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An Exploring Study on the Smart Learning Intention Model using Multi-level Structural Equational Modeling

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다층구조방정식을 적용한 스마트러닝 학습의도 모형 탐색 연구

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Abstract

Many previous studies did not consider the nested structure of the school. If we ignore the multi-level nested structure of the group feature, it can be an ecological or atomistic fallacy. It can mislead the inaccurate conclusion while we are interpreting the result of the analysis. In this study, we apply a multi-level structural equation approaches to find out the modeling of smart learning intention. Samples are 2,670 data from Heo and Goo(2017) study. We used Mplus 8 for analysis of multi-level structural equation modeling.

From the result, model 2 with school type is fitter than model 1. We can find that all effects are significant in the students' level. We also find there is a significant difference in usefulness for the school type.

Key words : Smart learning intention, Multi-level structural equation modeling, Technology acceptance model

Ⅰ. Introduction

Recently, because of the development of smart media, using devices in education became highly attractive in the field of education. By using smart media, educational opportunities can be expanded. We can learn anytime and anywhere with more fun as well as higher levels of learning outcomes. There are many researchers (Jeong, Lim, Sim, & Kim, 2010) attempting to apply smart media to the field of education. Recent meta-analyses of the research have reported positive effects of using smart media and have revealed structural relationships between smart media variables (Han, Kim, & Heo, 2014; Heo, Gu, Han, 2017; Heo & Goo, 2017).

Using smart media in the field of education can be a new challenge because it is not easy to change from traditional methods to emerging innovative media. In this context, the Technology Acceptance Model (TAM) helps determine how people accept the new technology or services. David (1989) explained this model by using two essential factors: i.e., perceived usefulness and

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perceived ease of use. Such a model or approach can also be applied to the intention of adopting smart learning. Recent research from Heo and Goo (2017) presented the structural equation modeling of smart learning by comparing 'general' and 'fisheries-marine' high school.

Many previous studies did not consider the nested structure of school. If we ignore multi-level nested structure of the group feature, by the covariance in the group, it will be difficult to obtain an accurate estimation (Woltman, Feldstain, MacKay, & Rocchi, 2002). It can mislead the inaccurate conclusion while we are interpreting the result of the analysis.

In this study, we apply to approach multi-level structural equation modeling which is based on the technology acceptance model (TAM). It is expected that we can find the structural relationship not only student level but also at the school level.

Ⅱ. Research Methods

1. Sample

This study used data from Heo and Goo (2017). This data was obtained from 2,670 high school students' survey responses. More specifically, there were 1,913 general high school students and 757 fisheries and marine-related high school students. Male was 64.2%, and female was 35.8% (Heo & Goo, 2017).

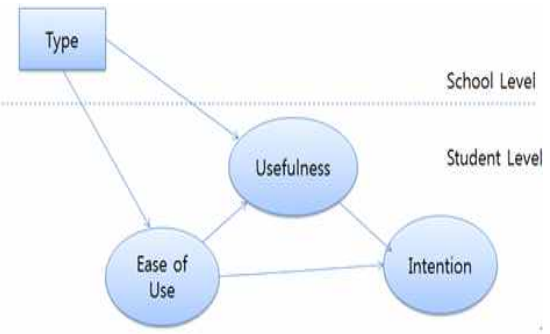
2. Measurement

In this study, we use three latent variables likes 'Usefulness for Smart Learning', 'Ease of Use for Smart Learning,' and "Smart Learning Intention.' Each latent variable has four items or three items. We modified these items from the technology acceptance model (Davis, 1989). Participants have responded to the five Likert scales.

3. Analysis

We set the data as two levels: student level (Level 1) and the school level (Level 2). Students were nested within the school. For exploring and explaining a multi-level structure, we used Multi-level Structural Equation Modeling (Elorza et al., 2016; Heck & Thomas, 2015). We decomposed our level-1 variables into within and between parts (Zhang, Zyphur, & Preacher, 2009). School type used as level 2 variable.

4. Research Model



[Fig. 1] Research Model

[Fig. 1] shows ideal research mode. Type is used as the second level, and others latent variables are used as the first level. As a result, [Fig. 1] shows the Model 2 in <Table 1> in the result section.

We can set the hypothesis from the research model like these.

H1. 'Type of school' effects on 'Ease of Use at the school level.'

H2. 'Type of school' effects on 'Usefulness at the school level.'

H3. ‘Ease of Use at the school level’ effects on ‘Usefulness at the school level’.

H4. ‘Ease of Use at the school level’ effects on ‘smart learning Intention at the school level.’

H5. ‘Usefulness at the school level effects’ on ‘smart learning Intention at school level.’

H6. ‘Ease of Use at the student level’ effects on ‘Usefulness at the student level.’

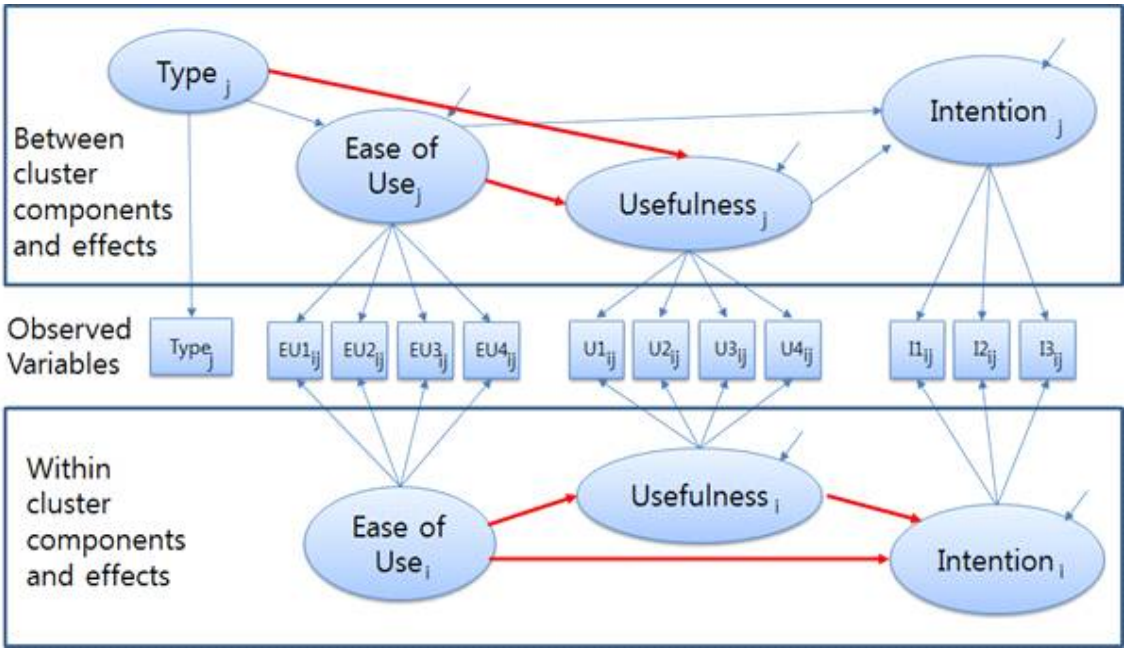
H7. ‘Ease of Use at the student level’ effects on ‘smart learning Intention at the student level.’

H8. ‘Usefulness at the student level’ effects on ‘smart learning Intention at the student level.’

Ⅲ. Results

Analyses were performed by using Mplus. Model 1 is based model for multi-level structural equation modeling which does not have external variables. The index of Model 1 is like these: RMSEA = .060, CFI = .948, TLI = .930, and chi-square(df) = 872.240(82). [Fig 2] shows the visualization of Model 2, and it is a final multi-level structural equation modeling with one external variable in the 2-level. The index of Model 2 is like these: RMSEA = .059, CFI = .947, TLI = .930, and chi-square(df) 16290.093(121). Compare to the Model 1; Model 2 fit better in the index of RMSEA and CFI. We finally choose Model 2.

From the results of hypothesis testing, H2, H3, H6, H7, and H8 were significant. It is the meaningful result that we can find not only student level but also a school level structural relation. H3 reveals that there is a relationship between “Ease of Use” and “Usefulness” in the school levels. H6, H7, and H8 show that the same results of traditional researches.



[Fig. 2] MSEM Result of Smart Learning Intention

There are not only direct effect on “Smart Learning Intention,” but also an indirect effect. There is a mediation effect in the level of student, but we could not find the mediation effect in the level of school.

<Table 1> Index of Criteria of Models

Index	Model 1	Model 2
Chi-sq	872.240	16290.093
df	82	121
CFI	.948	.947
TLI	.930	.930
RMSEA	.060	.059

<Table 2> shows a particular estimation parameter result. The structural relationship at the student level is the similar result of previous single-level approach, but Model 1 finds the causal relation between “ease of use” to “usefulness” at the school level. In the Model 2, “type” is a negative effect on “ease of use” in the level 2.

Ⅳ. Conclusion

In this study, we have applied multi-level structural equation modeling for considering nested data in the frame of the structural equation model. From the result, we conclude as follows.

First, we can find the same structural relationship with traditional technology acceptance model in the student level. This result supports the previous researches(Davis, 1989; Heo, Goo, 2017), and we can also confirm that smart learning intention’s structural relationship is similar to the TAM in the private level.

Second, there are the different structural relationship between student and school level in using smart media intention. Previous researches (Davis, 1989; Heo, Goo, 2017) find out the structural relationship without considering multi-level approaches, but we consider analysis as both student level and school level. From the result, we can find that easy of use effect on usefulness at the school level.

<Table 2> Parameter estimate for Models

Level	Effect	Model 1		Model 2	
		Estimate	S.E.	Estimate	S.E.
School Level	Ease of Use -> Usefulness	.830***	.237	.854**	.274
	Ease of use -> Smart learning Intention	.383	.807	.274	.649
	Usefulness -> Smart learning Intention	.389	.642	.502	.568
	Type -> Usefulness			-.080*	.036
	Type -> Ease of Use			.081	.085
Student Level	Ease of Use -> Usefulness	.702***	.023	.702***	.024
	Ease of use -> Smart learning Intention	.708***	.046	.710***	.047
	Usefulness -> Smart learning Intention	.143**	.054	.142**	.054

*** p<.001, ** p<.01, * p<.05

Third, we need to explore organizational level variables more. We find that school type effect on school level usefulness variable in the smart media using intention.

There are some limitations to this research. For example, the explanation of the research data is based on the context of a Korean high school context. In the future researches, we need to extend this research to an international scope. We can compare national data with various local and regional contexts.

References

Davis FD(1989). Perceived usefulness, perceived ease of use and user acceptance of information technology. MIS Quarterly, 13(3), 319~340.

Elorza U, Harris C, Aritzeta A and Balluerka N(2016). The effect of management and employee perspectives of high-performance work systems on employees' discretionary behavior. Personnel Review, 45(1), 121~141.

Han SJ, Kim HS and Heo G(2014). A meta-analysis on the effectiveness of smart-learning, The Journal of Fisheries and Marine Science Education 26(1), 148~155.

Heck RH and Thomas SL(2015). An introduction to multilevel modeling techniques: MLM and SEM approaches using Mplus (3nd ed.). New York: Routledge.

Heo G and Goo JM(2017). A study on the structural equation modeling of smart education between fisheries marine and general high school students. JFMSE, 29(6), 2011~2019.

Heo G, Gu JM and Han SJ(2017). A meta-analysis on the effectiveness of smart-learning in the field of general education and fisheries and marine education, The Journal of Fisheries and Marine Science Education 29(1), 128~136.

Jeong SJ, Lim K, Ko YJ, Sim HA and Kim KY(2010). The analysis of trends in smartphone application for education and suggestions for improved educational use. Journal of Digital Contents Society, 11(2), 203~216.

Woltman H, Feldstain A, MacKay JC and Rocchi M(2012). An introduction to hierarchical linear modeling. Tutorials in Quantitative Methods for Psychology, 8, 52~69.

Zhang Z, Zyphur, MJ and Preacher K(2009). Testing multilevel mediation using hierarchical linear models: problems and solutions. Organizational Research Methods, 12(4), 695~719. https://doi.org/10.1177/1094428108327450

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