*Journal of Innovations and Sustainability*
*ISSN 2367-8151*
*2022, Vol. 6, No. 1*
https://is-journal.com

# COMPETENCY MODEL FOR TECHNICAL EDUCATION: A METHODOLOGICAL REVIEW

**Sunday Rufus Olojuolawe**
*Bamidele Olumilua University of Education, Science and Technology, Nigeria*
*ORCID: https://orcid.org/0000-0002-2675-2281*

**Kehinde Elizabeth Adelowo**
*Bamidele Olumilua University of Education, Science and Technology, Nigeria*
*ORCID: https://orcid.org/0000-0001-7125-0646*

**Olojuolawe, R. S., & Adelowo, K. E. (2022). Competency model for technical education: a methodological review. *Journal of Innovations and Sustainability*, 6(1), 06. https://doi.org/10.51599/is.2022.06.01.06.**

**Purpose.** The place of research in the educational development of any nation cannot be downplayed. The adoption of a methodological approach is significant in achieving valid results and sustainability. However, there does not appear to be an agreement on the methodological approach to developing a competency model for research in technical and vocational education among researchers. This study was designed to analyze the different methods used by researchers to bring out their strengths towards ensuring the adoption of a uniform methodology.
**Results.** Findings show that there was no consistent and uniform technique for researching competency models in technical education. The outcome of this study has shown that researchers favour the use of qualitative and quantitative methods separately. This may be due to the ease and their convenience usage in terms of energy, time and resources.
**Scientific novelty.** The listing and review of current articles from 2018 to 2021 in the domain of competency in technical education is novel as it shows the strengths and weaknesses in the usage of different methods by researchers. Similarly, the result shows the rate of research outcomes on a regional basis and document types.
**Practical value.** The study is going to change the horizon and focus of researchers toward the adoption of the mixed-method research design in the 21st century because of its immense benefits in generating valid research results. The study was able to reveal that the source of data in mixed-method design is always acceptable to experts and the results of the findings can be generalized.
**Key words:** technical education, competency, model, methodology, review.

**Introduction.** The role of Technical Vocational Education and Training cannot be over-emphasized, for any developed and developing country. Technical and Vocational Education and Training (TVET) has been an integral part of national economic empowerment and Development (NEED) in industrialized societies (Mikailu, 2011). Vocational education strives to improve an individual's capacities in terms of knowledge, skills, and understanding so that he may effectively carry out activities in his chosen profession. According to Magaji (2015), vocational education is designed to build skills, abilities, understanding, attitudes, work habits, and appreciation, as well as the knowledge and information needed for workers to enter and progress in useful and productive employment. The application of applicable methodologies in research is critical to producing a valid and desirable outcome,

according to Othman et al. (2012). The value of TVET in nation-building is recognized by all nations (Moses, 2016).

Research has it that after graduation, the high rate of youth unemployment in most developing nations of the world is due to the absence of a valid competency model in the tertiary institutions. Saripudin et al. (2020) observe that many Nigerian students are confronted with challenges in their competency development. Skills and competencies are important for technology development, globalization and the need for innovation (Chalkiadaki, 2018). Consequently, a review of the competency model for technical education from 2018 to 2021 is the focus of this study. Fig. 1 shows the search strings.

| |
|---|
| Main search: Competency model |
| Sub search 1: Competency Model + Vocational and Technical Education |
| Sub search 2: Competency Model + Technical Education |

**Fig. 1. Search Strings**

*Source:* built by the authors.

**Review of literature.** Wahba (2010) opines that one of the most important and significant developments in TVET was the development of Competence-Based Standards to support the design of training programmes and curricula. The move toward competency-based standards started in the mid-1970s and represents a response to criticisms that education and training programmes were failing to meet the practical requirements of employment. In many occupational areas, employers found that newly qualified graduates of vocational training programmes were not capable of meeting the requirements of practice without substantial further education and training. The drive to develop competency-based standards started in mainly manual and craft occupations where the practical requirements of employment were clear to see. Training in these occupational areas was dominated by traditional 'school-based' approaches involving theoretical education combined with practical classes, often performed with out-of-date equipment and methods. The curriculum base of such programmes was clearly out of alignment with the rapidly changing needs of employers. Lai, Hamisu, & Salleh (2019) describes application competency to include staff selection theory and application aim at developing the competencies of the employees. It is the combination of skills and knowledge that helps employees to accomplish their duties effectively and efficiently in the organization by deciding what is right to do (Lai et al., 2019).

**Materials and methods.** This study was designed to analyze the different methods used by researchers to bring out their strengths toward ensuring the adoption of a uniform methodology.

The description of the materials and the methods used for the study is shown in Fig. 1 and the detail is described.

The search framework for the competency model in technical education is shown in Fig. 2.

Based on the search string a total number of 6,690 publications was retrieved from the database. The Google Scholar citation and the Excel package were used to analyze the result of the search to reflect the publications by authors and regions of the world.

This number was reduced by setting the scope for inclusions and exclusions as a criterion for articles to be selected for review.

*Inclusion and Exclusion.* The papers selected from the search engine include (i) Papers published between 2018 and 2021, (ii) Journal on technical education, (iii) Conference studies, and (iv) Papers that discuss the competency model to ensure that the search was restricted to relevant papers. Articles in the press, textbooks and book chapters, and anything not written in English are all excluded. The papers were refined down to 61.

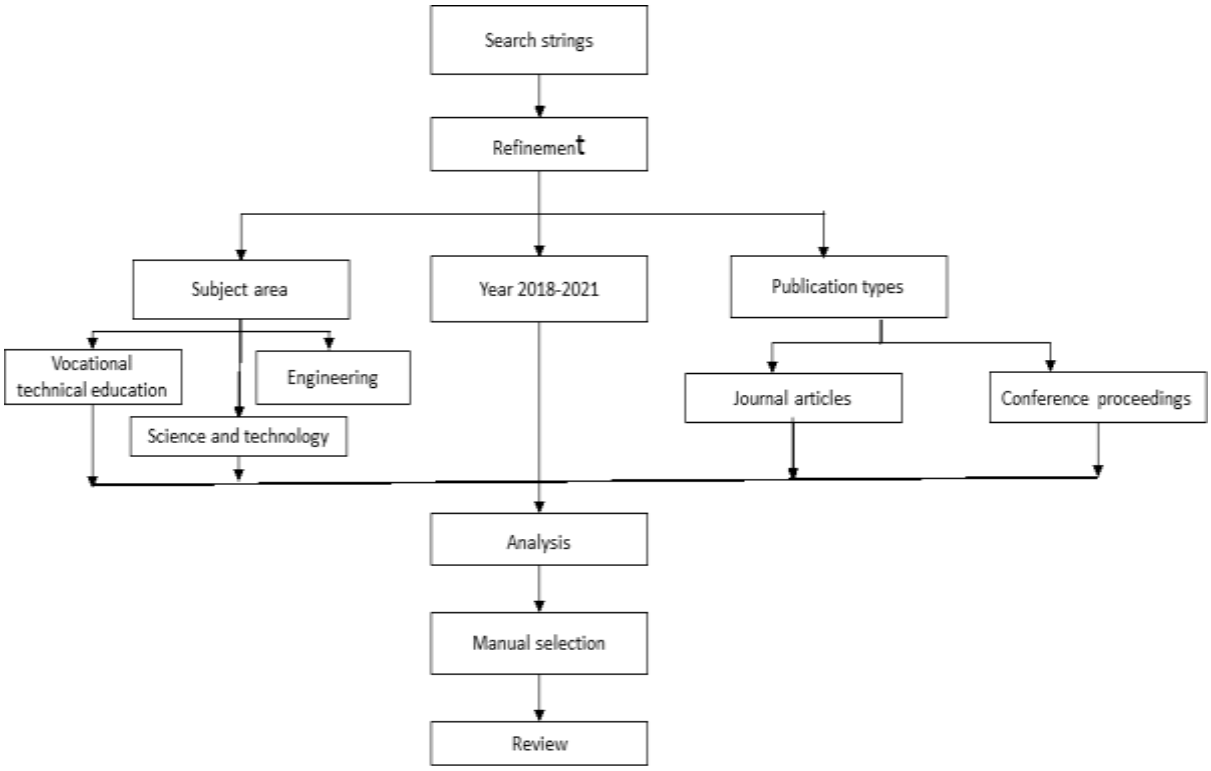


**Fig. 2. Competency Model in Technical Education Search Framework**

*Source:* built by the authors.

The manual selection and inclusion of the filtered literature were based on the relevance of the abstracts to the topic. This was accomplished by conducting a critical review of the literature. For the entire study, a total of 45 papers were available. The meta-analysis in Table 2 describes the data of the principal author and publication year, type of document, regions of publication the method used for analysis and the region of publication.

*Analysis and Findings.* The analysis of the review was based on the generation of charts that shows a pictorial representation of the results of the study. Emphasis was placed on the region of publication, type of document, and the method used by each researcher for conducting the study on the competency model for technical education. Their appropriateness was given careful consideration in the current study.

**Results and discussion.** The results showed that retrievals were mainly from two main sources. These are conference papers and journal articles. The distribution shows that 20 percent of the articles retrieved are conference papers. While 80 percent are Journal articles. The details analysis of the document type is shown in Fig. 3.

*Table 2*

**Meta-Analysis**

| No | Author/year | Type of publication | Name of Journal | Methodology | Region |
|---|---|---|---|---|---|
| 1 | (Il'yaschenko et al., 2018) | Journal | International Journal of Mechanical Engineering and Technology | Experimental / Internship | Europe/ Russia |
| 2 | (Khan, Khan, Tan & Loon, 2021) | Proceedings | Journal of Physics | Mixed methods | Asia |
| 3 | (Lai et al., 2019) | Journal | Journal of Technical Education and Training | Quantitative | Europe |
| 4 | (Jerman et al., 2020) | Journal | Organizacija | Qualitative | Europe |
| 5 | (Staškeviča, 2019) | Journal | Acta Oeconomica Pragensia | Qualitative | Europe |
| 6 | (Supermane, 2018) | Journal | International Information Institute | Quantitative | Asia |
| 7 | (Tepavicharova, Dikova & Zahars, 2019) | Proceedings | IVth International Innovative Mining Symposium | Mixed method | Europe |
| 8 | (Yao, 2018) | Proceedings | 2018 International Conference on Educational Research, Economics, Management and Social Sciences | Mixed method | Asia |
| 9 | (Osadchiy & Serezhkina, 2021) | Proceedings | Eighteenth International Scientific and Technical Conference "Optical Technologies for Communications" | Qualitative | Europe |
| 10 | (Lloyd-Jones, 2021) | Proceedings | 2021 ASEE Annual Conference | Qualitative | USA |
| 11 | (Abdurrahman, Widjanarko & Moeryanto, 2019) | Proceedings | Journal of Physics: Conference Series | Quantitative | Asia |
| 12 | (Khuzainey, Zulkifli, Sattar Rasul & Pang, 2020) | Journal | Journal of Technical Education and Training | Quantitative | Europe |
| 13 | (Nurtanto, Sofyan, Pardjono & Suyitno, 2020) | Journal | International Journal of Evaluation and Research in Education | Quantitative | Asia |
| 14 | (Abdullah, Hoque, Ramlan & Shafee, 2019) | Journal | SAGE Open | Quantitative | Asia |
| 15 | (Mohamad et al., 2019) | Journal | Journal of Technical Education and Training | Quantitative | Europe |
| 16 | (Jerman et al., 2020) | Journal | Organizacija | Qualitative | Europe |
| 17 | (Romero-Jeldres & Faouzi-Nadim, 2020) | Journal | Magis | Quantitative | Europe |

*Continuation of Table 2*

| | | | | | |
|---|---|---|---|---|---|
| 18 | (Lam & Hassan, 2018) | Journal | International Journal of Academic Research in Business and Social Sciences | Qualitative | Asia |
| 19 | (Arifin et al., 2018) | Journal | International Journal of Academic Research in Business and Social Sciences | Qualitative | Asia |
| 20 | (Nurtanto et al., 2020) | Journal | Journal of Technical Education and Training | Quantitative | Europe |
| 21 | (Kateryna et al., 2020) | Journal | International Journal of Learning, Teaching and Educational Research | Qualitative | Africa |
| 22 | (Jayalath & Esichaikul, 2020) | Journal | Technology, Knowledge and Learning | Qualitative | USA |
| 23 | (Ahmed & Sayed, 2021) | Journal | The Journal of Competency-Based Education | Other | USA |
| 24 | (Osman, Kob & Abdullah, 2019) | Journal | International Journal of Academic Research in Business and Social Sciences | Qualitative | Asia |
| 25 | (Zarrouk, 2021) | Journal | International Journal of research in Educational Sciences | Qualitative | Africa |
| 26 | (Pittich, Tenberg & Lensing, 2020) | Journal | European Journal of Engineering Education | Qualitative | Europe |
| 27 | (Remington, 2018) | Journal | Journal of Vocational Education and Training | Qualitative | Europe |
| 28 | (A Aziz, Ahmad & Mat Nashir, 2019) | Journal | Jurnal Pendidikan Sains Dan Matematik Malaysia | Quantitative | Asia |
| 29 | (Ismail et al., 2019) | Journal | Journal of Engineering Science and Technology | Quantitative | Asia |
| 30 | (Salleh & Sulaiman, 2015) | Journal | Asian Social Science | Qualitative | Asia |
| 31 | (Kyoung-Joo & Eun-Young, 2018) | Journal | Journal of Technology Management and Innovation | Qualitative | USA |
| 32 | (Nurtanto, Sofyan et al., 2020) | Journal | International Journal of Evaluation and Research in Education | Quantitative | Asia |
| 33 | (Lai et al., 2019) | Journal | Journal of Technical Education and Training | Quantitative | Europe |
| 34 | (Abdurrahman et al., 2019) | Proceedings | Journal of Physics: Conference Series | Quantitative | Europe |
| 35 | (Khan et al., 2021) | Proceedings | Journal of Physics: Conference Series | Quantitative | Europe |

*Continuation of Table 2*

| | | | | | |
|---|---|---|---|---|---|
| 36 | (Romero-Jeldres & Faouzi-Nadim, 2020) | Journal | Magis | Quantitative | Europe |
| 37 | (Vogel et al., 2021) | Journal | Journal of Culinary Science and Technology | Quantitative | USA |
| 38 | (Pittich et al., 2020) | Journal | European Journal of Engineering Education | Qualitative | Europe |
| 39 | (Mohamad et al., 2019) | Journal | Journal of Technical Education and Training | Quantitative | Europe |
| 40 | (Arifin et al., 2018) | Journal | International Journal of Academic Research in Business and Social Sciences | Qualitative | Asia |
| 41 | (Jayalath & Esichaikul, 2020) | Journal | Technology, Knowledge and Learning | Qualitative | USA |
| 42 | (Olojuolawe et al., 2020) | Proceedings | TVET Towards Industrial Revolution 4.0 | Qualitative | Asia |
| 43 | (Fraser et al., 2019) | Journal | Journal of Teaching and Learning for Graduate Employability | Qualitative | Asia |
| 44 | (Saripudin et al., 2020) | Journal | International Journal of Innovative Technology and Exploring Engineering | Quantitative | Asia |
| 45 | (Olojuolawe et al., 2019) | Journal | International Journal of Entrepreneurial Research | Qualitative | Asia |

*Source:* compiled by the authors.

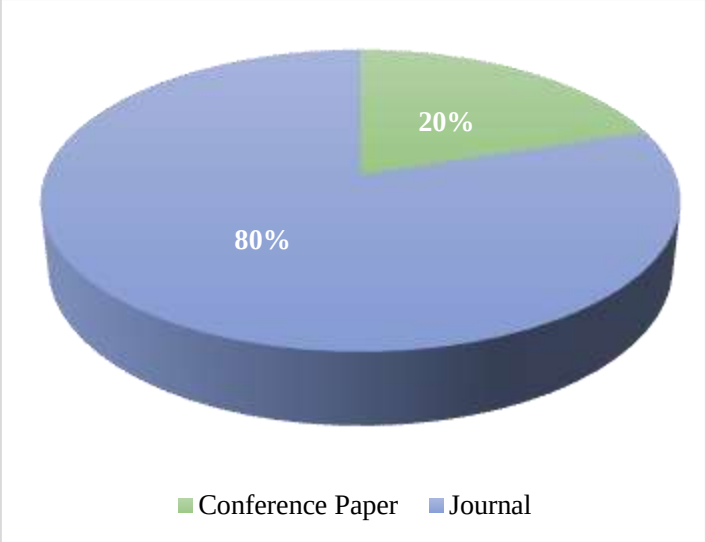


**Fig. 3. Distribution of Publication by Document Type**

*Source:* built by the authors.

Findings show that retrievals were from four continents of the world. The continents are Africa, Asia, the United State of America (USA) and Europe. The highest retrieval was from Europe and Asia respectively. This was followed by the

USA and the African continent occupying the least position as shown in Fig. 4.

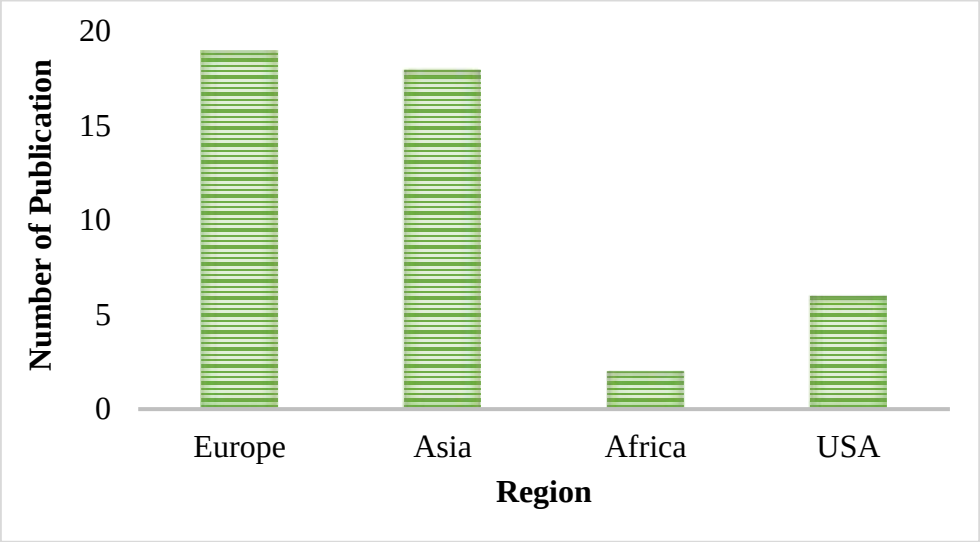


**Fig. 4. Regional Distribution of Publication**

*Source:* built by the authors.

Similarly, the findings for the methodology indicated that researchers employed the use of 4 methods in conducting their research. The quantitative and qualitative studies gained higher prominence among researchers with a percentage value of 42 % and 47 % respectively. The mixed-method has a value of 7 %. While others such as review recorded 4 %. This is shown in Fig. 5.

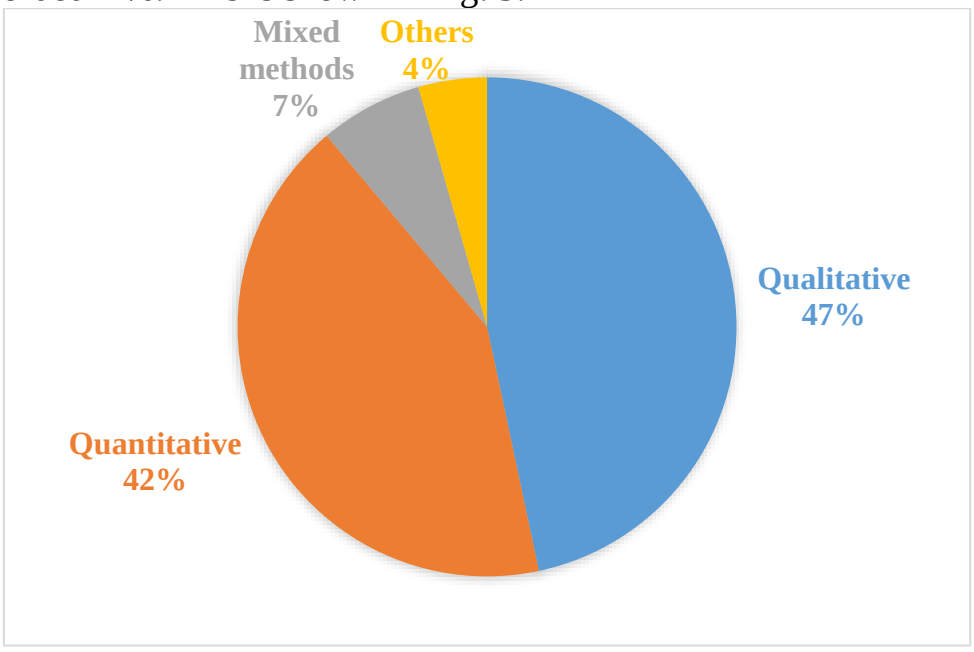


**Fig. 5. Findings for Methodology**

*Source:* built by the authors.

Findings revealed that 80 % of the articles reviewed on the competency model for technical education occurred in Journal articles. While 20 % came out in conference proceedings. Similarly, the majority of the publications occurred in the Asian and European continents with Africa recording the least publications. This may account to some extent the reason for the level of our education and the economic backwardness

of the region among the committee of nations. Research pointed to various factors responsible for the high rate of youth unemployment in Africa and Nigeria in particular (Deba, 2014; Ismail & Mohammed, 2015; Organisation for Economic Co-operation and Development (OECD), 2018). A variant of methods was used for the design and the development of the models by the different researchers and authors. While the outcomes of each study cannot be disputed, the streamlining of the methodologies will help to achieve depth and more valid outcomes (Creswell, 2013; Ivankova, 2014; Johnson & Onwuegbuzie, 2016). The combined strengths of the qualitative and quantitative research methods will provide an enhanced research result (Bentahar & Cameron, 2015; Creswell, 2014). The 7 % recorded in mixed-method seemed to be abysmally low and negates the desire of experts (Creswell John., 2014; Morgan, 2017). Therefore, with a quantitative strength of 42 % and a qualitative strength of 47 % combined, a research design employing a mixed method is recommended for future study in competency model development in vocational and technical education. This permits room for better generalization of results. Though, there exists a variation in teacher level of competency (Goh et al., 2017). The adoption of a unique and standardized method for conducting competency research in technical education will be vital for strengthening methodological and research outcomes.

**Conclusions.** The results of the study show that there was no consistent and uniform technique for researching competency models in technical education. The review of current articles in the domain of competency in technical education is novel as it shows the strengths and weaknesses in the usage of different methods by researchers. Similarly, the result shows the rate of research outcomes on a regional basis and document types. Based on the analysis, the following should be noted:

- The outcome of this study has shown that researchers favour the use of qualitative and quantitative methods separately.
- This may be due to the ease and their convenience usage in terms of energy, time and resources.
- However, the combination of the two methods will evolve a more valid research study whose source of data can be proven and the results generalized.
- The studies have exposed the near dearth of mixed-method in conducting research especially, competency-related studies in technical education.
- Therefore, for 21st century research, the mixed-method research is recommended for conducting competency studies in technical and vocational education to achieve uniformity and sustainability of approach and method.
- Future research should focus on the discipline approach.

**References**

1. A Aziz, N. F., Ahmad, H., & Mat Nashir, I. (2019). Validation of technical and vocational teachers' competency evaluation instrument using the Rasch model. *Jurnal Pendidikan Sains Dan Matematik Malaysia*, 9(1), 18–25. https://doi.org/10.37134/jpsmm.vol9.1.3.2019.

2. Abdullah, Z., Hoque, K. E., Ramlan, N. H., & Shafee, S. (2019). Designing the

Structural Model of TVET Lecturers' Professionalism and Generic Skills Based on an Empirical Study in Malaysia. *SAGE Open,* July-September, 1–18. https://doi.org/10.1177/2158244019861456.

3. Abdurrahman, Widjanarko, D., & Moeryanto. (2019). Implementation of automotive skill competency test through "discontinued" model on vocational school students in Semarang. *Journal of Physics: Conference Series*, 1321(3), 032135. https://doi.org/10.1088/1742-6596/1321/3/032135.

4. Adewumi, M., G., Olojuolawe, S. R., Bakare, S. F., Akegbejo, D. A. & Ojo, S. A. (2017). Promoting graduate employability through information and communication technology (ICT) For 21-st Century Jobs. *Journal of Multidisciplinary Engineering Science and Technology*, 4(10), 8427–8432. Available at: http://www.jmest.org/wp-content/uploads/JMESTN42352444.pdf.

5. Ahmed, A., & Sayed, K. (2021). An extensive model for implementing competency-based training in technical and vocational education and training teacher training system for Assiut-Integrated Technical Education Cluster, Egypt. *The Journal of Competency-Based Education*, 6(2), e01245. https://doi.org/10.1002/cbe2.1245.

6. Andriushchenko, K., Rozhko, O., Tepliuk, M., Semenyshyna, I., Kartashov, E. & Liezina, A. (2020). Digital literacy development trends in the professional environment. *International Journal of Learning, Teaching and Educational Research*. https://doi.org/10.26803/ijlter.19.7.4

7. Arifin, M. A., Rasdi, R. M., Anuar, M. A. M., & Omar, M. K. (2018). Competencies of Vocational Teacher: A Personnel Measurement Framework. *International Journal of Academic Research in Business and Social Sciences*, 7(4)б 147–164. https://doi.org/10.6007/ijarbss/v7-i14/3659.

8. Bentahar, O., & Cameron, R. (2015). Design and implementation of a mixed-method research study in project management. *Electronic Journal of Business Research Methods*, 13(1), 3–15. Available at: https://academic-publishing.org/index.php/ejbrm/article/view/1326.

9. Chalkiadaki, A. (2018). A Systematic Literature Review of 21st Century Skills and Competencies in Primary Education. *International Journal of Instruction*, 11(3), 1–16. https://doi.org/10.12973/iji.2018.1131a.

10. Creswell, J. W. (2013). *Research Design: Qualitative, Quantitative and Mixed Methods Approaches* (Fourth). London, UK.

11. Creswell, J. W. (2014). *Research Design Qualitative, Quantitative and Mixed Methods Approaches*, 4th ed. (K. Vicki Ed.). London, UK., SAGE Publications, Inc.

12. Deba, A. A., Deba, A. A., Mallanti, A., Khata, M. J., & Habibu, A. M. (2014). Enhancing entrepreneurial skills of undergraduate science, vocational and technical education students through entrepreneurship education. *Journal of Technical Education and Training*, 6(2), 38–55.

13. Fraser, C. J., Duignan, G., Stewart, D., & Rodrigues, A. (2019). Overt and covert: successful strategies for building employability skills of vocational education graduates. *Journal of Teaching and Learning for Graduate Employability*, 10(1), 157.

https://doi.org/10.21153/jtlge2019vol10no1art782.

14. Goh, P. S. C., Yusuf, Q., & Wong, K. T. (2017). Lived experience: perceptions of competency of novice teachers. *International Journal of Instruction*, 10(1), 20–36. https://doi.org/10.12973/iji.2017.1012a.

15. Il'yaschenko, D. P., Kievskaya, E. I., Ling, V. V., Gaibova, T. V., Kiyamova, A. G., & Mironova, A. A. (2018). The optimization of the competency model of bachelors of engineering specialties. *International Journal of Mechanical Engineering and Technology*, 9(9), 1085–1093. Available at: http://www.iaeme.com/IJMET/issues.asp?JType=IJMET&VType=9&IType=8.

16. Ismail, K., Nopiah, Z. M., Rasul, M. S., & Leong, P. C. (2019). Development of competency items for vocational teachers using Rasch model analysis. *Journal of Engineering Science and Technology*, spec. is. on ICEES2018, 51–58. Available at: https://jestec.taylors.edu.my/Special%20issue%20on%20ICEES2018/ICEES2018_07.pdf.

17. Ismail, S., & Mohammed, D. S. (2015). Employability Skills in TVET Curriculum in Nigeria Federal Universities of Technology. *Procedia – Social and Behavioral Sciences*, 204, 73–80. https://doi.org/10.1016/j.sbspro.2015.08.111.

18. Ivankova, N. V. (2014). Implementing quality criteria in designing and conducting a sequential quan → qual mixed methods study of student engagement with learning applied research methods online. *Journal of Mixed Methods Research*, 8(1), 25–51. https://doi.org/10.1177/1558689813487945.

19. Jayalath, J., & Esichaikul, V. (2020). Gamification to enhance motivation and engagement in blended e-learning for technical and vocational education and training. *Technology, Knowledge and Learning*, 27, 91–118. https://doi.org/10.1007/s10758-020-09466-2.

20. Jerman, A., Bertoncelj, A., Dominici, G., Pejić Bach, M., & Trnavčević, A. (2020). Conceptual key competency model for smart factories in production processes. *Organizacija*, 53, 68–79. https://doi.org/10.2478/orga-2020-0005.

21. Johnson, R. B., & Onwuegbuzie, A. J. (2016). Mixed methods research: a research paradigm whose time has come. *Educational Researcher*, 33(7), 14–26. https://doi.org/10.3102/0013189X033007014.

22. Khan, N., Khan, S., Tan, B. C., & Loon, C. H. (2021). Driving digital competency model towards IR 4.0 in Malaysia. *Journal of Physics: Conference Series*, 1793(1), 0–10. https://doi.org/10.1088/1742-6596/1793/1/012049.

23. Khuzainey, I., Zulkifli, M. N., Sattar Rasul, M., & Pang, C. L. (2020). Technical competency among vocational teachers in Malaysian public skills training institutions: Measurement model validation using PLS-SEM. *Journal of Technical Education and Training*, 12(1), 163–175. https://doi.org/10.30880/jtet.2020.12.01.017.

24. Kyoung-Joo, L., & Eun-Young, K. (2018). A leadership competency model of science and technology parks: the case of Chungbuk technopark in Korea. *Journal of Technology Management and Innovation*, 13(4). https://doi.org/10.4067/S0718-

27242018000400105.

25. Lai, C. S., Hamisu, M. A., & Salleh, K. M. (2019). Development of competency framework for Nigerian TVET teachers in tertiary TVET institutions. *Journal of Technical Education and Training,* 11(1), 011–018. https://doi.org/10.30880/jtet.2019.11.01.002.

26. Lam, K. W., & Hassan, A. (2018). Instructional technology competencies perceived by technical and vocational education and training (TVET) students in Malaysia. *International Journal of Academic Research in Business and Social Sciences*, 8(5), 339–362. https://doi.org/10.6007/ijarbss/v8-i5/4107.

27. Lloyd-Jones, B. (2021). Developing competencies for emotional, instrumental, and informational student support during the COVID-19 pandemic: a human relations/human resource development approach. *Advances in Developing Human Resources,* 23(1), 41–54. https://doi.org/10.1177/1523422320973287.

28. Mohamad, M. M., Yee, M. H., Tee, T. K., Ibrahim Mukhtar, M., & Ahmad, A. (2019). Teachers' pedagogical reasoning and action in technical and vocational education. *Journal of Technical Education and Training*, 11(3), 015–021. https://doi.org/10.30880/jtet.2019.11.03.003.

30. Morgan, D. L. (2017). Mixed methods research. *The Cambridge Handbook of Sociology*, 1, 153–161. https://doi.org/10.1017/9781316418376.015.

31. Moses, K. M. (2016). Improving the quality and competence of technical vocational education and training output through vocational school cooperation with industry: A case study of Uganda. *AIP Conference Proceedings* 1778, 030060. https://doi.org/10.1063/1.4965794.

32. Nurtanto, M., Arifin, Z., Sofyan, H., Warju, W., & Nurhaji, S. (2020). Development of a model for professional competency assessment (PCA) in vocational education: a study of the engine tune-up injection system assessment scheme. *Journal of Technical Education and Training*. https://doi.org/10.30880/jtet.2020.12.02.004.

33. Nurtanto, M., Sofyan, H., Pardjono, P., & Suyitno, S. (2020). The development model for competency improvement and national vocational qualification support frames in automotive technology. *International Journal of Evaluation and Research in Education*, 9(1), 168–176. https://doi.org/10.11591/ijere.v9i1.20447.

34. Olojuolawe, R. S., Amin, N. F., Abdul Latif, A., & Arsat, M. (2020). Employability skills of higher education graduates: a review and integrative approach. In *TVET Towards Industrial Revolution 4.0,* 1st ed. (pp. 113–120). Routledge.

35. Olojuolawe, S. R., Fadila, N. B. M. A., & Abdul Latif, A. (2019). Soft skills needed by electrical technology students for 21st-century jobs. *International Journal of Entrepreneurial Research*, 2(3), 14–21. https://doi.org/10.31580/ijer.v2i3.903.

36. Organization for Economic Co-operation and Development (OECD) (2018). The future of education and skills: education 2030. *OECD Education Working Papers*, 23. Available at: http://www.oecd.org/education/2030/E2030.

37. Osadchiy, I. S., & Serezhkina, A. E. (2021). Competency model of an optical communication systems engineer. *Optical Technologies for Telecommunications*,

11793. https://doi.org/10.1117/12.2592022.

38. Osman, M. Z., Kob, C. G. C., & Abdullah, S. S. S. (2019). Competency of teachers in teaching practical implementation of subject furniture manufacturing for Malaysian skills certification program. *International Journal of Academic Research in Business and Social Sciences*, 9(5), 78–89. https://doi.org/10.6007/ijarbss/v9-i5/5841.

39. Pittich, D., Tenberg, R., & Lensing, K. (2020). Learning factories for complex competence acquisition. *European Journal of Engineering Education*, 45(2), 196–213. https://doi.org/10.1080/03043797.2019.1567691.

40. Remington, T. F. (2018). Public-private partnerships in TVET: adapting the dual system in the United States. *Journal of Vocational Education and Training*, 70(4), 497–523. https://doi.org/10.1080/13636820.2018.1450776.

41. Romero-Jeldres, M. R., & Faouzi-Nadim, T. (2020). Structural model of didactic professional competency for non-educator technician-teachers. *Magis*, 13, 1–22. https://doi.org/10.11144/JAVERIANA.M13.MECP.

42. Salleh, K. M., & Sulaiman, N. L. (2015). Technical skills evaluation based on competency model for human resources development in technical and vocational education. *Asian Social Science*, 11(16), 74–79. https://doi.org/10.5539/ass.v11n16p74.

43. Saripudin, S., Juanda, E. A., Abdullah, A. G., & Ana, A. (2020). Integration of ICT Skill Among Vocational School Teachers: A case in West Java, Indonesia. *International Journal of Innovative Technology and Exploring Engineering*, 9(5), 251–260. https://doi.org/10.35940/ijitee.b7281.039520.

44. Staškeviča, A. (2019). The importance of competency model development. *Acta Oeconomica Pragensia*, 27(2), 62–71. https://doi.org/10.18267/j.aop.622.

45. Supermane, S., Tahir, L. M., Ahmad, J., Ali, M. F. & Udin, A. (2018). The development of knowledge management. *International Journal on Information*, 21(3), 895–906. Available at: https://www.researchgate.net/publication/326987977_The_Development_of_Knowledge_Management_Competency_Model.

46. Tepavicharova, M., Dikova, L., & Zahars, V. (2019). Development of a competency model for selection of human resources in the mining and quarrying sector in Bulgaria. *E3S Web of Conferences*, *105*. https://doi.org/10.1051/e3sconf/201910504029.

47. Vogel, D., Sohn, A. P., & Gomes, K. (2021). Analysis of competencies models in culinary arts higher education. *Journal of Culinary Science and Technology*, 19(2), 171–186. https://doi.org/10.1080/15428052.2020.1738299.

48. Wahba, E. M. (2010). Competency standards for technical and vocational education and training TVET, 1–23. Available at: http://www.unevoc.unesco.org/e-forum/CompetenceStandardsforTVET.pdf.

49. Yao, C. (2018). Research on competency model of cross-border e-commerce professional talents, (Erems). *2018 International Conference on Educational Research, Economics, Management and Social Sciences* (pp. 187–190).

https://doi.org/10.25236/erems.2018.043.

50. Zarrouk, S. M. (2021). Design and use a proposed training model in acquiring the technical technological competencies of the applied project and its impact on developing the productive achievement motivation and achieving the perceived self-efficiencies for students of the industry. *International Journal of Research in Educational Sciences*, 4(1), 378–386. https://doi.org/10.29009/ijres.4.1.10.