# A Discussion on Effective Implementation and Prototyping of Voice User Interfaces for Learning Activities on Moodle

Toshihiro Kita[1], Chikako Nagaoka[1], Naoshi Hiraoka[1], Katsuaki Suzuki[1] and Martin Dougiamas[2]

[1]*Research Center for Instructional Systems, Kumamoto University, Kumamoto, Japan*
[2]*Moodle HQ, Perth, Australia*

Keywords:      VUI, LMS, VLE, Chatbot, Artificial Intelligence, Smart Speakers, Voice Command, Hands Free Speaker.

Abstract:      Voice User Interfaces (VUI) are effective and intuitive for many people. The VUI is rapidly becoming suitable for various practical purposes using voice-operated smartphones, or smart speakers like Amazon Echo or Google Home. If VUIs, which may require less cognitive load to use, are available on learning management systems (LMS) like Moodle, they could enhance LMSs' functionality. This study demonstrates examples of existing educational applications for VUIs and chatbot interfaces. Design suggestions for VUIs for several Moodle activities are also described, and a prototype VUI for Moodle quizzes has been developed with the Dialogflow platform.

## 1 INTRODUCTION

Voice User Interfaces (VUIs) (Pearl, 2016), with which we can operate computers by voice, have greatly improved in recent years and have become usable for practical purposes in our daily life. VUI is an effective and intuitive user interface for many people. Thanks to improvements in the accuracy of speech recognition and synthesis using machine learning approaches, VUIs are rapidly becoming suitable for various practical purposes using voice-operated smartphones, or smart speakers like Amazon Echo or Google Home.

Moodle (Moodle.org, 2017b) is one of the most popular Learning Management Systems (LMS) or Virtual Learning Environments (VLE) in the world. If VUIs, which may require less cognitive load to use, are made available on LMSs like Moodle and if well-designed courses use them effectively, they could enhance the functionality of LMSs. VUIs are also very useful for blind learners.

Though the final goal should be to enable all operation through a VUI on Moodle, it is meaningful to first discuss which Moodle activities are appropriate for VUI.

## 2 WHAT IS A VUI?

A Voice User Interface (VUI) is a human-computer interface that allows people to use voice input to control computers and devices (Amazon.com, 2017h). It has a long history going back to the 1950s (Pearl, 2016), and during the last decade VUIs have quickly grown smarter thanks to evolving Natural Language Understanding (NLU) techniques, and have become well known through the spread of smart speakers, such as Amazon Echo and Google Home.

Compared to inputting information by text, voice input has advantages (Pearl, 2016) of

- speed (faster than typing)
- hands-free use (usable even if you are doing something)
- intuitiveness (it works even if you are not familiar with technology)
- empathy (voice conveys more information than text messages).

Especially in private spaces, VUIs may become as widely used as today's smartphones in the near future. Smart speakers are designed to be located at the center of a room and to always be ready to respond from wherever the user talks to it.

Chatbot interfaces, which have much in common with VUIs, are similar to the text interface used by Facebook Messenger or Skype Instant Messaging, but

the other side (whom you send your messages to) is a computer. In other words, a VUI is the voice version of a chatbot interface. The same development tools can be used for building both interfaces. The script for describing how a user and computer interact with is also almost the same, except that chatbot interfaces can display images and clickable hyperlinks, while VUIs can play sound at any intended timing.

## 3 VUI DEVELOPMENT TOOLS

Tools and documents for building VUIs are found at the Amazon Alexa site (Amazon.com, 2017a) and the Actions on Google site(Google Developers, 2017a). Both are full of examples and templates to quickly start development of VUIs, including integration with external systems like Moodle.

On Amazon Alexa, users can build and publish an Alexa Skill (an app for VUIs) that you can use on Alexa devices like Amazon Echo (Amazon.com, 2017d) smart speakers.

With Actions on Google, users can build apps to use on Google Assistant devices like Google Home (Google, 2017) smart speakers.

## 4 APPLICATION EXAMPLES OF VUIs OR CHATBOTS TO EDUCATION

There are several newly developed educational applications for VUIs, especially in online learning.

An Alexa Skill called 'Canvas' (Amazon.com, 2017c; Moodlenews, 2017a) is a good example. With the Skill, users can quickly access information like grades, missing assignments, due dates, etc. on their Canvas LMS by speaking to Amazon Echo. Possible commands include "What are my course grades?" "Do I have anything missing?" or "Do I have anything due this week?" Available commands for the Skill are listed on a Canvas Community page (Canvas, 2017). When users enable the Canvas Skill, they are required to link their Canvas account to their Alexa devices.

Another Alexa Skill called 'My Blackboard for Blackboard Learn' (Amazon.com, 2017f; Moodlenews, 2017a) can connect to a user's school Blackboard account and the user's report grades and course announcements. This Skill requires some setup of the Alexa Connection link on the Blackboard system side.

There is also a Moodle-related Alexa Skill called 'News for the Moodle.org Community' (Amazon.com, 2017g) for teachers and admins to listen to current Moodle.org announcements, forum posts, etc. This is a Flash Briefing Skill, meaning that users can listen to the information together with other news, assuming that the user has enabled it, when they ask Amazon Echo questions like "Alexa, what's in the news?" The information provided by the Skill includes

- Moodle.org Announcements (Moodle updates and so on from Moodle HQ)
- Moodle.org recent forum posts
- Moodle.org Resources (recently updated Plugins, Moodle Jobs, etc.)

and users can select which of these to hear in their Flash Briefing. With the Alexa app on a smartphone, users can see more information about each piece of Moodle news.

A chatbot interface is like a VUI, as stated in Section 2. Compared to VUIs, there are more chatbots applications for education.

One of the most famous chatbots for educational purposes is used at Georgia Tech's online master's of science (Maderer, 2016). They reported that students did not know their Teaching Assistant was a computer.

A chatbot called 'FreudBot' teaches Freud's theory and concepts through chat (Heller et al., 2005). In their research, learners who experienced FreudBot were asked to rate the importance of chatbot applications in other areas. The results showed that a 'practice quizbot' and a famous personality chatbot like FreudBot were most desired.

The last example in this section is for Moodle. Moodle Global search using a chatbot interface (Porritt, 2017; Moodlenews, 2017b) has recently been developed and demonstrated. The chatbot employs Natural Language Understanding and Amazon Rekognition (AWS, 2017). It recognizes images stored in a Moodle site so users can search for them by keyword even if the images do not have metadata or captions.

## 5 POSSIBLE INTRODUCTION OF VUIs TO MOODLE ACTIVITIES

This section contains suggestions about which Moodle activities could be equipped with a VUI and how the VUI should be implemented for the activity, described mainly in the form of dialog examples.

The following three examples of VUIs are just suggestions and have not actually been implemented (except for the subset of functionality shown in Subsection 5.1, which has been implemented as shown

in Section 6), although they are feasible using current VUI development tools and the current version of Moodle.

It is assumed that users have already linked (Google Developers, 2017b; Amazon.com, 2017e) their Moodle account to a VUI device for the following three examples.

## 5.1 Attempting Moodle Quizzes through a VUI

Table 1 shows an example of how a learner attempts a Moodle Quiz through VUI.

The flow of interaction begins with a 'welcome' phase, followed by a loop of 'question-answer' phases. When all the questions in the quiz have been asked and answered, the grade is spoken to the learner and the session ends.

There are several possible uses for attemtping quizzes via VUI. For example, before deciding to enroll in a course or at early stages of learning in a course, a 'trial quiz' via VUI may allow learners to quickly grasp what they will be able to learn, distinguish, and perform after completing the course. (The trial quiz must be designed to assess the required skills for the course and to engage learners' interest.) The intent is to get learners interested in the subject rather than to rigorously evaluate the learners' knowledge or skills. It may also be an incentive for less motivated learners to redevelop their motivation.

## 5.2 Moodle Lessons through a VUI for Simulation Learning

Moodle Lesson (Moodle.org, 2017d) is good for role-play simulations and decision-making exercises. Table 2 shows an example of a Moodle Lesson using a VUI.

This is an example of simulation-based learning about what to do when an earthquake occurs. Depending on the situation that learners face, they can practice and learn skills by answering within a restricted amount of time via VUI. To evoke more realistic feelings in learners, it is better to play sound effects according to the situation by using sound files embedded in the Lesson pages.

With this kind of integration, Moodle Lesson could also be a tool for building scripts or scenarios using VUI. If the scenario is complex enough (has a lot of branches) to simulate realistic problems, this will provide effective learning.

## 5.3 Notifications through a VUI to Assist Learners

If learners can get information about their Moodle courses from smart speakers that they often use, then it may help them to plan and schedule their learning. Table 3 shows an example of this. The information provided through the dialog is basically the same as indicated on the Course Overview (Moodle.org, 2017a) and Upcoming Events blocks (Moodle.org, 2017c) that are displayed on the learner's Moodle Dashboard.

To let the user easily select the information they want, a very simple menu ("You have two assignments and one quiz that are due, and one reply in the forum.") is spoken first, after which the user can interact with the VUI to gradually specify the desired information. The menu options should be repeated anytime that the user tries to select another piece of information. Various notification sounds according to the relative importance of the information could be effective for notifying learners.

This would be a good way for learners to easily and quickly get information that they cannot miss if they are to keep learning.

## 6 PROTOTYPE OF MOODLE QUIZ ATTEMPTING VUI

We have developed a prototype of a VUI for Moodle Quizzes. Dialogflow(Dialogflow, 2017) (with the webhook feature) was used for prototyping.

Communication between Moodle and the Dialogflow agent is done through the webhook script that is invoked by Dialogflow Intents (interaction rules between a user and agent). The webhook script is written in PHP and uses Moodle web service REST API (Moodle.org, 2016), such as "mod_quiz_get_quizzes_by_courses" or "mod_quiz_start_attempt". The prototype supports multiple-choice questions, as shown in Figure 1, and is currently available through Google Home smart speakers (for limited users). Thanks to Dialogflow Integrations' features, it is also available through Facebook Messenger or other common messaging services that have a chatbot style interface.

For the prototype system to work, the Moodle site settings "Enable web services for mobile devices" and "Enable web services" must be set to 'Yes.'

The quiz-attempt interaction data is sent to and stored in the Moodle Quiz attempt history, so the learner is able to review the attempt on the Moodle

Table 1: An example of a quiz using interaction between a user and smart speaker.

| | |
|---|---|
| User: | Talk to Quiz on Moodle. |
| Speaker: | OK. Do you want to attempt a quiz? |
| User: | Yes. |
| Speaker: | Most recently you attempted the quiz 'Eigenvectors' in the course 'Linear algebra I.' |
| | Do you want to attempt the same quiz? |
| User: | No. |
| Speaker: | Do you want to attempt a quiz in the same course? |
| User: | Yes. |
| Speaker: | Which quiz do you want to attempt? |
| User: | 'Eigenvalues' |
| Speaker: | Do you attempt 'Eigenvalue quiz'? |
| User: | Yes. |
| Speaker: | OK. Please answer questions by saying 'a,' 'b,' or 'c.' |
| | Question 1. When an eigenvalue of a matrix is 2, The characteristic of the matrix is ... |
| | a. rotating. b. stretching. c. static. |
| User: | b. |
| Speaker: | Your answer is b. Question 2 ... |
| .................. | ................ (snip) ................ |
| User: | c. |
| Speaker: | Your answer is c. This is the end of the quiz. |
| | Here is your result. The first question score is 1.0 out of 1 points. (snip) |
| | Your total grade is 80 out of 100. Great. |
| | You can review your attempt on the Moodle course page. |

Table 2: An example of a Moodle Lesson using VUI.

| | |
|---|---|
| User: | Talk to Moodle Lesson. |
| Speaker: | Which Lesson do you want to do? |
| User: | 'Earthquake lesson' in the course 'Disaster Management' |
| Speaker: | OK. Here's 'Earthquake lesson' in the course 'Disaster Management' |
| | You are in your room at home. Watch out! Earthquake! |
| | What action do you take now? Select one of the following three actions. |
| | Get under a desk. Get closer to a window. Get out of the room. |
| User: | Get under a desk. |
| Speaker: | OK, you get under a desk. After a while, it stops shaking. |
| | What is your next action? Select one of the following three actions. |
| .................. | ................ (snip) ................ |
| User: | Shut off electricity. |
| Speaker: | OK, you turned off the electricity. |
| | Congratulations, end of lesson reached. Your score is 8 out of 12. |
| | You can review your Lesson attempts on the Moodle course page. |

Table 3: An example of getting notifications through VUI.

| | |
|---|---|
| User: | Talk to Moodle Notification. |
| Speaker: | You have two assignments and one quiz that are due, and one reply in the forum. |
| | What do you want to check? |
| User: | Assignments. |
| Speaker: | Which course do you want to check? 'Information processing' or 'Statistic analysis'? |
| User: | Information processing. |
| Speaker: | The Assignment is "Summarize the history of information technology in less than 300 words." |
| | Shall I read out loud the page from the same section? |
| User: | Yes, please. |
| Speaker: | The page from section 2 reads "The history of IT: In 1941, Germany started to develop ... (snip)." |
| | You have two assignments and one Quiz that are due, and one reply in the forum. |
| | What do you want to check? |
| User: | Forum. |
| Speaker: | In Forum 'Discussion 1' of 'Multimedia and Education,' |
| | you have one reply from John Smith "I strongly agree with your opinion because ...(snip)." |
| | Shall I read out loud your original post? |
| User: | No. |
| Speaker: | OK. Quitting. |
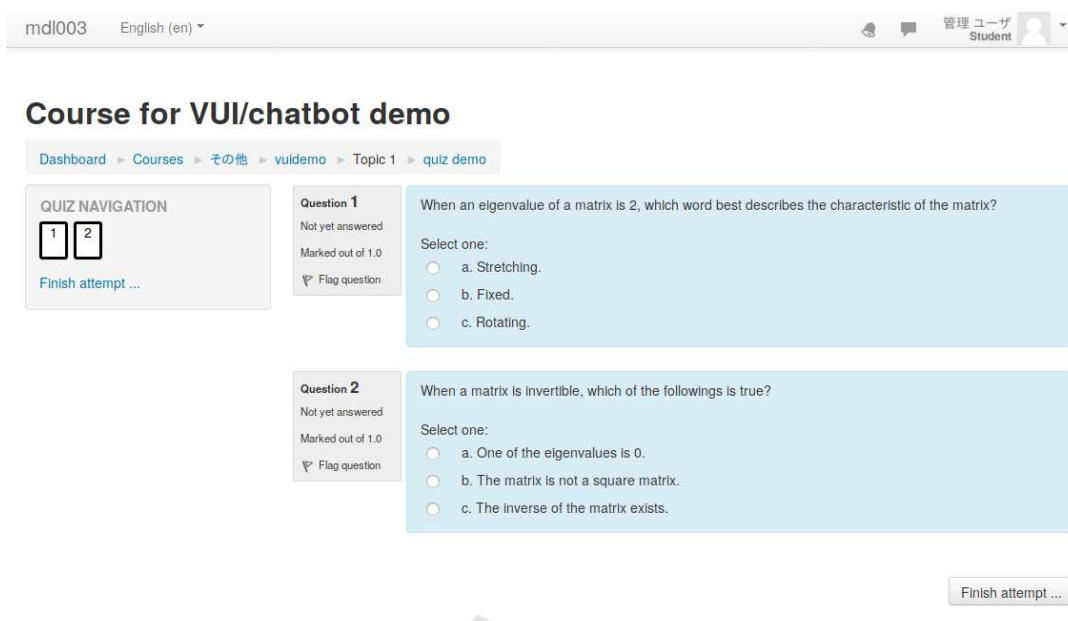
Figure 1: Moodle Quiz example.

site later.

Figure 2 shows the prototype being tested using Actions on Google Simulator. It indicates how a learner (on the right side) attempts the quiz (Figure 1) on a Moodle site with responses from the agent (on the left side) linked to the Moodle site. Currently, the latter half of the dialog shown in Table 1 has been realized for the first Quiz instance in a fixed course for a fixed user.

# 7 DISCUSSIONS AND CONCLUSIONS

A web article (Noble, 2016) suggests how chatbots could serve in education:

- Coaching (virtual coach that provides a knowledge base)
- Reference (helping people to find answers)
- Performance support (just-in-time learning and troubleshooting)
- Drill and practice (gamified learning to fill downtime)
- Cohorts and social learning (bots as moderators and experts in forums)
- Personalization (personalized interface with all learning resources)

Most VUI examples described in Section 4 and our prototype described in Section 6 do not seem to fall clearly into the categories of purpose that Noble has suggested, because the examples are yet small and not so rich in user interactions. Overtime, however, the more intelligent and interactive applications of VUIs suggested by Noble are expected to appear.

Optimal design is important for VUIs, just like e-learning materials. As pointed out in the design checklist (Amazon.com, 2017b), 'make it clear how customers can benefit from your skill' (e.g. clear definition of the learning goal) and 'watch customers try to use your skill' (e.g. formative evaluation) are very important.

By prototyping the quiz VUI, we confirmed that our suggestions for implementing the quiz VUI are feasible and came to several conclusions.

It is important for VUIs to always speak in short phrases. If it must be long, however, the VUI had better inform users of the total time first, because they will begin to wonder when it will end (for a GUI, it is not so hard to know the total size of the text materials, as we can recognize the size by just looking at them). Therefore, it is not a good idea to use existing content on an LMS without change for VUIs. Content often needs redesigning to make the most of learning through a VUI.

A VUI on an LMS should be used not only to supply information or activities, but also to assist or asses learners in a natural manner. For that purpose, small talk between a learner and LMS would be effective and is already feasible using current Natural Language Understanding techniques.

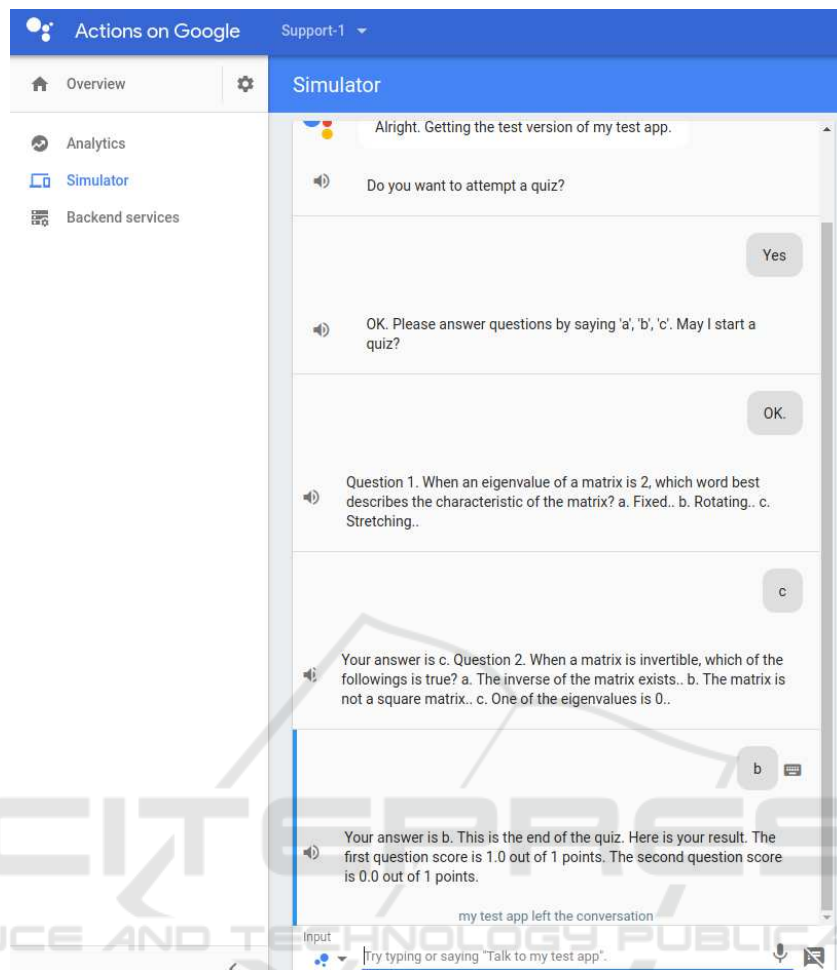A VUI has the merit that learners 'feel heard'

Figure 2: Quiz VUI Prototype being tested on Actions on Google Simulator.

through conversation with the virtual agent (behind an LMS or something else) whose role is to assist learners. The interactions that learners experience are expected to positively affect their motivation.

Based on the prototype VUI we have developed, we are going to implement VUIs for Moodle as suggested in this paper, and will improve them through evaluation at real educational sites.

Feedback from readers of this paper is welcome.

## ACKNOWLEDGMENTS

## REFERENCES

Amazon.com (2017a). Amazon alexa. https://developer.amazon.com/alexa.

Amazon.com (2017b). Amazon Alexa voice design guide. https://developer.amazon.com/designing-for-voice/.

Amazon.com (2017c). Canvas: Alexa skills. https://www.amazon.com/Instructure-Canvas/dp/B073YNGXMR.

Amazon.com (2017d). Echo & Alexa - Amazon devices - Amazon Official Site. https://www.amazon.com/b/?ie=UTF8 &node=9818047011.

Amazon.com (2017e). Link an Alexa user with a user in your system. https://developer.amazon.com/docs/custom-skills/link-an-alexa-user-with-a-user-in-your-system.html.

Amazon.com (2017f). My Blackboard for Blackboard Learn: Alexa skills. https://www.amazon.com/My-Blackboard-for-Learn/dp/B072JVLVG6.

Amazon.com (2017g). News for the moo-

dle.org community: Alexa skills. https://www.amazon.com/dp/B074P9ZPGW.

Amazon.com (2017h). What is a voice user interface (VUI)? https://developer.amazon.com/alexa-skills-kit/vui.

AWS (2017). Amazon Rekognition video and image - AWS. https://aws.amazon.com/rekognition/.

Canvas (2017). Digital assistant: Canvas skill for Alexa. https://community.canvaslms.com/docs/DOC-11957-digital-assistant-canvas-skill-for-alexa.

Dialogflow (2017). Basics — Dialogflow. https://dialogflow.com/docs/getting-started/basics.

Google (2017). Google Home. https://store.google.com/product/google_home.

Google Developers (2017a). Actions on google. https://developers.google.com/actions/.

Google Developers (2017b). Implementing account linking. https://developers.google.com/actions/identity/account-linking.

Heller, B., Procter, M., Mah, D., Jewell, L., and Cheung, B. (2005). Freudbot: An investigation of chatbot technology in distance education. In *the World Conference on Multimedia, Hypermedia and Telecommunications*, pages 3913–3918.

Maderer, J. (2016). Artificial intelligence course creates AI teaching assistant. http://www.news.gatech.edu/2016/05/09/artificial-intelligence-course-creates-ai-teaching-assistant.

Moodlenews (2017a). Alexa, teach me! voice-activated features coming to Canvas and Blackboard LMS. https://www.moodlenews.com/2017/alexa-teach-me-voice-activated-features-coming-to-canvas-and-blackboard-lms/.

Moodlenews (2017b). The first Moodle chatbot, at last. MoodleMoot Australia 2017. https://www.moodlenews.com/2017/the-first-moodle-chatbot-at-last-moodlemoot-australia-2017/.

Moodle.org (2016). Web services - MoodleDocs. https://docs.moodle.org/dev/Web_services.

Moodle.org (2017a). Course overview - MoodleDocs. https://docs.moodle.org/33/en/Course_overview.

Moodle.org (2017b). Moodle - open-source learning platform. https://moodle.org/.

Moodle.org (2017c). Upcoming events block - MoodleDocs. https://docs.moodle.org/33/en/Upcoming_events_block.

Moodle.org (2017d). Using Lesson - MoodleDocs. https://docs.moodle.org/33/en/Using_Lesson.

Noble, M. (2016). Chatbots for learning. http://www.clomedia.com/2016/09/12/chatbots-for-learning/.

Pearl, C. (2016). *Designing Voice User Interfaces*. O'Reilly Media.

Porritt, M. (2017). Find all the things! https://assets.moodlemoot.org/sites/15/20171002060419/Find-all-the-things-presented-by-Matt-Porritt-Catalyst.pdf.