Evaluation of 3D Apparel Design Spatial Visualization Training for Cognitive Functioning Improvement of Older Adults: Cross-Cultural Comparisons

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Introduction: One of the major challenges of aging is the decline of cognitive functioning and memory. Previous research found that majority of older adults experience varying degrees of cognitive decline (Zlatar et al., 2018). Furthermore, this cognitive decline can cause the difficulty with daily activities of older adults (Wolinsky et al., 2006). As this cognitive decline is closely related to the health and quality of life, it is important to find a way to help prevent the cognitive decline by using the effective training program. Especially, spatial visualization skills are closely related to the cognitive development, including memory improvement and problem solving (Charcharos et al., 2016). However, current available spatial visualization activities are mainly designed for children and teens, and there are limited resources for older adults. Even though there are some resources available for older adults, these activities are tiresome and difficult to complete (Chandler & Sweller, 1991). Therefore, the purpose of this study is to provide the new and innovative spatial visualization training using 3D apparel design and to examine how older adults of four different ethnic groups evaluate it by applying the Technology Acceptance Model (TAM) and the Unified Theory of Acceptance and Use of Technology (UTAUT).

Literature Review: The rate of older population growth is constantly increasing and this necessitates more resources for the old population (Vincent & Velkoff, 2010). In particular, research demonstrates that African Americans and Hispanics have lower cognitive functioning than Whites (Roth et al., 2001). Cognition is the brain action that functions to understand external stimuli when necessary (Hirschfeld & Gelman, 1994). Among many cognitive trainings, spatial visualization training provides a skill to manipulate the information about a 2D or 3D object rotate in an imaginative space. Literature demonstrates a gradual healthy aging process is often related with this ability which is one major cognitive functioning (Lu et al., 2011). Therefore, properly designed spatial visualization training will improve older adults' spatial mental rotation as well as cognitive functioning. Furthermore, self-efficacy, an individual's belief in his/her ability to accomplish a given task, can affect the time and effort required to learn a new behavior or technology (Kulviwat et al., 2014). Especially, the level of self-efficacy is found to be different by ethnic groups and it affects the behavior of these different groups (Mau, 2003). Based on TAM, an individual's decision of adopting technology is affected by perceptions (Davis, 1985). In addition, according to UTAUT, expectation of performance, i.e., efficiency of technology, and expectation of effort, i.e., cost and time effort, are related to the technology usage intention (Venkatesh et al., 2016). Thus, these two theoretical frameworks help understand new technology training and further find the effective way to develop and modify its structure and program.

Method: This study used a quantitative research design using the online survey with questionnaires drew on the previous literature. After the screening question in the beginning, participants watched the virtual technology training video that applies the concept of spatial

visualization to apparel design. After the training, the participants were asked to answer questions to evaluate the training. A quota sampling method with the Qualtrics' panel was used to recruit four different ethnic groups in the US, i.e., Caucasian, African American, Hispanic American, and Asian American. A total of 600 usable data were used for data analyses (n=150 for each ethnic group). The structure equation modeling (SEM) was conducted, followed by a confirmatory factor analysis (CFA) using LISREL for this study (Brown & Moore, 2012). Furthermore, the ANOVA test was used to see the differences of sample means for latent variables among four ethnic groups.

Results: The measurement model analysis was based on six latent variables: self-efficacy, perceived ease of use, performance expectancy, effort expectancy, attitude, and behavior intention. The result of the CFA model shows the good model-data fit: (RMSEA=0.062, NFI=0.98, CFI=0.98, and TLI=0.98). The SEM result using the maximum-likelihood estimation procedure also shows the good model-data fit (RMSEA=0.074, NFI=0.97, CFI=0.98, and TLI=0.97) with the significant relationships among most of the latent variables. Perceived ease of use and performance expectancy affected attitude toward the training significantly (γ_{12}=3.38**; γ_{13}=5.44***). However, self-efficacy and effort expectancy did not affect the attitude. Self-efficacy and the positive attitude toward the spatial visualization training positively affected the training usage intention (γ_{21}=2.27*; β_{31}=16.72***).

The ANOVA result show the significant mean differences of all latent variables among four ethnic groups, except the self-efficacy (e.g., for PEU, F (3,596) = 20.292, p =.000). Asian American had the significantly highest means, followed by Hispanic American and African American (Interestingly, these two groups didn't have significant mean differences), and Caucasian American for five factors, including perceived ease of use, performance expectancy, effort expectancy, attitude, and behavior intention.

Discussion: The findings of this study revealed the importance of perceived ease of use and the performance expectancy to increase the positive attitude toward the training for older adults. That is, if they felt that the training platform is easy to use and if they were convinced that the training provides the values to their learning, they will have a positive attitude toward that training. Therefore, it is crucial to provide the clear guideline and support for them to start the training in a convenient way. Furthermore, our training might feel difficult for our older adult participants. This finding about the challenges of adopting a new technology by older adults are in line with the finding of Kuo et al. (2012). Especially, Caucasian participants felt the training to be most difficult and less likely to use compared to other ethnic groups. This shows that the need in training design for considering the different needs and understanding of each ethnic group.

Implications and Future Research: There are practical and academic implications based on the unique findings of our study. First, this study found the theoretical support of the TAM and UTAUT to examine the new technology training utilizing the concept of apparel design. Thus, other technology training in apparel field can adopt and broaden the use of this framework for further research. In addition, the finding of this study shows the practical implication to design the training based on different ethnic groups. Future research should consider the different age and gender groups how they evaluate the apparel design-based spatial visualization training. The actual cognitive functioning improvement using the training should also be further examined.

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