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研究課題名(和文) Cross-institutional study on the effects of an intelligent embedded training system on language learning in a mobile environment.

研究課題名(英文) A cross-institutional study into speech recognition for language learners, analyzing usage patterns

研究代表者

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研究成果の概要(和文)：今回の研究では、オンラインで言語を学ぶ環境下では、特に音声認識を伴う時に、自動的フィードバックが自発的に伸びる可能性があることが示唆された。しかしながら、Eメールのような直接的フィードバックは、モチベーションを上げる可能性は低い。学習者は、フィードバックが瞬間的、且つ知的で客観的である場合には、課題に取り組むことをいとわないようである。さらに、音声認識はネイティブスピーカーと学習者とを識別することができるが、驚くことに音声認識によって分けられたスピーチレベルと標準化した書くテストの点数との間には、明確な相関は見出されないことを実証した。

研究成果の概要(英文)：The current study suggested that automatic feedback in an online language learning environment can lead to a possible increase in autonomy especially when coupled with speech recognition. However, direct [pushed] feedback, such as in an email, is unlikely to increase motivation. Learners appear to become more willing to engage in tasks when the the feedback is instant and appears objective and intelligent. A secondary result demonstrated that speech recognition could distinguish between a native speaker and a learner, but surprisingly, there was no detected correlation between speech levels graded by speech recognition and scores in a standardized written test.

研究分野：CALL

キーワード：autonomy feedback speech recognition speech synthesis testing mobile

1. 研究開始当初の背景

(1) Numerous studies have suggested that online and mobile learning can provide a learning environment for students that is engaging and empowering. However, access to technology alone does not make users more willing or competent. There is also recent interest in the concept of dynamic feedback (Tzouveli, Mylonas & Kollias, 2008), and Stockwell (2007) noted that computers have the ability to track learning. Thus, it is possible to give intelligent automated feedback beyond what a teacher can achieve.

(2) However, many of these technologies are relatively new and untested. Modern mobile technologies are just being integrated into education and pre-smartphone studies showed students preferred their PC over their mobile device (Stockwell, 2010). However, with the advent of smartphones, this landscape has changed considerably, and pre-smartphone devices can be considered a different technology. Furthermore, new technologies of benefit to the language learners are emerging rapidly. Indeed, during the course of this research speech recognition and synthesis went from a fringe technology to a major interface, and thus this major advance was integrated into the project.

2. 研究の目的

The project analyzed the effect of intelligent feedback on autonomy, student attitudes to autonomous feedback, and attitudes toward different kinds of devices, as well as analyzing

speech recognition patterns in language learners.

3. 研究の方法

(1) The research was divided into three stages: (i) In the first stage, the online system was developed and tested. Particular care was devoted to ensuring that the interface made the system broadly simple to use, and functioned on modern devices and browsers where possible. (ii) In the second stage, we investigated whether the use of a system that gave feedback lead to autonomous learning, which activities were effective, and student attitudes toward the system, (iii) Based on the results of student interactions with the system we further developed the online speaking system to prepare for further research.

(2) The main research was conducted on 2 English language classes (about 75 students) 2nd-year Pharmacy Students at the University of Kanazawa, and I developed about 50 speaking activities in the form of spoken dialogues, and drill-response patterns. Each semester generated on average 2000 utterances per student leading to about 160,000 utterances. Each utterance was analyzed using speech recognition, and upon each utterance the student received a feedback score. Based on the database logs, an analysis was made to determine: student accuracy, student autonomy (based on the number of practices attempted), plus any correlation between speech ability and scores in standardized online written tests. Further feedback was gleaned from use at Ishikawa

Prefectural University and at Shimane University.

4. 研究成果

1) The first stage involved developing and building the online system with its feedback system. As noted above, the release of speech recognition systems had just started to appear in mainstream use, and because of the unique benefits of speech practice for Japanese learners extensive testing and feedback was performed to ensure that speech practice was practical and worked effectively. Each student performed speaking activities each week, and the system was tested for robustness. Utterances were essentially graded by the percentage of words in each sentence spoken correctly with partial credit for nearly correct words. In some of the practices students could see and thus read the responses, but in others the student was required to respond to a drill prompt. On the whole the system worked effectively. Students expressed satisfaction (3.8/5 Likert) that they could practice speaking at any time. They were highly impressed by the speech recognition ability to transcribe and grade their speech (4.2/5). However, a small number of students expressed disappointment that the transcription could differ from their intended speech, and questioned whether the issue was the accuracy of the speech recognition system or their own inaccuracy. Due to this issue, later in the study it was stressed that the score was just a feedback guide, and the system would respond by simply giving more practice

rather than having any effect on grade. Some students commented that initially it felt strange talking to a computer, but as they got used to it, they became more confident because they didn't feel embarrassed by mistakes. Others commented that they felt were being graded objectively for the first time on speech. On a technical level, there were a number of issues. At present, speech recognition has different levels of support on mobile. Particularly, iOS restrictions meant that recognition did not work well on iPhones. However, the system worked well on all PCs, and some Android devices. Analysis of the logs, showed student pauses in speech could cause problems, and thus activities had to be adapted so that target utterances weren't too long. Feedback from students and analysis of logs indicated that progress notifications by email were not especially helpful, and generally ignored. Initial analysis suggests that students suffer from notification overload and prioritize messages/emails to personal usage and essential communications (Email overload, of course, is a general problem not limited to students). Further research and design strategies are required in this area, and it was decided to focus on the instant speech feedback for the remainder of the project.

(2) In the second stage of the project, an analysis of the spoken speech was undertaken. The results of a class that also took a standardized test are shown here:

Students (n): 73 (+1 dropout)

Level: CEFR 2A/2B

Utterances: 160,135

Mean/Required: 2194 /1730

Required completed (n): 100% (73)

Utterance Score Mean (SE): 70.4%(7.5)

Utterance Mean (Range): 50.2 ~ 86.3%

Native Mean: 94%

Score - Paper Test Correlation: 0.07

There were a number of important results we could infer from this analysis. First, 100% of student completed all the work without exception, and on average students did 26% more work than was required (2194 vs 1730) even though any extra work did not count toward a grade. This was in contrast to other forms of assignment where no student did significantly more than the required amount, and 29% of students did less suggesting that autonomy improved. Interviews with students suggested that repeats attempts to perfect an utterance until the computer gave them an improved score felt meaningful, in contrast to repeating a multiple-choice test, for example. There was a large range of spoken scores even though standardized paper tests suggested the students fell in a limited range. Furthermore, the system could distinguish between the best student and a native speaker ($p < 0.001$). However, a very surprising result was the complete lack of correlation ($r=0.07$) between the average speaking score and the score on a standardized paper test (Oxford Online Test). Possible explanations are: the level range of this particular group of

students was too narrow to produce a result; Japanese English language students' skill sets are focused on grammar, and thus speaking skill is independent of measured English ability in such students; other reasons, such as students regarding the test as a level-check rather than a graded assignment and thus not trying as hard. A future study will try to replicate and/or ascertain the reason for this result.

(3) The final stage of the project was to improve the system in preparation for further research and extended mobile use. It cannot be underestimated the importance of a well-designed and elegant online interface. The present generation of learners have grown up with sophisticated mobile computers with slick interfaces, and expect such technology to work without complication. A new technology such as online speech may appear to be ineffective if the technological implementation is poor, leading to such technology to being overlooked rather than re-designed. A 5-point Likert-scale scored an average of 4.1 (Agree) on the overall usability of the system on PC. Due to technical constraints, mobile use was scored not for usability but for desirability and the score was 4.4 (Agree), suggesting that students would like to use such a system on mobile if it was available. As mobile support for speech becomes better supported this issue can be further investigated.

(4) Based on this research, it seems email feedback to devices was not an effective motivation strategy per se, but

more research is required to compare different forms of pushed feedback (Gamified scores and graphs, for example). On the other hand, direct speech feedback appeared to promote autonomy, gained positive student feedback, and is an effective way to practice speaking in Japanese university learners of English.

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5. 主な発表論文等

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