Shih, JL. et al. (Eds.) (2023). Proceedings of the 31st International Conference on Computers in Education.
Asia-Pacific Society for Computers in Education

Exploring Business Students' STEM Literacy for Work Preparedness

De-Qi ZHANG[a*] & Morris Siu-Yung JONG[a]
[a]*Department of Curriculum and Instruction, The Chinese University of Hong Kong, Hong Kong, China*
*deqizhang@link.cuhk.edu.hk

Abstract: This paper presents a proposed doctoral study exploring STEM (science, technology, engineering, and mathematics) literacy for business students' work preparedness. The overall research consists of two studies. Study 1 will develop a theoretical model relating business students' STEM literacy for work preparedness by adopting a grounded theory approach. Based on the model, a measurement scale, viz. Business Students' STEM Literacy Scale (BSSLS), will be developed. Study 1 will involve fresh business graduate workers and business students with work experience in STEM-related industries. Study 2, which aims to recruit around 500 participants in mainland China and Hong Kong, will validate the BSSLS and investigate the current situation of final-year business students' STEM literacy. The proposed research will contribute to generating new insights into researching STEM literacy in higher education and incorporating this literacy as a curricular component in business education.

Keywords: STEM literacy, business students, work preparedness

1. Research Motivation

Over the past two decades, there has been a rapid evolution in STEM (science, technology, engineering, and mathematics) products, leading to an unprecedented expansion in related industries (Podobnik et al., 2023). As a result of this growth, business workers have become increasingly involved in the business processes of STEM industries (Hallioui et al., 2022). Business work tasks related to STEM industries are interdisciplinary business processes rather than relying on individual disciplines (Fedyk et al., 2017; Ransbotham et al., 2017; Sollosy & McInerney, 2022). Therefore, business students should be equipped with STEM literacy for their work preparedness, which is an interdisciplinary ability to solve STEM-related challenges that cannot be solved by a single discipline (Mohr-Schroeder et al., 2020). However, the current problem is that business students are ill-prepared for working with STEM (Sollosy & McInerney, 2022), which is not yet adequately addressed by higher education. This may cause a gap between the required skills expected by employers and the actual skills possessed by business graduates.

STEM education has been widely regarded as a globally important initiative across primary to higher education (Huang et al., 2022; Lau et al., 2022), but limited research has been conducted on STEM literacy in business education (Bunch, 2020; Sollosy & McInerney, 2022). It is unknown what STEM literacy business students should possess to adapt to the constantly updating business workplace, and whether they currently possess the corresponding literacy. It might be because education researchers overlooked the significance of business employers' perspective and business studies. While some universities have attempted to cultivate business students' STEM literacy (e.g., CUHK, 2023), the effectiveness of the existing curriculum remains to be determined because the theoretical standard is unknown.

This research aims to bridge the gap in researching business students' STEM literacy for work preparedness. The anticipated outcomes seek to enhance the overall understanding and implementation of STEM education in business schools.

2. Research Questions

This research aims to explore business students' STEM literacy for work preparedness and identify the gap between the STEM literacy that business students need to possess and that they currently possess. The objectives of this research consist of four folds: (a) develop a theoretical model of constructs that relate business students' STEM literacy for work preparedness; (b) generate the Business Students' STEM Literacy Scale (BSSLS), a measurement scale based on the theoretical model; (c) use the BSSLS to collect data from a large group of final-year business students to test the theoretical model; and (d) use the scale to examine final-year business students' STEM literacy level. To achieve the objectives, the research will address the following research questions:

- What is the theory that explains business students' STEM literacy for work preparedness?
- What is the scale's reliability and validity, as analyzed through exploratory and confirmatory factor analysis?
- Does the scale's factor structure confirm the theoretical model?
- What is the current STEM literacy state of final-year business students?

3. Potential Contributions

This research aims to develop a theoretical model of STEM literacy for work preparedness in business education. While frequent rhetoric promotes STEM literacy is essential for this generation (Kayan-Fadlelmula et al., 2022), there exists a research gap in business education regarding STEM literacy for work-preparedness. Current studies on STEM literacy models or constitutions are mainly conducted in K-12 contexts (e.g., National Research Council, 2014; Huang & Jong, 2020; Jackson et al., 2021), STEM teacher education (e.g., Chai et al., 2020; Jong et al., 2021), and general education (e.g., Zollman, 2012; Mohr-Schroeder et al., 2015; Tang & Williams, 2019). However, limited studies have delved into STEM literacy in business education.

The theoretical model can provide a foundation for developing a measurement scale to examine the STEM literacy that final-year business students currently possess. By precisely identifying the areas of STEM literacy in which final-year business students are lacking, the research can provide insights to optimize curricula design for business students' work preparedness. Higher-quality business curricula can equip business students with enhanced workforce competitiveness, thereby further supporting their future professional development.

Furthermore, the research outputs can also serve as a reference for future studies focusing on STEM literacy in higher education. That is, researchers and educators of other majors can draw inspiration from this research to investigate corresponding STEM literacy models for work preparedness for different professions.

4. Methodology

This research consists of two studies. Study 1, via a grounded theory approach, will develop a theoretical model which delineates the necessitated business students' STEM literacy for work preparedness. Based on this model, the initial items of the BSSLS will be generated. The results of Study 1 will provide a comprehensive understanding of business students' STEM literacy for work preparedness, which has not been depicted in previous research. Study 2 will validate the BSSLS and investigate the current situation of final-year business students' STEM literacy. The gap between current business students' STEM literacy and what they need to possess will be identified. The findings of Study 2 can offer insights for curricula design to improve business students' work preparedness, enhance their workforce competitiveness and support their future professional development.

4.1 Study 1: Business Students' STEM Literacy for Work Preparedness

4.1.1 Sampling and Participants Recruitment

Study 1 will follow the tenets of grounded theory and take a theoretical sampling approach (Strauss & Corbin, 1990). The sampling process intends to be purposive, iterative, and adaptive until saturation. Theoretical saturation appears when no new properties of categories have been discovered, leading to the emergence of theory (Aldiabat & Le Navenec, 2018). In-between data analysis will be conducted to refine the next round of data collection.

Study 1 plans to recruit fresh business graduate workers and business students with work experience in STEM-related industries. Fresh business graduate workers refer to those who have just entered the workforce and have not yet been promoted. To collect rich data, this study will recruit participants by balancing three considerations: working departments, business backgrounds, and gender.

4.1.2 Data Collection and Analysis

Study 1 will employ semi-structured interviews. Participants will be invited to share their views based on their current experiences. The interview questions for grounded theory should strike a balance between being broad enough to encompass various experiences and specific enough to delve into the participants' individual experiences (Charmaz & Belgrave, 2012). Therefore, participants will be first invited to share their stories. Then, the researcher will open the interviews accordingly and ask follow-up questions (ibid.). Besides, because this study plans to conduct several rounds of interviews until saturation, interview questions might be adapted slightly in each successive round.

A grounded theory approach will be employed to analyze the interview data (Glaser et al., 1968) through Nvivo10. The analytical process will involve several rounds of data collection, analysis, and visualization. Open, axial, and selective coding and modeling will be applied (ibid.). Based on qualitative data analysis, this step will generate the initial items for BSSLS.

Study 1 intends to employ two validating strategies to ensure the trustworthiness of the interpretations (Creswell & Báez, 2020). Firstly, STEM literacy and business education experts will be invited to review the research and findings. Additionally, the researcher plans to invite some participants to review the final report and provide feedback on the findings.

4.2 Study 2: BSSLS and Final-year Business Students' STEM Literacy

4.2.1 Sampling and Participants Recruitment

Study 2 will adopt stratified sampling. Sampling should meet the following conditions for typicality and representation: (a) the participants should be final-year business students; (b) balancing the proportion of male and female participants; and (c) conducting the sampling in business schools of different levels. Thus, 200 final-year business students from mainland China and Hong Kong will be recruited for the pilot test. In the following validation test, Study 2 plans to employ another 300 final-year business students.

4.2.2 Data Collection and Analysis

The pilot test aims to refine the initial items proposed for the BSSLS. Approximately 200 and 300 business students (from mainland China and Hong Kong) will be recruited to participate in the pilot test and validation test respectively. At the validation stage, participants will be asked to complete the revised BSSLS. The data collected in the pilot test will be analyzed with descriptive statistical analysis, exploratory factor analysis using principal components analysis with varimax rotation, and principal axis factor analysis. The data collected in the validation test will be analyzed with descriptive statistical analysis and confirmatory factor analysis.

References

Aldiabat, K. M., & Le Navenec, C. L. (2018). Data saturation: The mysterious step in grounded theory methodology. *The Qualitative Report, 23*(1), 245–261.

Bunch, K. J. (2020). State of undergraduate business education: A perfect storm or climate change?. *Academy of Management Learning & Education, 19*(1), 81–98.

Chai, C. S., Jong, M. S. Y., & Yan, Z. M. (2020). Surveying Chinese teachers' technological pedagogical STEM knowledge: A pilot validation of STEM-TPACK survey. *International Journal of Mobile Learning & Organisation, 11*(2), 203–214.

Charmaz, K., & Belgrave, L. (2012). Qualitative interviewing and grounded theory analysis. In J. F. Gubrium, J.s A. Holstein, A. B. Marvasti, & K. D. McKinney (Eds.), *The SAGE handbook of interview research: The complexity of* the craft (2nd Ed.) (pp. 347–365). Sage.

Corbin, J. M., & Strauss, A. (1990). Grounded theory research: Procedures, canons, and evaluative criteria. *Qualitative Sociology, 13*(1), 3–21.

Creswell, J. W., & Báez, J. C. (2020). *30 essential skills for the qualitative researcher.* Sage.

CUHK. (2023). *CUHK x CUHK(Shenzhen) Interdisciplinary Data Analytics + X Double Major Programme*. Retrieved June 6, 2023, from: https://admission.cuhk.edu.hk/dmp/tc/

Fedyk, T., Singer, Z., & Soliman, M. (2017). The sharpest tool in the shed: IPO financial statement management of STEM vs. non-STEM firms. *Review of Accounting Studies, 22*, 1541–1581.

Glaser, B. G., Strauss, A. L., & Strutzel, E. (1968). The discovery of grounded theory; strategies for qualitative research. *Nursing research, 17*(4), 364.

Hallioui, A., Herrou, B., Santos, R. S., Katina, P. F., & Egbue, O. (2022). Systems-based approach to contemporary business management: An enabler of business sustainability in a context of industry 4.0, circular economy, competitiveness and diverse stakeholders. *Journal of Cleaner Production*, 133819.

Huang, B., & Jong, M. S. Y. (2020). Developing a generic rubric for evaluating students' works in STEM Education. *Proceedings of the 6th International Symposium on Educational Technology (ISET 2020)* (pp. 210–213). IEEE.

Huang, B., Jong, M. S. Y., King, R. B., Chai, C. S., & Jiang, M. Y. C. (2022). Promoting secondary students' twenty-first century skills and STEM career interests through a crossover program of STEM and community service education. *Frontiers in Psychology, 13*, 903252.

Jackson, C. D., & Mohr-Schroeder, M. J. (2018). Increasing STEM literacy via an informal learning environment. *Journal of STEM Teacher Education, 53*(1), 43–52.

Jong, M. S. Y., Song, Y., Soloway, E., & Norris, C. (2021). Teacher professional development in STEM education. *Educational Technology & Society, 24*(4), 81–85.

Kayan-Fadlelmula, F., Sellami, A., Abdelkader, N., & Umer, S. (2022). A systematic review of STEM education research in the GCC countries: Trends, gaps and barriers. *International Journal of STEM Education, 9*(1), 1–24.

Lau, W. W., & Jong, M. S. (2022). Typology of teachers' stages of concern for STEM education. *Research in Science & Technological Education*, 1-19.

Mohr-Schroeder, M., Bush, S. B., Maiorca, C., & Nickels, M. (2020). Moving toward an equity-based approach for STEM literacy. In C. Johnson, M. J. Mohr-Schroeder, T. Moore, & L. English (Eds.), *Handbook of research on STEM education,* (pp. 29–38). Routledge.

Mohr-Schroeder, M., Cavalcanti, M., & Blyman, K. (2015). STEM education: understanding the changing landscape. In A. Sahin (Ed.), *A practice-based model of STEM teaching* (pp. 3–14). Brill.

National Research Council. (2014). *STEM integration in K-12 education: Status, prospects, and an agenda for research.* National Academies Press.

Podobnik, B., Dabić, M., Wild, D., & Di Matteo, T. (2023). The impact of STEM on the growth of wealth at varying scales, ranging from individuals to firms and countries: The performance of STEM firms during the pandemic across different markets. *Technology in Society, 72*, 102148.

Ransbotham, S., Kiron, D., Gerbert, P., & Reeves, M. (2017). Reshaping business with artificial intelligence: Closing the gap between ambition and action. *MIT Sloan Management Review*. https://sloanreview.mit.edu/projects/reshaping-business-with-artificial-intelligence/

Sollosy, M., & McInerney, M. (2022). Artificial intelligence and business education: What should be taught. *The International Journal of Management Education, 20*(3), 100720.

Tang, K. S., & Williams, P. J. (2019). STEM literacy or literacies? Examining the empirical basis of these constructs. *Review of Education, 7*(3), 675–697.

Zollman, A. (2012). Learning for STEM literacy: STEM literacy for learning. *School Science and Mathematics, 112*(1), 12–19.