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研究課題名(和文) Investigating the Effects of Affect Variables on the Instructional Efficiency of Four Mobile Learning Activities: How Engagement, Interest, and Focus, Affect Mental Effort and Learning Outcomes

研究課題名(英文) Investigating the Effects of Affect Variables on the Instructional Efficiency of Four Mobile Learning Activities: How Engagement, Interest, and Focus, Affect Mental Effort and Learning Outcomes

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研究成果の概要(和文)：本研究では、プロジェクト用に開発され400名を超える日本人大学生に利用された英語学習アプリ(文法、語彙、リスニング)の学習効果に関する報告を行う。本アプリでは学習者が利用を進めるごとに難易度が調整される。回帰分析、多変量共分散分析(MANCOVA)、t検定を用いて、タスクに対する学習時間と、事後テストスコアの伸び、また事後テスト完了にかかる時間との関係性を見た。結果、本アプリの利用とテストスコアの伸び、タスク完了にかかる時間には相関関係がみられ、学習教材への継続的かつ反復的な取り組みが、習熟親密度に大きく効果的であることがわかった。

研究成果の学術的意義や社会的意義

These results offer an important indication for teachers and students using educational apps. When users consistently and repeatedly engage with the app materials in an appropriate and efficient manner, they can achieve proficient and superior familiarity with the platform.

研究成果の概要(英文)：This project reports how an English language learning app specifically created for this study, was used by over 400 Japanese university students. The app included grammar, vocabulary, and listening activities of increasing difficulty. Regression, MANCOVA, and t-test analyses were used to determine the existence and strength of the relationship between the overarching metric of time on task, with increase in post-test score and speed of post-test completion. Results clearly show that the time spent using the app was positively correlated with both students' improvement in test scores and the time taken to complete the test, a finding that indicates the importance of consistent and repeated engagement with materials to achieve proficient familiarity.

研究分野：Technology Enhanced Learning (TEL)

キーワード：Language learning Smartphone apps Mobile technology Microlearning

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1. 研究開始当初の背景

This project set out to address the interlinked issues of language teaching, student autonomy, and available technology. As language teachers, we know our students don't automatically learn what we are attempting to teach in class; we know that even if they do learn the content, they don't always acquire it to a sufficient depth that they are able to recall and utilize the word, grammatical structure, or linguistic skill at a time most beneficial for them; we also realize there is rarely enough time in a class or course to cover every aspect of language performance we would like. For these reasons, student autonomy, the act of taking some agency over their learning, has developed into an important component of language learning. With the teacher still in control of the what is being studied, why it is being addressed, and how many activities, pages, or lines of dialogue must be covered in a lesson, week, or course of study, the student is increasingly able to determine when and where this content is covered, at a time and place most convenient to them. In addition, technology is increasingly being used to provide the method of study, how the material is introduced, covered, and finally assessed. The overlap between these aspects formed the background to everything laid out in this study.

2. 研究の目的

Noted improvements in both available technology and the understanding of the pedagogical implications of introducing mobile devices into language classrooms, lead us to how best to avail ourselves of its noted advantages. The app produced for this research was called "English Gauge," and it was specifically designed for this project. After an exhaustive beta-testing period, a pilot study was conducted using students at two universities in Japan, Kyushu University and Meiji University. Analysis of the pilot study data suggested that the time users spent on the app were a significant determiner of their success in the later, more difficult stages of the app. Therefore, in this study we set out to explore the following research question: To what degree does time on task with an English language learning app indicate increased proficiency with the platform, as measured by pre-post test scores?

3. 研究の方法

The app was divided into four packs of increasingly difficult tasks, with each pack containing six themes, each theme containing three standard types of activities, with each activity having ten sets of questions to be completed. This gave each pack 180 unique items for students to complete in a week of study. The three standard activities were named "How many words," "Build the response," and "Find the word." These activities drew from a themed bank of A/B couplets, either a question/answer or statement/response. Each theme had its own set of spoken couplets that would be deployed in various ways according to the activity architecture. "How many words," a listening activity, gave students one of the lines of dialogue and asked them to state how many words were in that line. The intent was to build familiarity with the contents while building a schema of listening not often practiced; the activity addressed aspects of elision and liaison in fluent spoken English. Build the response gave students the A part of the couplet and asked them to construct the B sentence from several chunks of text. "Find the word" gave students a single word and asked them to select the synonymous word in the sentence. As the difficulty of the pack level increased, the lexical level and grammatical difficulty increased, as did the rate of speech in the spoken sentences. Therefore, the word counting became more difficult, the number of chunks increased, and the number of possibly synonymous words also grew.

Students (n=244) from four universities in Japan were given access to the app in class and asked

to run through a series of practice activities with dummy text in them. This allowed the students to become familiar with the main activities and what was being requested of them. They then took a pre-test for pack 1 and were told to complete the pack activities, 180 questions in total, before the next week's class. In the next class, students took a post-test for pack 1, followed by the pre-test for pack 2, and were given this pack for homework. This pattern was repeated over the next two weeks for packs 3 and 4.

4. 研究成果

The main research question sought to determine to what degree does time on task with an English language learning app indicate increased proficiency with the platform, as measured by pre-post test scores. The following describes the analyses performed to answer this question using the data gathered in this study: a regression analysis and a multivariate analysis of covariance (MANCOVA). These analyses were conducted to determine the existence and strength of the relationship between the overarching metric of time on task (actual app usage between classes), with increase in post-test score as well as speed of post-test completion, thereby indicating if platform proficiency use increased.

Regression

The predictor variable was time on task. However, time on task is used in the context of micro-learning and even though the total time engaged with the activity is used in the regression analysis as would be expected, the time on task was not a continuous chunk of time. On the contrary, time on task was broken up into small segments. Therefore, to distinguish time on task used in the conventional sense from how we are using it in a microlearning context, we will use the term segmented time on task. As stated above, a typical participant who completed all four packs would have spent on average over 23 separate sessions averaging about 11 minutes each. Below, regression analyses were performed for both score and time to complete the test.

The results of the regression analysis for score indicated that segmented time on task, $t(235) = 12.03$, $p < .001$ is a significant predictor of post-test score increase. The final model summary is $R = .618$, adjusted $R^2 = .380$, $F(1,234) = 145$, $p < .001$. Using < 0.2 to 0.49 as a small effect size, 0.5 to 0.8 as a medium effect size, and > 0.8 as a large effect size, it can be seen that with $R^2 = .382$ accounting for 38.2 percent of the variance and multiple $R = .618$, there is a medium effect on the dependent variable score increase. Based on these results, segmented time on task can be said to have medium strength as a predictor of the score increase when using the English language learning app.

Table 1. *Regression Analysis Summary for Score*

Variable	<i>B</i>	<i>SE B</i>	β	R^2	ΔR^2
Constant	-2.688	.847	-	-	-
Segmented time	.00213	.000	.618	.380***	0.382***

*** $p < .001$

A second regression analysis was also carried out for the time to complete the test using segmented time on task as the independent variable. The results indicated that segmented time on task, $t(234) = -10.46$, $p < .001$ is a significant predictor of the speed in which the post-test was completed. The

final model summary is $R = .564$, adjusted $R^2 = .318$, $F(1,234) = 109$, $p < .001$. With $R^2 = .318$ accounting for 31.8 percent of the variance and multiple $R = .564$, it can be said that there was a medium effect size. Based on these results, segmented time on task has medium strength as a predictor of the faster time to complete the post-test when using the English language learning app.

Table 2. *Regression Analysis Summary for Time*

Variable	<i>B</i>	<i>SE B</i>	β	R^2	ΔR^2
Constant	-7.82	13.605	-	-	-
Segmented time	-.03	.003	-.564	.318***	.315***

*** $p < .001$

Multivariate Analysis of Covariance

To determine whether there was a difference in test score improvement and time to complete the test, a MANCOVA was conducted with score and time as the dependent variables. Here, time refers to the time to complete the pre- and post-tests. Additionally, the treatment time was used as a covariate. The four factors in this analysis were the four content packs in the app. The resulting bar graphs and tables can be seen below.

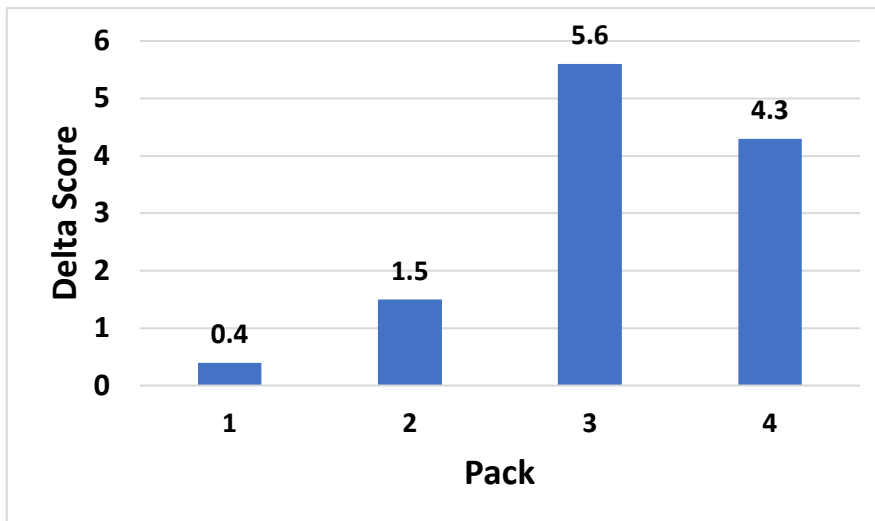


Figure 1. Pack versus delta score

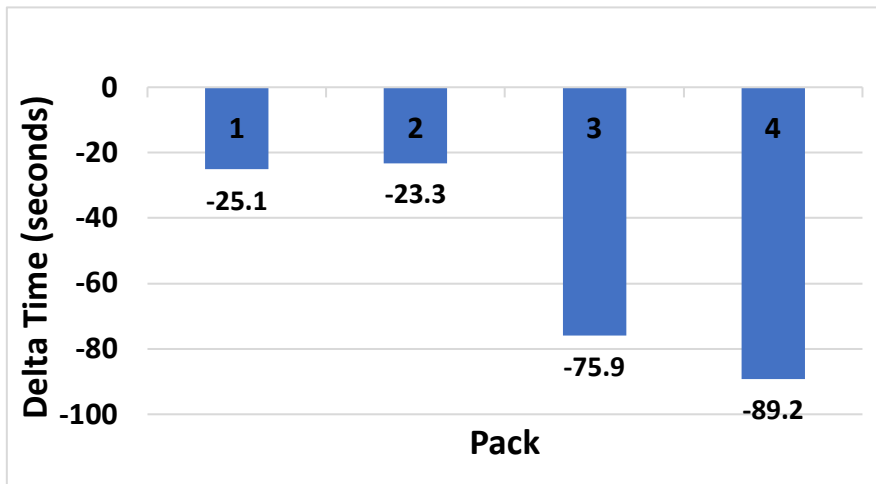


Figure 2. Pack versus delta time

Table 3. Significant Multivariate Effects (at $p < .001$ level)

Variable	Pillai's Trace	F	df	Error df
Group	.244	20.67	6	894

Table 4. Multivariate Analysis of Covariance Summary

Source	DV	df	SS	MS	F	p	η^2
Contrast	Time	3	158,679.35	52,893.11	11.65	.000	.073
	Score	3	1,739.79	579.93	39.96	.000	.211
Error	Time	447	2,029,444.54	4,540.14			
	Score	447	6,486.87	14.51			

Using Pillai's trace, there was a significant effect as time progressed. $V = .24$, $F(6,894) = 20.68$, $p < .001$. Separate univariate ANOVAs revealed that there were both score and speed gains, $F(3,447) = 39.96$, $p < .001$, and $F(3,447) = 11.65$, $p < .001$, respectively. Pairwise comparisons showed that in both cases, score and speed, there was no difference between packs 1 and 2 nor packs 3 and 4. However, there was a significant difference between packs 2 and 3, $t_{score}(112) = 4.13$, $p < .001$; and $t_{time}(112) = 44.65$, $p < .001$; with a large effect size, Cohen's $D_{score} = 1.01$, and Cohen's $D_{time} = 0.85$.

In conclusion, smartphones are a ubiquitous item of our age; rarely can one spend any time in a public space without seeing them being used, generally as anything but a phone. The barrier to entry into this digital space is also constantly being lowered, allowing app production for almost any purpose. Therefore, the question is not "can we use smartphone technology to put our materials in front of the eyes of language students?", but rather "is it beneficial for students, for teachers to do so?" This research project demonstrated familiarity with the app resulted in our students becoming more efficient users, improving in both speed and accuracy over time. The data also show those users who remained with the app to the end of the project were the best users overall. Educators would like their students to spend quality time with necessary assignments; app developers would like users to spend as much time as possible connected to their creations – our study has shown such time on task, although segmented, is beneficial for the users, a finding that should please both parties.

5 . 主な発表論文等

〔雑誌論文〕 計0件

〔学会発表〕 計6件（うち招待講演 0件 / うち国際学会 4件）

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4 . 発表年 2019年

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〔図書〕 計0件

〔産業財産権〕

〔その他〕

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