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授与した学位	博士		
専攻分野の名称	工学		
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学位授与の要件	自然科学研究科 産業創成工学専攻 (学位規則第 4 条第 1 項該当)		
学位論文の題目	Enhancing E-Learning Efficiency: A Comprehensive Approach for Computer-Aided Rote Learning through Automated Deck Generation and Audio Reinforcement (e ラーニング効率の改善のための包括的アプローチ：自動デッキ作成と音声強化によるコンピュータ支援型単語学習)		
論文審査委員	准教授 YUCEL ZEYNEP	教授 門田暁人	教授 太田 学
学位論文内容の要旨			
E-learning systems have gained popularity for their accessibility and flexibility, but challenges such as self-motivation, social isolation, and distractions can hinder their effectiveness. In response to these issues, our study centers on rote learning, utilizing spaced-repetition virtual flashcard software. To begin, we introduce a method automating the creation of vocabulary decks based on word frequency, ensuring both uniformity and diversity. Experiments employing this algorithm reveal its positive impact on user behavior, regardless of word class. Next, we explore the reliability of learners' subjective opinions and pose three hypotheses. Our experiments uncover vulnerabilities consistent with our expectations, shedding light on the subjective evaluation process. Subsequently, we delve into the impact of stimulus medium on users' memory registration. Results indicate that audio stimuli enhance recollection rates, especially in simpler verbal and numerical content. Drawing from these insights, we propose an automatic audio reinforcement strategy for e-learners, confirming its efficacy in improving the efficiency of e-learning. We believe that our holistic approach effectively tackles various challenges, thereby enhancing the efficiency of e-learning methodologies.			

論文審査結果の要旨

E-learning systems have recently gained popularity due to their convenience in terms of accessibility and flexibility. However, it is known that there are factors that impede their effectiveness, such as self-motivation and social isolation. In response to these factors and to improve e-learning efficiency, this thesis focuses on rote learning and utilizes spaced repetition flashcard software. In particular, the thesis handles three aspects as preparation of study material, learners' subjective evaluations of difficulty, and the effect of audio incorporation in e-learning.

First, preparation of study material is studied. The main contribution of this part of the thesis is the proposal of an automatic deck creation algorithm based on word frequency. Human subject experiments are conducted using decks created by the proposed method. Learner's interaction logs are examined and learning material difficulty is shown to be adjusted properly.

Next, the reliability of learners' subjective evaluations of difficulty is investigated. The main contribution of this part of the thesis is the demonstration of lexical vocabulary class as a factor inducing vulnerabilities on learners' decision-making. In human subject experiments, it is shown that learners often fail to judge vocabulary difficulty in a fair manner, which implies that it is necessary to incorporate more intrinsic behavioral cues in content design and scheduling.

Finally, the influence of audio stimulation on users' memory registration is studied. One of the main contributions of this study is the development of a system that estimates memory improvement or decline based on computer-recorded behavioral variables. The second main contribution is determination of audio type that leads to highest improvement concerning each learning content type. The third contribution is the triggering of audio signal for incorporating audio channel into information registration. Experiments with human subjects confirm the effectiveness of the proposed system in improving learning efficiency.

These research results will be important in the development of e-learning systems and support for learners, and will also greatly contribute to the development of academic research in this area. Thus, the thesis is judged to have a value as a doctoral thesis.