A Supportive Information Assistant on Mobile Devices for Non-Technical Students Learning Programming

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Abstract—Mobile devices are now ubiquitously used by students, which causes difficulty of delivering content in classroom. A chatbot is build using IBM Cloud Service and Facebook Messenger API to help non-technical students learn programming as a supportive information assistant. Along with textbook or handbook, the chatbot will provide just-in-time supportive information during the procedural of complex learning. In such setting, the distraction could be a minimum, since mobile devices are used as tool for learning and their displays must be in sync with the class context. This might improve the mental workload of students and increase the academic achievement. The chatbot can also be utilized for online e-learning systems to reduce the loading of teaching assistant.

Index Terms— chatbot, complex learning, 4C/ID, supportive information, programming,

I. INTRODUCTION: BACKGROUND AND OBJECTIVES
A. Programming Capability for Every Student

In order to improve the "programming capability" of students, the Ministry of Education in Taiwan set the goal that at least 50% of the students participating in the Higher Education Sprout Program (HESP) should learn programming. To lower the barriers to students, most non-technical departments in our school use visual programming tools, including block programming tools such as App Inventor, Scratch, Microbit or Blockly. These visual tools are simpler to install than traditional development tools and are presented by cloud technology [1]. No complicated installation environment and processes are required. However, once the program block is wrong, the tool is relatively lacking information about debug and syntax error solutions.

Programming is difficult for non-technical students in Taiwan. Because of the professional division and gap in the vocational education system, non-technical students have two main excuses for programming lessons: first, the programming language is in English, and second, they don’t know why they have to learn programming.

In order to ensure e-learning accessibility, wireless networks are ubiquitously accessible and smart phones has surpassed the context of teaching materials in classroom at Chihlee. No matter how good the sound and visual effect of teaching materials are, students would rather attend to the content of their own interests on mobile devices, forming a phenomenon of divided media streams in classroom. The screen of computer in labs has already lost its appealing power, too. In addition, the utilization of traditional supportive information (textbooks or paper handouts) in classrooms is reduced by factors such as students’ purchasing power, willingness and environmental awareness, resulting in a decline of the learning outcomes.

B. Using Chatbot as a Teaching Aid

Chatbots have been utilized as assistant tools for second language and distance learning in higher education based on the earlier developed chatbot, ELIZA [2][3]. Fryer et al [4] found that students engaged more in learning according to higher number of conversations, since the chatbots are superior of handling iterative question-answer practices than human counterparts, who are eligible of feeling fatigue for a long period of iterative conversations. Though the chatbot conversations are limited in topics, students found it is interesting to learning foreign language with chatbot and spent more time practicing. A research-in-progress suggests that, with proper design method, a chatbot using Facebook Messenger service for JAVA programming class is implemented as the first place for students asking questions [5].

This research-in-progress intends to use dialogue robots to help students learn how to debug and solve basic programming problems, reduce the loading, and improve the teaching efficiency of large class (around 60 students per class). At the same time, students are encouraged to use smart phones as a learning tool to enhance the literacy and cognition of digital technology, not just content consumers.

II. METHODS AND TOOLS

The script of a chatbot is build according to the four-component instructional design (4C/ID) for complex learning and provides timely support information in computer labs. A prototype is built using IBM Watson Assistant and Facebook Messenger API for test.

A. Complex Learning and 4C/ID

The 4C/ID for complex learning is based on the cognitive load theory. Its main point is that the transformation from working memory into long-term memory requires proper mental activities. The process includes induction, elaboration, knowledge compilation and reinforcement, through systematic coding (or
individual learning style), to allocate skills and knowledge from short-term working memory to long-term, even the change of behavior. To cope with expert's learning process, the so-called four elements refer to learning tasks, support information, part of work drills and instant information [6]. The complete instructional design is developed based on these elements, from simple to complex, easy to difficult. Therefore, it is suitable for procedural work, training and teaching and is more preferable to e-learning [7].

B. Chatbot as a Teaching Assistant

In recent years, due to the development of science and technology, the ubiquitous environment has had a great impact on teaching in classrooms. The rapid accumulation of knowledge makes teaching and learning in the classroom are out of phase with each other. This chatbot, making full use of the mobile devices to provide timely support, is already an indispensable element of the new learning environment. The chatbot serves as a teaching aid to enhance teaching effectiveness and student learning outcomes. The goal of deploying programming education is not to train all the students to become programmers [8], but instead of cultivating them to develop computational thinking, which can transform abstract ideas or concepts into practical solutions [9].

C. Watson Assistant and Facebook Messenger API

Figure 1 shows a typical workflow for a chatbot, which includes need definition, intent analysis, dialogue design, user response analysis, and modification. The benefits of using IBM Cloud Service and Facebook Messenger API are multiple. We just need to focus on the conversation development and test. According to the architecture of a Watson Assistant Project shown in Figure 2, the training of AI and servers are leveraged by IBM Cloud Services. The supported features in Traditional Chinese are still in Beta, so there is no “Content Catalog” available. Some basic intents and dialog need to be established at the time of this writing. Table 2 shows the “#hello_world” intent with its examples and could be responded with two possible answers. The process of developing the chatbot is iterative and could be modified as many versions according to the change of services.

Figure 1. The workflow of developing a conversational assistant (by IBM)

<table>
<thead>
<tr>
<th>Intents</th>
<th>Examples</th>
<th>Dialog</th>
<th>Responses</th>
</tr>
</thead>
<tbody>
<tr>
<td>#hello_world</td>
<td>你好</td>
<td>歡迎</td>
<td>您好，有什麼能為您服務的地方？</td>
</tr>
<tr>
<td></td>
<td>welcome</td>
<td></td>
<td></td>
</tr>
<tr>
<td>你是誰</td>
<td>您好！我</td>
<td>可以幫助你學習 App Inventor 2，請開始。</td>
<td></td>
</tr>
<tr>
<td>嗨</td>
<td></td>
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<td></td>
</tr>
</tbody>
</table>

Figure 2. The architecture of Watson Assistant as a conversational assistant (by IBM)

III. RESULTS AND SUGGESTIONS

Figure 3 demonstrates two user interfaces for test. The iOS app in (a) is developed with Xcode tool on Mac in Swift. Figure 3(b) is integrated with Facebook Messenger API.

With preliminary test, the prototype reveals the feasibility of using a chatbot as a teaching aid for large class and possibly retains the attention of students back to learning context in computer labs. However, the features of App Inventors 2 are still under analysis according to the 4C/ID principles, which are not extensible enough to cover all the programming problems encountered by students. Further test and modification are necessary due to the iterative process shown in Figure 1.

The advantage with Facebook is that students can post their questions on the fan page of a course. In such setting, the related pieces of information are kept together, which fulfills the contiguity principle of multimedia learning. If proper tags are also posted, the fan page in Facebook could be a solution pool for students who are taking the class. The chatbot could too be utilized by the other departments to benefit the teaching and learning of
programming for the goal of HESP of the Minister of Education in Taiwan.

Figure 3. Watson Assistant deployed as (a) an iOS app; (b) integrated with Facebook Messenger.

REFERENCES


AUTHORS

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