Conversational Bots as Electronic Performance Support System for the Professional Development of Teacher Educators

Shamini Thilarajah
National Institute of Education
Singapore

Shanti Divaharan
National Institute of Education
Singapore

With the increased demand and interest in designing technology-enhanced lessons for 21st Century learners, ways to empower and enable teacher educators to use educational technologies effectively underpinning sound instructional strategies had to be reinvented. Teacher educators may require on-demand support in order to have the necessary knowledge and skills to meet the needs of the rapidly changing learning landscape. A learning intervention or a job aid had to be developed to provide just-in-time bite-sized knowledge in time of need. This conceptual paper elaborates the design and development of a next generation electronic performance support system for teacher educators and outlines a possible approach of using a rules-based chatbot as a means of empowering teacher educators to become active designers of meaningful technology-enhanced lessons.

Keywords: Electronic Performance Support Systems, Chatbot, Instructional Design, Educational Technology, Teacher Education

1. Introduction

Technology has been an integral part of higher education evolving into the 21st century. In order for universities to strive and thrive in the 21st century, we will need to develop the next generation of teaching-learning practices enabled with various technology tools. Even more than before, faculty are now required to work in tandem with learning experience design and educational technology teams to constantly innovate in their classrooms by designing and developing technology-enhanced lessons.

In 2015, the National Institute of Education (NIE), Singapore's only teacher education institution and an institution of Nanyang Technological University (NTU) carried out a "Pedagogical Approaches and Technological Tools Survey" for the very first time for all 12 academic groups. The purpose of the survey was to ascertain the status of technology mediated learning in NIE. The survey was administered to 319 faculty and had a response rate of 63%. The findings from the survey (Divaharan, 2017) revealed that 52% of the courses offered by NIE are technology mediated, 48% are non-technology mediated and 0% are fully online. The survey results had also given insights into the top 10 pedagogical approaches, instructional strategies and educational technology tools prevalently used across the 12 academic groups.

The quantitative and qualitative data collected from this survey have also revealed there is a cognitive dissonance and lack of common understanding of terminologies related to pedagogy, instructional methods and affordances of technology tools. Hence, this led to various interpretations and the disparate views on technology mediated learning. To design, operationalize and facilitate technology-mediated courses, a fundamental understanding of pedagogies and affordances of technology is required and even more so important in a teacher-education institute like NIE where the best and next practices are modeled.

To empower and enable faculty to meet the emerging needs, NIE has decided to adopt a multi-pronged approach. A professional development series that varies from learning by the means of traditional instructor-led classroom trainings to performance-based through individualized and just-in-time support is in place for faculty.

In the past couple of years, there has been a significant shift in the demand for instructor-led workshops to individualized just-in-time support to help ease the transition of face-to-face lessons to blended. As stated by Rosenberg M. J., (1995), for a performance-based approach the concepts of students, courses, curricula and instruction have little meaning. Rosenberg, Coscarelli, & Hutchison (1999) note that the overwhelming amount of complex information required to perform work at a competent level has placed considerable strain on traditional education and training systems. This situation has led to the development of job aids, computer databases, and electronic training systems as well as of structured text design.

Therefore, with the availability of new technologies, the use of Electronic Performance Support Systems (EPSS) to increase both performance and productivity has prevailed.

The goal of an EPSS is to enable learning in the workflow while performing the job (Laffey, 1995). Additionally, Gery (1989 & 1995), Raybould (1995) and Gustafson (2000) concur that the utmost goal of an EPSS is to provide the right amount of information and detail, at the time of need in order to reduce the time spent on performing a task. Laffey (1995) also describes an EPSS as not a passive medium that just disseminates information, but it is one that is very tightly integrated with the context of the task which includes, a dynamic work environment and workflow.

The purpose of this article is to describe the design and development of an EPSS for teacher educators of NIE and eventually make this resource available to NIE student teachers and teachers from our local primary and secondary schools and junior colleges. The primary objective is to help improve the teacher educators' understanding of learning theories, pedagogies, instructional strategies and affordances of technology tools and ability to design technology mediated learning activities. We approached the development of the EPSS by examining what is their thought process and questions that arises when designing technology mediated learning and used this data to develop an EPSS eventually.

2. EPSS on Pedagogical Approaches & Educational Technology Tools for Technology Mediated Learning Design

A basic definition of an Electronic Performance Support System (EPSS) is a custom built computer-based system that supplies access to one, several, or all of the following: integrated information, advice, learning experiences, expert consultation, and tools where the user can control the sequence and scope of the information at the moment when the information is needed (Gery, 1991; Raybould, 1990). Learning may occur during the use of an EPSS, but the primary purpose is to help the user to perform a task and improve productivity (Witt & Wager, 1994).

2.1 Web-based Pedagogical Database

For the first phase of developing an EPSS, we performed a literature review to curate definitions, theoretical frameworks and characteristics. A sitemap was created for an online database to organize the curated content and visually represent the link amongst the broad categories (refer to Figure 1).

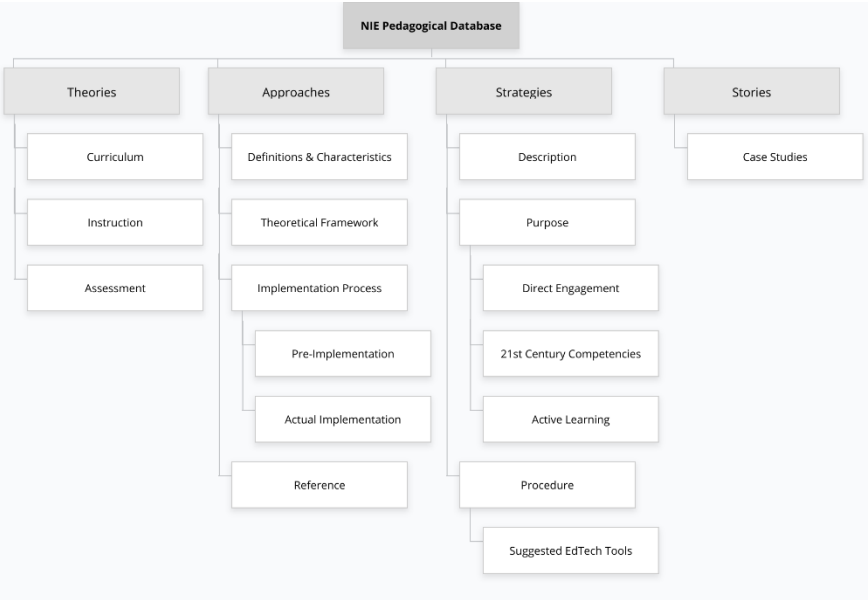

Figure 1: Sitemap of content for 'NIE Pedagogical Database'

In addition, task analysis was carried out on the tasks performed by teacher educators and the data was used to write the implementation processes. The implementation processes were accompanied by infographics or animation to illustrate how a selected pedagogy and instructional strategy will be facilitated with the use of technology and how it should be executed in an actual classroom (refer to Figure 2). The Teaching and Learning

Committee that comprises of a representative from each academic group provided feedback for enhancements and extensions to the prototype. Thus, the initial prototype reflected ideas of both the learning designers as well as the teacher educators.

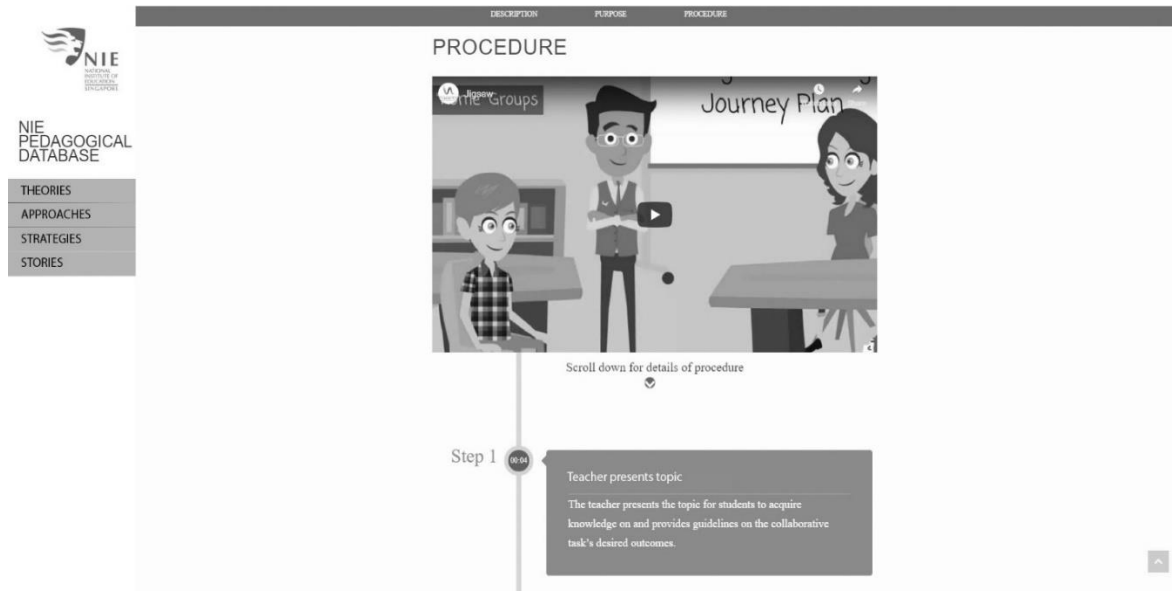

Figure 2: Screenshot of the Procedure section of the 'Jigsaw' strategy page from 'NIE Pedagogical Database'

2.2 Tessa, a Conversational AI

The prototype of the Pedagogical Database was enhanced further to render human like conversations to replicate the conversations that teacher educators have in person, via phone calls or emails with the learning design and educational technology teams. In order for them to get information quickly, they could select the default responses presented for each pre-determined question in order to receive more information or leave their contact details via text-based chat should they not obtain a satisfactory answer. Thus, a decision was made for the use of a chatbot, a tool for users to submit their query, system fetches information from an online source and responds in a natural-language dialogue. In order to identify the type of chatbot we needed for our purpose, we analysed all email inquiries, categorised and list them under pedagogy and technology. A coded dialog flow map was created and tables were used to link the queries to ideal responses that will direct users to appropriate content in the Pedagogical Database prototype. Based on the plan we had on paper, the closed domain retrieval-based chatbot (refer to Figure 3) that imitates an agent while answering the questions from customer best suited our requirements. Thus, various online retrieval-based chatbot platforms were evaluated.

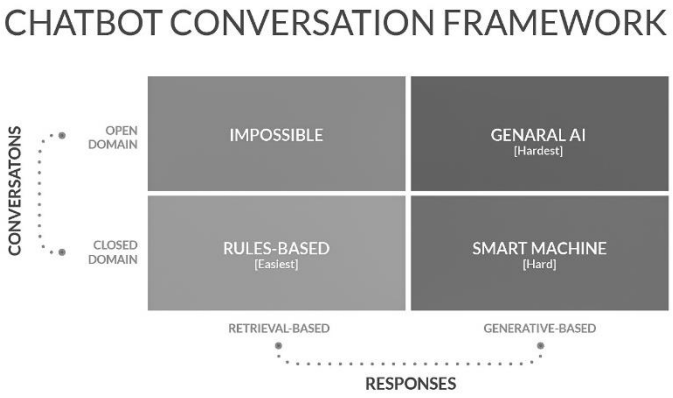

Figure 3: Typology of chatbots
Source: https://www.datasciencecentral.com/profiles/blogs/a-comparative-analysis-of-chatbots-apis

The chatbot used in our context was named 'Tessa'. This chatbot was derived by an online chatbot platform Quriobot. Several approaches can be used to add knowledge to a chatbot created using Quriobot. One possible approach is to use an existing sample bot by Quriobot. For Tessa, an empty database to which chatbot designer program the database so that it has pre-programmed questions, phrases or words and how it is to respond to each question, phrase or word (refer to Figure 4). The options selected by users are captured in the backend report enabling the chatbot designer to learn from user inputs on possible knowledge and skills gaps.

Figure 4: Pre-programmed questions in a conversation with Tessa

Based on the data from the backend report generated from 31 January 2019 to 30 June 2019, we are able to report there has been 39 attempts to use the chatbot using desktop or mobile devices via a browser. Out of the 39 attempts, 19 attempts were to seek guidance on getting started on designing their own tech-enhanced lessons or courses. 31.6% selected the option to explore ICT platforms to facilitate online communication and collaboration whereas 42.1% selected the option to know more about pedagogy and instructional strategies specifically those rooted in Constructivism. The remaining 26.3% selected the option to find more ways feedback and assessment can be used to test for student understanding. This set of preliminary data ascertains the conclusion drawn from the "Pedagogical Approaches and Technological Tools Survey". It is also evident that undeniably most interest is in the area to gain a better understanding of terminologies related to pedagogy and instructional methods grounded in Constructivism to aid in designing lessons and courses for 21st century learners. Tessa has indeed been effective in providing support to faculty on-demand as the report generated further informs us that chat attempts were made as early as 7.15AM and as late as 11.26PM. This would not have been possible if faculty was rendered support the traditional way as the learning design and educational technologist teams operate 8.30AM to 5.30PM only on weekdays.

Therefore, for successful integration of an EPSS, it is necessary for developers to understand the total work environment. Providing the resources that performers need to be successful is important, but it is just as important that these resources support the processes of the work environment (Laffey, 1995). It is hard for any computer tool to be effective when it does not support the performances within work environment. Thus, we must carefully analyze the current work performances and events that can and do influence these performances. Furthermore, we should provide a tool that is customized to the needs of the teachers (Chiero, 1996).

3. Conclusions and Recommendations

In summary, an EPSS can contain tools and templates that are relevant to the tasks of the employee, mini-tutorials and simulations that are relevant to a specific sub-task, a database that provides information to support job performance, and a set of guides to aid the performance as it is being carried out (Gery, 1991). The key to the inclusion of specific features is to tailor it to the performance that it is designed to support which in our context was to provide faculty with knowledge and tools to design and develop technology mediated lessons and courses. In the case of our initiative, we went beyond an online database of curated content and produced graphics and animations on possible ways to implement, but we also aim to include templates and mini-tutorials that goes

beyond "knowing" and allows teacher educators to perform the action of designing technology-mediated lessons by "doing" as they use Tessa as an EPSS.

In order to support a 21st Century teacher educator's competencies, it is necessary to align the professional development goals with the institution's goals. In our case, it was extremely crucial in understanding the current status of the technology mediated courses at NIE with the deployment of the "Pedagogical Approaches and Technological Tools Survey" to measure the difference between the institution's goals and actual outcomes in order to develop a functional, robust tool that teacher educators and eventually teachers would use. Drawing conclusions from the survey results and backend report generated from Quriobot, this survey should be carried out on a biennial basis so that we are aware of our current technology mediated learning status and to study the trends. This survey could also be used as a tool to measure the effectiveness of Tessa as an EPSS by analyzing the data pre and post Tessa.

Furthermore, using chatbots as an extension of human-human conversation and not as a replacement is recommended in order for teacher educators to not underestimate the complexity involved in the actual works of learning design.

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Please cite as: Thilarajah, S. & Divaharan, S. (2019). Conversational Bots as Electronic Performance Support System for the Professional Development of Teacher Educators. In Y. W. Chew, K. M. Chan, and A. Alphonso (Eds.), *Personalised Learning. Diverse Goals. One Heart. ASCILITE 2019 Singapore* (pp. 577-581).