



Review

Chatbot technology: A possible means of unlocking student potential to learn how to learn

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Abstract

This paper explores the possibility of implementing a constructivist learning environment using chatbot technology as a basis of enabling students acquire global economy and technological information age skills and competencies (21st century skills) within the context of a developing country. The suggested approach is to integrate chatbot technology into the prevailing teaching-learning environment taking into consideration enabling and constraining factors. Social constructivism provides the basis for concretization of this approach, where social interaction plays a fundamental role in the development of cognition, with mediation using cultural tools and scaffolding contributing to the process of learning.

Keywords: Chatbot, technology, social constructivism, ICT, learn how to learn, 21st century skills.

INTRODUCTION

Across many schools in developing countries, the key players in the teaching-learning transaction of the teacher, the student, instructional media and content are still found engaged in the traditional pedagogical approach characterized by teacher-centeredness, verbal delivery of information, learner passivity, and a great deal of reliance on use of the chalkboard (Hennessy et al., 2010; Gabriella and Erika, 2007; Wambui, 2005). Such an approach cannot adequately address the challenges posed by the information age and global economy to the educational process, and is ill-equipped to empower students with the skills (also referred to as 21st century skills) required of students in a technological, global, and information age: digital age literacy, inventive thinking, higher-order thinking, effective communication, high productivity, knowledge construction, adaptability, finding and organizing information, information management, critical thinking, teamwork, and citizenship (Voogt, 2011; Tinio, 2002).

The pedagogical approach that contributes to acquisition by students of global economy and information age skills has been identified as having the aspects of being active, collaborative, creative, integrative, and evaluative (Tinio, 2002). Information and communication technologies (ICTs), defined as a diverse set of technological tools and resources used to create, communicate, disseminate, store and manage information (Blurton, 2002), have the potential of enabling

teachers implement this pedagogical strategy by helping them to transform the teaching-learning environment into one that is learner centered, interactive, and collaborative. The technologies that have the potential of best enabling the realization of interactive and collaborative learning are networked computers and the Internet, and as Tinio noted, “their full potential as educational tools will remain unrealized if they are used merely for presentation or demonstration.” (Tinio, 2002:11). The purpose of this paper is to highlight a way in which chatbot technology, available through networked computers and the Internet, may be put to use in developing country schools in order to promote interactive and collaborative teaching and learning from a social constructivist perspective.

Chatbots and Learning

Chatbots potentially can be used in a wide variety of ways in instructional situations. For instance, Kowalski et al. (2011) wrote that ‘chat bots can play a useful role for educational purposes, because they are an interactive mechanism as compared to traditional e-learning systems. Students can continually interact with the bot by asking questions related to a specific field’ (Kowalski et al., p. 91). However, they went on to note that ‘although chat bots have been around since the middle of 1960’s,

only few of them have been used for educational purposes and all were related to specific subjects' (p. 91). This potential was also noted by Bayan (2005), who wrote that 'a chatbot could be used as a tool to learn or study a new language; a tool to access an information system, a tool to visualize the contents of a corpus; and a tool to give answers to questions in a specific domain...a chatbot could be trained with any text in any language' (Bayan, 2005:2).

As of now, not much research has been conducted in developing countries to uncover specific ways of chatbot technology use in classrooms, what the key players of teachers and students think of the technology, and actual benefits of use, though research on uses of computers in instruction, use of chatbots in some instructional contexts, and specific use of chatbots in the teaching of English in non-English speaking countries (also to a limited extent) is extant (Murithi and Indoshi, 2011; Mwei et al., 2011; Torma, 2011; Osodo et al., 2010; Gimeno, 2008; Wang, 2008; Bayan and Atwel, 2007). Systematic theory, integration, application and evaluation studies are therefore necessary to widen findings and scope and this paper is a suggested contribution to specific application in theory and practice. This is in the light of the fact that ICT use in education has beneficial effects (Roblyer and Doering, 2010; Kok, 2010; Oloo, 2009; Mbangwana, 2008; Tinio, 2002), that these benefits of ICT use in education are attained only through effective integration strategies (Hughes, 2011; Earle, 2002; Ertmer, 1999), that integration of ICT in teaching and learning (particularly in developing countries) continues to be a challenge because of diverse constraints and challenges to integration (Hennessy, Harrison and Wamakote, 2010; Kozma, 2005; Rogers, 2004; Tinio, 2002; Vosniadou and Vassilios, 2001), and that there is a need for students to be exposed to teaching and learning environments that will help them acquire and develop skills that are in line with emergent society needs (21st century skills) through actual use of ICTs, particularly computer and internet technologies (Voogt, 2011; Venesky, 2004; Tinio, 2002).

Social constructivism theory asserts that social interaction plays a fundamental role in the development of cognition, with learning being manifest 'in the intellectual aptitude, cognitive strategies, motor skills, and dispositions people develop while working toward a goal within a community of others' (Powell and Kalina, 2009; Bronach et al., 2006:221). A chatbot has the potential to be used in social contexts, since it is a computer program that is created to simulate intelligent human language interaction through text or speech (Kowalski et al., 2011; Torma, 2011; Alencar and Netto, 2011; Heller and Procter, 2010; Dryden, 2008; Wang 2008; Bayan and Atwell, 2007; Heller et al., 2005). It therefore has capability to promote social interaction between people and between the chatbot itself and individuals; they are socially and interactively oriented. Chatbots further can provide a mediation means in instructional contexts,

where 'semiotic mechanisms (including psychological tools) mediate social and individual functioning, and connect the external and the internal, the social and the individual' (John-Steiner and Mahn, 1996:4). The import of the above theoretical framework and chatbot technology considerations is that chatbot technology can be used to form the basis of, or set the stage for, a social-constructivist teaching-learning environment providing social context, enhanced social interaction, collaboration, scaffolding, and 'teaching as-assisted-performance in the zone of proximal development' (John-Steiner and Mahn, 1996:19). The aim is to establish a social-constructivist teaching-learning environment enabling interaction and collaboration in a social context with more knowledgeable or skilled others (peers, teachers, experts, chatbots, avatars, and even virtual worlds) in the zone of proximal development to support scaffolding through mediation.

A model of chatbot technology use in schools: The case of chatbot knowie

A specific application scenario illustrating the foregoing considerations is as follows:

A Biology teacher desires to teach a topic on Genetics and inheritance. Apart from usual classroom and Biology lab lessons and practical sessions, the teacher proposes that the class programs a chatbot (named Knowie) with facts about Gregory Mendel and his contribution to the field of Genetics. The programming sessions are to be carried out in the computer lab at arranged times, with the students being grouped according to the number of computers available in the computer lab for each group to program their chatbot. On completion of chatbot programming, the chatbots developed by the students will each be rated on comprehensiveness of the responses it makes to questions it is asked pertaining to the topic.

Implementation software for the technology is open source to address school cost concerns: Ubuntu Linux, Python, JDK, PyAIML, and MakeAiml. The chatbot Knowie was derived from the open source chatbot Howie, originally created by Stratton (2003) and which the author programmed and modified for educational research and application purposes. The programming language used for the bot is Python. Most chatbots are internet-based, but internet access costs are prohibitive to most schools in developing countries. Hence the chatbot Knowie has been set up to be able to run on a standalone computer, meaning that it can be installed on a single computer and be run from it. It can also be installed on a server in case a school has a network and accessed from the server, with the capability of extension to internet-based access and use if a school has a website.

The bot's knowledge comes from AIML files. The AIML pattern syntax was designed as a simple pattern

language for chatbot knowledge programming purposes (Wallace, 2009; Seshagiri; 2009). A further simplification to AIML file creation was possible through use of MakeAiml Editor, created by Dryden (2008) and which “allows a programmer to reduce the amount of work required to write an AIML file by providing a shorthand way to represent AIML tags and their contents” (Dryden, 2008:2). As an example, Dryden (2008) gives the example that the AIML file typed in Notepad as

```
<aiml>
<category>
<pattern>HELLO</pattern>
<template>Hi! How are you?</template>
</category>
</aiml>
```

is typed in MakeAIML as

```
p Hello
t Hi! How are you?
```

In other words, one need only specify the pattern (p) and template (t) pairs as illustrated above in creating an AIML file. This therefore provides an inherently simple means for teachers and students to program the chatbot (which initially has no response to any question when it has no aiml files) with desired school subject matter patterns and templates through their involvement in the creation of aiml files, thus enabling the chatbot to eventually provide comprehensive responses to questions by students on any school subject matter.

CONCLUSION

The potential benefits of chatbot technology use in instruction is yet to be realized in many developing country schools. The benefits of their use in instruction include collaboration, cooperation, interaction, active learning, constructive learning, creative learning and social learning – ingredients necessary to help students prepare for their future which demands 21st century skills of them. Exposure to use of chatbots in their instructional processes is therefore a step in the right direction. The above scenario is a contribution towards this in a developing country context.

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