TRENDS OF SCIENCE EDUCATION RESEARCH FOR PAST 8 YEARS in IJSE and JRST

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Introduction

➢ It is meaningful for a researcher to understand research trends in his field. This has been similarly emphasized in science education. In order to predict the research trends in the future while grasping the status of his own research in the whole flow of science education, it is necessary to understand the research trend from the past to the present.

➢ In addition, it provides opportunity to reflect on the meaning of research in the context of diversified research fields, so that it can link meaning of research in the whole context and present a more productive perspective in future research.

➢ There have been many studies on research trends so far.

- White (1997) analyzed 77 articles in three years (1975, 1985, 1995) submitted to RISE.

- The Tsai research group conducted three studies for each five year (1998 ~ 2002, 2003 ~ 2007, 2008 ~ 2012) on the articles submitted to IJSE, JRST, and SE (Tsai, & Wen, 2005; Lee, Wu, & Tsai, 2009; Lin, Lin, & Tsai, 2014). The frequency of authors' nationality, research methods, and research topics were examined.

➢ Most of the previous studies examined the frequency of the characteristics of each article by dividing them into several factors. However, each study does not have an independent relationship with each other. Preceding research affects subsequent studies, and studies between adjacent subjects are influenced by each other. Therefore, in order to analyze research trends more meaningfully, it is important not to look at each research independently, but to see how the relationship between researches is established.

Methods

(1) Data Mining

➢ The process of collecting data is the process of converting the information on the website, including Wiley Online Library and Taylor & Francis Online.

➢ Since the website is published in HTML format, it has been converted into Excel XML (*.xlsx) format, which is structured data that can be easily analyzed through HTML Parsing. In the HTML codes, items are stored in the form of <meta> tag, so it is easy to extract the necessary information accurately. A computer program is developed so that a large amount of data can be collected at a high speed.

unsturctured data → parsing → structured data

(2) Data Analysis

➢ **Keyword-based Analysis.** We analyzed the keywords of each research article. It is assumed that the keywords include words related to the subject of the research and the more frequently the two keywords appear in the same article simultaneously, the more the two keywords have a high correlation with each other.

➢ **Making Keyword List.** All of the keywords appearing in the whole paper are listed. The total number of keywords listed was 1,040. In the case of similar keywords, they were merged into one. For example, 'informal education' and 'informal science education' were integrated into one keyword. In addition, general subjects that do not provide implications were also excluded from the analysis. A total of 998 subject word was selected.

➢ **Calculating Correlation Matrix.** A matrix (M) with a boolean matrix which values are determined as 0 and 1 depending on whether or not the keywords appears in each article. Correlation matrix (M_{adj}) was calculated in the following way to identify the correlation.

$$M_{adj} = MM^T$$

- *Time Complexity.* In order to calculate the above equation, we have to perform the operation of the square of the number of keywords. That is, the time complexity is O (n^2), which requires a considerable amount of time. It is impossible for human to analyze it. Therefore, the data analysis process is also implemented through the R so that the entire process can be performed by the computer.

(3) Data Visualization

➢ Data visualization is the process of presenting the analyzed data in the easiest form to interpret. We analyzed the correlation of each research topic in the main text, and visualized it as a network graph that can best represent it.

➢ The layout of the network graph is *Fruchterman-Reingold Layout Algorithm.* This is useful in that it is faster than other algorithms and can be used in three dimensions (Fruchterman et al., 1991).

➢ One keyword is visualized as one vertex and the correlation between two keywords is visualized as a node.

Research Questions

➢ In this study, we analyzed the research trends by focusing on the topic among the various relationships between researches. We analyzed the trends of science education research by visualizing them in the form of a network graph in order to express them in an easy-to-understand form. Based on the necessity of the research discussed above, the major research problems to be revealed in this study are as follows.

(1) What are the main topics of articles submitted to the IJSE and JRST for the last 8 years?

(2) What are the closely related topics of articles submitted to the IJSE and JRST for the last 8 years?
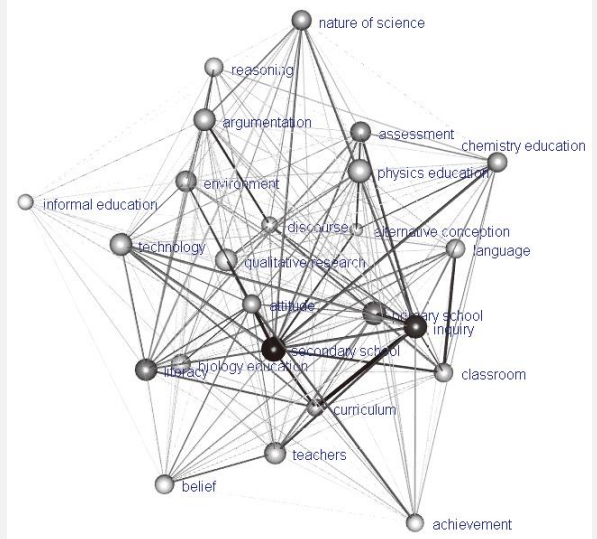
Results

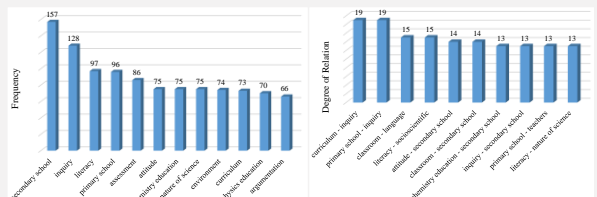Figure 1 **Visualized result of science education trends**

Figure 2 **Highly frequent keywords**

Figure 3 **Highly correlated keywords**

➢ **Main topics of keywords in science education articles**. Topics which were most frequently occurred were 'inquiry', 'literacy', 'assessment', 'attitude', and 'nature of science'.

- By school level, studies on secondary schools were significantly higher than those in primary schools. The research in elementary education has many topics related to inquiry and teachers, and the research in secondary education has a lot of 'attitude' and 'classroom'.

- By each sub-science, research on chemical education was the most common, followed by research on physics education and biology education. However, there were relatively few studies on earth science education, and many of them were studies of astronomy. There are few studies on geology and little research on atmospheric science or oceanography. Research on secondary education was actively conducted in all four sub-science, while research on elementary education was as active as research on secondary education only in the field of earth science.

➢ **Main correlations of keywords in science education articles.** The main subjects with the highest correlation are 'inquiry' and 'curriculum'. Most of the articles were researched on the effectiveness of the inquiry-based curriculum, and other articles were distributed on various topics. The second largest correlation was in 'primary school' and 'inquiry'. The most common researches in this correlation were teachers' knowledge, beliefs, perception, and value. In addition, there were research on classroom instruction of teachers, teacher professional development, and students' dialogue analysis. The third largest correlation was in 'classroom' and 'language'. The majority of researches has examined the discourse of students and teachers in the classroom. There are a number of studies on various expressions beyond words and writings in the classroom, though not many. The fourth largest correlation was in 'literacy' and 'socioscientific'. All of the articles covered SSI (socioscientific issue), and most of them were SSI classes for students.

References

➢ Lee, M.-H., Wu, Y.-T., & Tsai, C.-C. (2009). Research trends in science education from 2003 to 2007: A content analysis of publications in selected journals. International Journal of Science Education, 31(15), 1999–2020.

➢ Shih, M., Feng, J., & Tsai, C.-C. (2008). Research and trends in the field of e-learning from 2001 to 2005: A content analysis of cognitive studies in selected journals. Computers & Education, 51(2), 955–967.

➢ Tsai, C.-C., & Lydia Wen, M. (2005). Research and trends in science education from 1998 to 2002: A content analysis of publication in selected journals. International Journal of Science Education, 27(1), 3–14.

➢ White, R. (1997). Trends in research in science education. Research in Science Education, 27(2), 215–221. https://doi.org/10.1007/BF02461317