposed to use and continued use of chatbots in their instruction.

The twentieth item in the questionnaire sought improvement suggestions from students for the chatbot and any other comments about the experience they underwent. These were analyzed and summarized as presented in Table 5.

The most frequently suggested improvement is to have the chatbot respond to questions in other school subjects (9), followed by the suggestion for the chatbot response to be extended to include responses to questions about other areas of school life such as current affairs and guidance and counseling issues (6). This ties with a need for the chatbot's interface to be improved (6). The next suggestion was improvement of clarity of response to the questions asked (5), followed by a requirement for an exhaustive answer to a particular question (4). Off-topic responses (3) are designed to keep chatting going on, but a number of students feel that these should be minimized. There is also a need to add capability to display pictures and videos (2) and improve chatbot response speed (2). The last suggestion is to expose all students in the school to chatbot use.

The student chat-logs reinforce these suggestions as a number of students requested advice from the bot on academic matters (for example advice on how to do better in a subject), on matters to do with careers (for example what courses one has to do to become a lawyer or a doctor) and matters social (for example requesting the bot to sing, recite a poem, deal with stress or give facts about politics and current affairs). A number of questions were also directed at the nature of the bot, for example what shape, size, and whether male or female.

These findings indicates that students recognize the potential for chatbots to be extended to all topics in a given subject, all subjects offered in schools, and even to other areas of concern in school and outside school.

CONCLUSION AND RECOMMENDATION

Findings from the study indicates that students are positively disposed to use of chatbots during instruction. This should be exploited, not only in Computer Studies, but also in other subject areas offered in school curricula. Answers given by chatbots should be exhaustive and a chatbot should be able to handle all possible questions regarding a given topic. Since chatbot programming is an intensive and extensive process, a possible approach is

Table 2. Average Attitude Rating Score – Student Attitude to Use of Chatbots in their Instruction

	N	Minimum	Maximum	Mean	Std. Deviation
item1	30	1.00	5.00	4.6667	.80230
item2	30	1.00	5.00	4.5000	.82001
item3	30	2.00	5.00	3.9667	1.12903
item4	30	1.00	5.00	3.6667	1.15470
item5	30	1.00	5.00	4.4000	1.16264
item7	30	1.00	5.00	4.0667	.90719
item8	30	1.00	5.00	3.9333	1.28475
item9	30	1.00	5.00	3.8667	1.16658
ittem10	30	1.00	5.00	3.8333	1.05318
item11	30	1.00	5.00	4.4000	.93218
item12	30	2.00	5.00	4.4667	.73030
item13	30	1.00	5.00	4.0333	1.15917
item14	30	1.00	5.00	3.2667	1.38796
item15	30	1.00	5.00	4.4333	.93526
item16	30	1.00	5.00	4.1333	1.13664
item17	30	1.00	5.00	3.9667	1.03335
item18	30	1.00	5.00	4.4333	.85836
Valid N (listwise)	30				
			Total	70.0334	
			Average	4.1196	

Table 3. Average Rating Score – Chatbot Time of use in Instruction

	N	Minimum	Maximum	Mean	Std. Deviation
item6	30	1.00	5.00	2.5000	1.35824
Valid N (listwise)	30				

Table 4. Student Willingness to chat again with Chatbot

		item19			
		Frequency	**Percent**	**Valid Percent**	**Cumulative Percent**
Valid	Yes	26	86.7	86.7	86.7
	No	4	13.3	13.3	100.0
	Total	30	100.0	100.0	

not to expect an individual to carry out the programming, but to offer opportunity for a community of learners, teachers, and researchers to contribute to a given bot's knowledge base. For example, subject, class and school chatbots can be programmed as group tasks within schools. This approach of using various developers is widespread in chatbot development and free software development (Wallace, 2009; Stratton, 2003). Over time, the bot would be able to handle a wide range of questions ranging from school, subject-topic, specific questions, to inquiries about the school and other areas of interest. Of interest also is the potential of a chatbot to be used in handling student career and social concerns. Questions on the nature of the bot indicates the need for students to be able to see some screen representation of the bot, implying a requirement for chatbot interface development, for example a Graphical User Interface, an agent, or even an avatar (Gimeno, 2008). Further investigations are thus called for in these areas of chatbot use and potential.

Table 5. Chatbot Improvement Suggestions and Additional Comments

No.	Suggestion	Frequency of mention (*f*)
1	Have answers for questions in other subjects	9
2	Include answers to questions about other areas of school life e.g. current affairs and guidance and counselling issues.	6
3	Improve chatbot interface	6
4	Improve clarity of response to question asked	5
5	Give an exhaustive answer to a particular question	4
6	Minimise off-topic responses	3
7	Add capability to display pictures and videos	2
8	Improve response speed	2
9	Expose all students in school to chatbot use	1

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How to cite this article: Bii P, Too J, Langat R (2013). An investigation of student's attitude towards use of chatbot technology in Instruction: the case of Knowie in a selected high school. Educ. Res. 4(10):710-716