International Journal of Education and Literature (IJEL)
Amik Veteran Porwokerto
https://ijel.amikveteran.ac.id/index.php/ijel/index
E- ISSN : 2829-6249
P -ISSN : 2829-6656

Systematic Literature Review: TPACK-Integrated Design Thinking in Education

Abdul Rahman[1*], Tomi Apra Santosa[2], Aulia Sofianora[3], Flavia Oktavianti[4], Rodhiatul Alawiyah[5], Ringgo Putra[6], Ilwandri[7]
[1] Education Science Lecturer , FKIP, Universitas Sebelas Maret
[2,7] Doctor of Science Education, FMIPA, Universitas Negeri Padang
[3,4,5] Teacher Professional Education, FKIP, Universitas Jambi
[6] Master Islamic Education, FTIK, UIN Imam Bonjol
E-mail: abdul.rahman@staff.uns.ac.id[1]

ARTICLEINFO

Article history:
Received 03 February 2023
Received in revised form 02 March 2023
Accepted 30 April 2023
Available online 02 May 2023

Keywords:
Design Thinking, TPACK, Education, Systematic Literature Review

ABSTRACT

This research aims to analyze design thinking integrated with technological pedagogical content knowledge (TPACK) in ducation. This research is a type of systematic literature review (SLR) research with the PRISMA method. The data sources in the study came from 10 national and international journals published between 2018- 2023 and indexed by SINTA, Scopus, and WOS. The search for data sources comes from Google Scholar, MPDI, ScienceDirect, Wiley, and Eric. The analysis shows that 1) TPACK-integrated design thinking has a positive impact on the learning process, and 2) design thinking integrated with TPACK in education has a variety of forms both in theory and practice. Based on these findings, it can be concluded that the concept of design thinking integrated with TPACK is very necessary to be developed in the education system in Indonesia. Design thinking integrated with TPACK is able to encourage students' critical thinking skills and creativity in learning.

Correspondent authors: Abdul Rahman
Universitas Sebelas Maret
Email: abdul.rahman@staff.uns.ac.id

I. INTRODUCTION

The development of science and technology has a very important impact on the world of education (Aguilera & Revilla, 2021; Suharyat et al., 2023; Fradila et al., 2021). Education is a process to form a more mature and disciplined mind (Zulkifli et al., 2022; Argaw et al., 2017; Elfira et al., 2023; Faiz et al., 2021). The current education process develops the potential of students and teachers to master 21st century learning (Beier et al., 2019; Ashton & Newman, 2019). The 21st century education system focuses on developing the potential of students and teachers in mastering learning technology (Suganda et al., 2021; Razak et al., 2021; Khan et al., 2022;Yusuf et al., 2020; Santosa et al., 2021; Zulyusri el at., 2020). In addition, teachers must be able to develop students' critical, creative, collaborative and communicative thinking skills in learning (Ichsan et al., 2023; Ferdyan et al., 2021). Not only that, education also helps students to form a better character (Wati et al., 2020; Oktarina et al., 2021; Karim et al., 2022; Ichsan , 2023).

Muhafidin, (2022) Education in Indonesia has experienced many problems after the Covid-19 pandemic, especially for its students. Based on the results of PISA 2018, the quality of Indonesian education is still in the low category (Adi et al., 2021 ; Umbara & Suryadi, 2019; Ichsan et al., 2022; Suhaimi et al., 2022). Indonesia's PISA score still far behind Malaysia, Singapore and Thailand (Gill & Berezina, 2020). In addition, students are less active in learning, the learning system is still teacher-centered (Effendi& Mukminin, 2019; Santosa &

Yulianti, 2020). According to (Maulida et al., 2021) Teachers in Indonesia focus more on improving students' cognitive skills so that students' character is lacking. Furthermore, students' critical thinking and problem-solving skills and creativity are still low (Oktiningrum & Hartono, 2016; Mundia, 2010; Beier et al., 2019; Santosa et al., 2021.; Supriyadi et al., 2023).

Design thinking is a learning method that can provide solutions in problem solving (Zebdyah, 2022; Polat & Bayram, 2022; Vallis & Redmond, 2021). Design thinking helps students be more innovative and creative in learning (Gallico, 2021). Design thinking becomes a tool used in problem solving (Syahrul & Palcomtech, 2019; Mohamad & Ahmad, 2022). Furthermore, Design thinking can also encourage students to think critically in solving a problem (Huyen et al., 2021; Pratomo, 2021). According to Studies & Bilgiler (2023) students who have the ability to think critically, actively and easily understand concepts. So, the Design thinking model is very necessary to be applied in learning

TPACK is one of the learning models that can be integrated with Design thinking. TPACK is a science that has to do with the correct application of technology by combining the right knowledge or content (Hayani & Sutama, 2022; Ibrohim et al., 2022 ;Suprapto et al., 2021; Suharyat et al., 2022; Shi & Jiang, 2022). The Technological Pedagogical Content Knowledge (TPACK) approach is very helpful for teachers in improving professionalism in teaching. (Ichsan et al., 2022). In addition, TPACK is able to make the teaching and learning atmosphere more effective and efficient (Schmidt et al., 2009).

Previous research Oxman (2017) explained that Design Thinking encourages students to be more creative in thinking, thus helping students solve problems in learning (Cesar & Russo, 2018) stated that Design Thinking is a method that can provide solutions in problem solving. Research by (Wrigley et al., 2015) stated that Design Thinking has an influence on critical thinking and problem solving skills. In addition, research by (Matthee et al., 2019) stated that the Design Thinking model has a positive influence in improving teachers' skills for critical thinking, problem solving and designing learning concepts. Based on the above problems, this research aims to analyze design thinking integrated with Technological Pedagogical Content Knowledge (TPACK) in Indonesian Education.

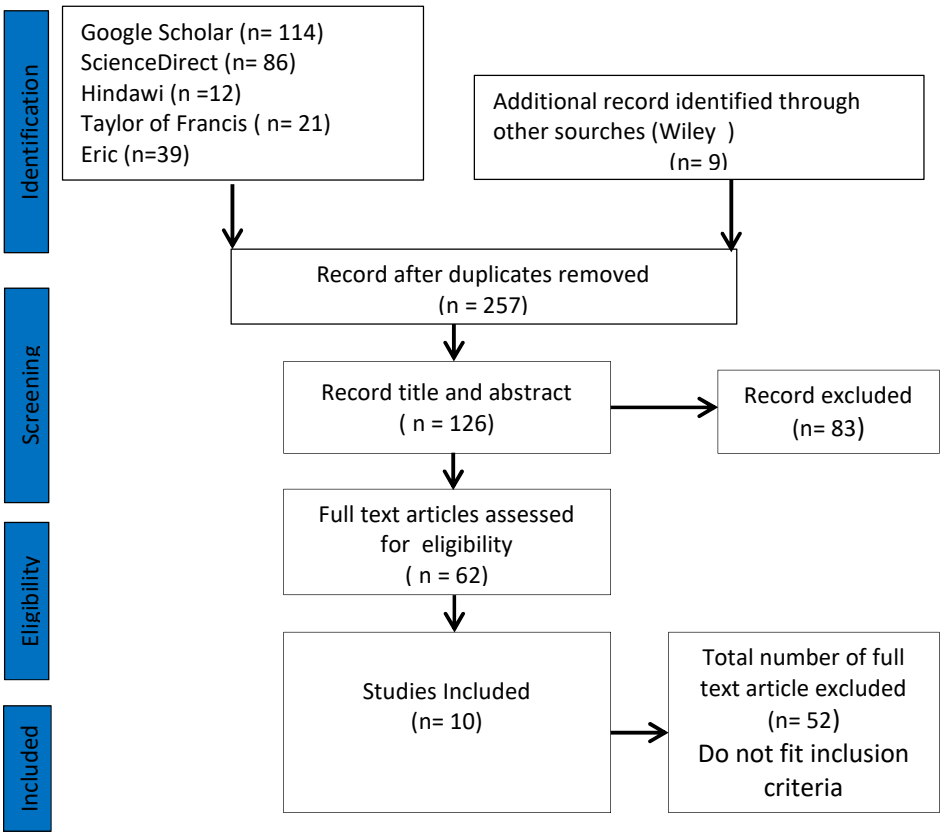
Research Question

1. What Design Thinking model was used in the sample studied?
2. How is TPACK-integrated Design Thinking distributed in terms of countries?
3. How is Design Thinking distributed in terms of research methodology ?
4. How is TPACK-integrated Design Thinking distributed in terms of publication year?

RESEARCH METHODS

This research is a type of Systematic Literature Review (SLR) research. SLR is a research method that is in accordance with certain topics that have met predetermined eligibility criteria. (Deng, 2022; Xiao & Watson, 2019). The data sources in this study came from 10 national and international journals from 257 journals indexed by SINTA, Scopus and Web of Science published in 2018-2023. The process of selecting data sources is the PRISMA method (Figure 1). The PRISMA method consists of four stages, namely identification, screening, eligibility and inclusion. With the PRISMA method, we selected journals related to Design Thinking integrated with TPACK in the Indonesian education system. Furthermore, the inclusion criteria and exclusion

of journals can be seen (table 1.). Search for data sources through google scholar, Hindawi, Sciencedirect, Eric, Taylor of Francis and ProQuest.



Gambar 1. PRISMA Flow Diagram

Tabel 1. Inclusion and Exclusion Criteria

Inclusion Criteria	**Exclusion Criteria**
Journal Publish Year 2018-2023	< 2018
Index Journal	SINTA, Scopus, WOS, Review Jurnal
Indonesian and English	Non- Inggris
Specific to Design Thinking and TPACK	The latest learning model

RESULT AND DISCUSSION

From the analysis of national and international journals (n = 10) published from 2018-2023 on Design Thinking integrated Technological Pedagogical Content Knowledge (TPACK). Analysis based on research questions:

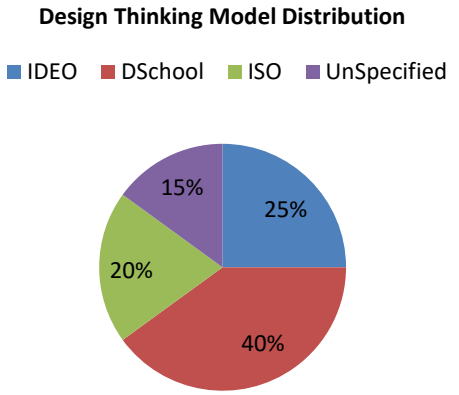


Figure 2: Distribution of Design Thinking Models

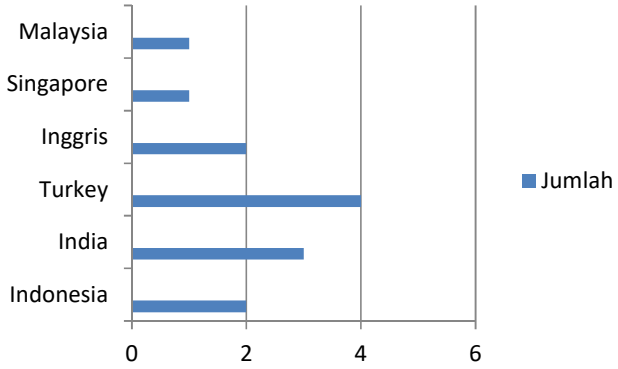


Figure 3: Distribution of Research Studies in terms of Country

What Design Thinking model was used in the sample studied

The first question in the study relates to the Design Thinking models used in education based on the sample studied. The Design Thinking models used, namely IDEO, DSchool, ISO and UpSpecific, can be seen in (Figure 2.). The majority of the Design Thinking models used, namely DSchool (40 % n = 6) (Littlefield & Zimmerman, 2017; Thoring & Müller, 2011; Jobst et al., 2011; Waidelich et al., 2018; Kwon et al., 2021) dan dikuti oleh IDEO (25 % n= 3) (Auernhammer & Roth, 2021; Davis, 2010;Wrigley et al., 2018). In addition, the DSchool Design Thinking model is able to provide such benefits to the teaching and learning process (Melles et al., 2011). In addition, the DSchool Design Thinking model is able to provide such benefits to the teaching and learning process. (Gonen, 2019), so as to be able to create a project (Chou, 2017).

TPACK-integrated Design Thinking is distributed in terms of countries

(The geographical distribution of researchers is the second research subject. (Figure 3.) Describes the distribution of research based on the country where the research was conducted. This shows that most of the research was conducted in Turkey n= 4) (Atun, 2019; Hwee et al., 2015; McCulloch et al., 2017; Chai, 2018). Research conducted in India (n= 3) (Kale et al., 2020; Choi & Young, 2021;Celik, 2023). Furthermore, there are 2 studies conducted in Indonesia (Aulia et al., 2021; Supriyadi et al., 2022) dan Inggris (Schmid et al., 2021; Akyuz, 2018), and 1 study in Malaysia (Hwee et al., 2014) dan Singapura (Santos & Castro, 2021).

Furthermore, TPACK-integrated Design Thinking is less widely discussed by researchers in other countries, e.g. Jordan ((Zebdyah, 2022), Thailand ((Buphate & Esteban, 2022), dan Banglades ((Quintanilla et al., 2022). Therefore, it is necessary to conduct further research on TPACK-integrated Design Thinking in other countries.

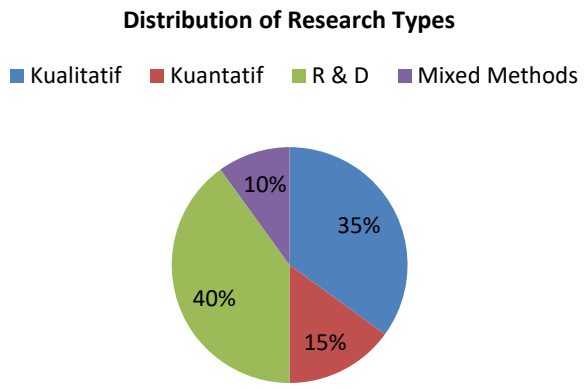


Figure 3. Distribution of Design Thinking by Research Type

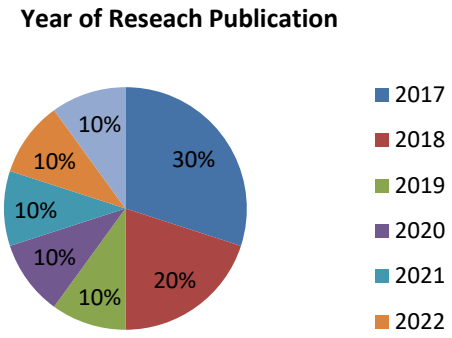


Figure 4. Distribution of Design Thinking by Year of Publication

Distribution of TPACK-Integrated Design Thinking by Research Type

The third question about the distribution of Design Thinking based on the type of research can be seen in (Figure 3.). Based on these findings, there are 4 types of research used in this study, namely qualitative (35 % n= 3) (Huyen & Lam, 2021; Pratomo, 2021; Bene & Mcneilly, 2020), Kuantitatif (15 % n = 2) (Junior et al., 2020; Galoyan et al., 2022), R&D (40 % n= 4)(Rodriguez et al., 2020; Lin, 2021; Meepung & Pratsri,

2022;Boyle et al., 2022) and Mixed methods (10 % n = 1) (hasibuan & Mukminin, 2019). Furthermore, there is a wide range of data collection methods used in the research that shows there are no major errors and the topic is suitable for the research conducted.

Distribution of TPACK-Integrated Design Thinking by Year of Publication

The fourth research question on the distribution of TPACK-integrated Design Thinking by publication year (Figure 4.) describes the most publications on TPACK-integrated design thinking in 2017 (30 % n = 3) (Oxman, 2017;Wrigley et al., 2017;Khan et al., 2017), 2 Design Thinking 2018 publications (20 % n = 2) (Elsbach & Stigliani, 2018; Mcgann et al., 2018) serta tahun 2019- 2023 only 1 publication of TPACK-integrated Design Thinking (Panke, 2019;Gill & Berezina, 2020;Albay & Eisma, 2021;Solodikhina & Solodikhina, 2022;Soysal & Soysal, 2023).

DISCUSSION

Design thinking has a huge impact in encouraging the quality of education. TPACK-integrated Design Thinking has a positive impact on education in various countries (Tramonti & Dochshanov, 2023; Gashoot et al., 2021). Design thinking models that are commonly used are DSchool (40%) and IDEO (15%). This is in line with (Todoroff et al., 2021) stated that the DSchool and IDEO models are able to encourage student creativity in designing something. In addition, the model improves students' critical thinking skills in problem solving. (Buphate & Esteban, 2022; Meepung & Pratsri, 2022;Khan et al., 2022). In addition, Design Thinking integrated with TPACK can motivate students to be more active in learning (Ladachart et al., 2022).

TPACK-integrated Design Thinking learning in the education system will help teachers and students in the learning process. (Ibrohim et al., 2022; Yazlik & Celik, 2022). Design Thinking integrated with TPACK can improve teachers' soft and hard skills in teaching. In the learning process, teachers must be required to be able to provide material and lesson concepts that are easy for students to understand (Santosa et al., 2021; Ferry et al., 2020;Sofianora et al., 2023; Kusuma, 2022). Furthermore, research on TPACK-integrated Design Thinking has been conducted in Turkey (n=4). So, the integrated Design Thinking model is commonly used in Turkish schools.

(Dewi et al., 2021) stated that TPACK encourages students to be more motivated in teaching and learning activities. TPACK-integrated Design Thinking effectively helps students and teachers in designing learning models (Chaidam & Poonputta, 2022; Gustavo et al., 2021). In addition, research on TPACK-integrated Design Thinking is generally R&D research (40 %). According to (Ajloni et al., 2021) TPACK research generally uses the development method. Furthermore, TPACK-integrated Design Thinking is more effective using the R&D research type. The TPACK-integrated Design Thinking model really needs to be implemented in the education system in Indonesia. The Design Thinking model strongly supports students in facing the 21st century(Davis, 2010; Suhaimi et al., 2022).

CONCLUSION

Based on the research above it can be concluded that 1) TPACK-integrated design thinking has a positive impact on the learning process, and 2) design thinking integrated with TPACK in education has a variety of forms both in theory and practice. Based on these findings, it can be concluded that the concept of design thinking integrated with TPACK is very necessary to be developed in the education system in Indonesia. Design thinking integrated with TPACK is able to encourage students' critical thinking skills and creativity in learning.

REFERENCE

Adi, W. C., Saefi, M., Setiawan, M. E., & Sholehah, N. (2021). The Impact of Covid-19 to Biology Teacher Education : Emergency Distance Learning at Islamic Universities in Indonesia. *Journal ofTurkish Science Education*, *23*(10), 60–76.

Aguilera, D., & Ortiz-Revilla, J. (2021). Stem vs. Steam education and student creativity: A systematic literature review. *Education Sciences*, *11*(7). https://doi.org/10.3390/educsci11070331

Ajloni, M., Psych, M. E. D., & Toole, M. O. (2021). *Adopting TPACK to Video Technology in the Context of the Jordanian Education System*. *20*(2), 1–13.

Akyuz, D. (2018). Computers & Education Measuring technological pedagogical content knowledge (TPACK) through performance assessment. *Computers & Education*, *125*(May 2017), 212–225. https://doi.org/10.1016/j.compedu.2018.06.012

Albay, E. M., & Eisma, D. V. (2021). Social Sciences & Humanities Open Performance task assessment supported by the design thinking process : Results from a true experimental research. *Social Sciences & Humanities Open*, *3*(1), 100116. https://doi.org/10.1016/j.ssaho.2021.100116

Al-Dein Al-Zebdyah, S. W. (2022). English Language Teachers' Perceptions about Design Thinking. *Journal of Curriculum and Teaching*, *11*(4), 97–107. https://doi.org/10.5430/jct.v11n4p97

Allison W. McCulloch et a. (2017). DESIGN PRINCIPLES FOR THE DEVELOPMENT OF PROFESSIONAL NOTICING OF STUDENTS' TECHNOLOGICAL MATHEMATICAL PRACTICES. *2018 International Conference on Computing Sciences and Engineering, ICCSE 2018 - Proceedings*, *16*(3), 1–6. https://www.weforum.org/whitepapers/cyber-resilience-in-the-oil-and-gas-industry-playbook-for-boards-and-corporate-officershttps://doi.org/10.1016/j.jnca.2018.04.004http://aisel.aisnet.org/pacis2007/73

Apra, T., 1 , S., Razak, A., Arsih, F., Sepriyani, E. M., & Hernaya, N. (2021). Meta-Analysis: Science Learning Based on Local Wisdom Against Preserving School Environments During the Covid-19 Pandemic. *Journal of Biology Education*, *10*(2), 244–251. http://journal.unnes.ac.id/sju/index.php/ujbe

Argaw, A. S., Haile, B. B., Ayalew, B. T., & Kuma, S. G. (2017). The effect of problem based learning (PBL) instruction on students' motivation and problem solving skills of physics. *Eurasia Journal of Mathematics, Science and Technology Education*, *13*(3), 857–871. https://doi.org/10.12973/eurasia.2017.00647a

Article, R., & Panke, S. (2019). *Design Thinking in Education : Perspectives , Opportunities and Challenges*. *2018*, 281–306.

Ashton, J., & Newman, L. (2019). An unfinished symphony: 21st century teacher education using knowledge creating heutagogies. *British Journal of Educational Technology*, *37*(6), 825–840. https://doi.org/10.1111/j.1467-8535.2006.00662.x

Atun, H. (2019). *The effects of programming education planned with TPACK framework on learning outcomes Ertuğrul USTA*. *6*(2), 26–36.

Auernhammer, J., & Roth, B. (2021). The origin and evolution of Stanford University ' s design thinking : From product design to design thinking in innovation management. *Journal of Product Innovation Management*, *38*, 623–644. https://doi.org/10.1111/jpim.12594

Aulia, D. M., Parno, & Kusairi, S. (2021). Pengaruh E-module Berbasis TPACK-STEM terhadap Literasi Sains Alat Optik dengan Model PBL-STEM Disertai Asesmen Formatif. *Jurnal Riset Pendidikan Fisika*, *6*(1), 7–12. http://journal2.um.ac.id/index.php/jrpf/

Beier, M. E., Kim, M. H., Saterbak, A., Leautaud, V., Bishnoi, S., & Gilberto, J. M. (2019). The effect of authentic project-based learning on attitudes and career aspirations in STEM. *Journal of Research in Science Teaching*, *56*(1), 3–23. https://doi.org/10.1002/tea.21465

Bene, R., & Mcneilly, E. (2020). *GETTING RADICAL : USING DESIGN THINKING TO FOSTER COLLABORATION*. 50–57.

Boyle, F., Walsh, J., Riordan, D., Geary, C., Kelly, P., & Broderick, E. (2022). *education sciences REEdI Design Thinking for Developing Engineering Curricula*.

Buphate, T., & Esteban, R. H. (2022). *Using Ideation Discussion Activities in Design Thinking to Develop EFL Students ' Speaking and Critical Thinking Abilities*. *0672*(June).

Celik, I. (2023). Computers in Human Behavior Towards Intelligent-TPACK : An empirical study on teachers ' professional knowledge to ethically integrate artificial intelligence (AI) -based tools into education. *Computers in Human Behavior*, *138*(May 2022), 107468. https://doi.org/10.1016/j.chb.2022.107468

Cesar, J., & Russo, R. D. F. S. M. (2018). Design Thinking Integrated in Agile Software Development : A Design Thinking Systematic Integrated in Agile Software Literature Review Development : A Systematic Literature Review. *Procedia Computer Science*, *138*, 775–782. https://doi.org/10.1016/j.procs.2018.10.101

Chai, C. S. (2018). Teacher Professional Development for Science , Technology , Engineering and Mathematics (STEM) Education : A Review from the Perspectives of Technological Pedagogical Content (TPACK). *The Asia-Pacific Education Researcher*. https://doi.org/10.1007/s40299-018-0400-7

Chaidam, O., & Poonputta, A. (2022). Learning Achievement Improvement of 1st Grade Students by Using Problem-Based Learning (PBL) on TPACK MODEL. *Journal of Education and Learning*, *11*(2), 43. https://doi.org/10.5539/jel.v11n2p43

Choi, B., & Young, M. F. (2021). TPACK-L : teachers ' pedagogical design thinking for the wise integration of technology ABSTRACT. *Technology, Pedagogy and Education*, *00*(00), 1–18. https://doi.org/10.1080/1475939X.2021.1906312

Chou, D. C. (2017). APPLYING DESIGN THINKING METHOD TO SOCIAL ENTREPRENEURSHIP PROJECT. *Computer Standards & Interfaces*. https://doi.org/10.1016/j.csi.2017.05.001

Davis, B. M. (2010). Creativity & Innovation in Business 2010 Teaching the Application of Design Thinking to Business. *COINs2009: Collaborative Innovation Networks Conference Creativity*, *2*(4), 6532–6538. https://doi.org/10.1016/j.sbspro.2010.04.062

Deng, P. (2022). How does culture influence innovation ? A systematic literature review. *Management Decision*, *56*(5), 1–20. https://doi.org/10.1108/MD-05-2017-0462

Dewi, N. R., Rusilowati, A., Saptono, S., Haryani, S., & Wiyanto, W. (2021). *Technological , Pedagogical , Content Knowledge (TPACK) Research Trends : A Systematic Literature Review of Publications Between 2010 - 2020*. *18*(4), 589–604.

Effendi-hasibuan, M. H., & Mukminin, A. (2019). The Inquiry-based Teaching Instruction (IbTI) in Indonesian Secondary Education : What Makes Science Teachers Successful Enact the Curriculum ? *Journal of Turkish Science Education*, *16*(1), 18–33. https://doi.org/10.12973/tused.10263a

Elfira, I., & Santosa, T. A. (2023). Literature Study : Utilization of the PjBL Model in Science Education to Improve Creativity and Critical Thinking Skills. *Jurnal Penelitian Pendidikan IPA*, *9*(1), 133–143. https://doi.org/10.29303/jppipa.v9i1.2555

Elsbach, K. D., & Stigliani, I. (2018). *Design Thinking and Organizational Culture : A Review and Framework for Future Research*. https://doi.org/10.1177/0149206317744252

Faiz, F. R. F., Nurhadi, N., & Rahman, A. (2021). Pembentukan Sikap Disiplin Siswa Pada Sekolah Berbasis Asrama. *QALAMUNA: Jurnal Pendidikan, Sosial, Dan Agama*, *13*(2), 309–326.

https://doi.org/10.37680/qalamuna.v13i2.902

Ferdyan, R., Vauzia, Zulyusuri, Santosa, T. A., & Razak, A. (2021). Model Pendidikan Lingkungan Hidup: Kegiatan Pembelajaran pada Siswa Sebagai Bagian dari Lingkungan di Era New Normal. *Natural Science: Jurnal Penelitian Bidang IPA Dan Pendidikan IPA*, *7*(1), 51–61. https://ejournal.uinib.ac.id/jurnal/index.php/naturalscience/article/view/2453

Ferry, D., Santosa, T., & Kamil, D. (2020). Pengetahuan Mahasiswa Institut Agama Islam Negeri Kerinci Tentang Teori Asal Usul Manusia. *BIOEDUCA : Journal of Biology Education*, *1*(1), 11. https://doi.org/10.21580/bioeduca.v1i1.4945

Fradila, E., Razak, A., Santosa, T. A., Arsih, F., & Chatri, M. (2021). Development Of E-Module-Based Problem Based Learning (PBL) Applications Using Sigil The Course Ecology And Environmental Education Students Master Of Biology. *International Journal of Progressive Sciences and Technologies (IJPSAT*, *27*(2), 673–682. http://ijpsat.ijsht-journals.org

Gallico, D. (2021). *E-LEARNING DESIGN THINKING AND DESIGN DRIVEN INNOVATION*. 91–98.

Galoyan, T., Barany, A., & Donaldson, J. P. (2022). *Connecting Science , Design Thinking , and Computational Thinking through Sports*. *15*(1), 601–618.

Gashoot, M., Eve, B., & Mohamed, T. (2021). *Implementing Technology for Teaching : The Use of a Mobile / Tablet Approach for Enhancing Students ' Learning (Design Interaction) Technology-Enhanced Learning (TEL)*. https://doi.org/10.1177/00220574211016397

Gill, C. H. D., & Berezina, E. (2020). School performance in three South East Asian countries: lessons in leadership, decision-making and training. *European Journal of Training and Development*, *45*(2-3), 136–148. https://doi.org/10.1108/EJTD-01-2020-0014

Gonen, E. (2019). *Development Review Tim Brown , Change by Design : How Design Thinking Transforms Organizations and Inspires Innovation (2009) Tim Brown , Change by Design : How Design Thinking Transforms Organizations*. *4*(2). https://doi.org/10.23860/MGDR-2019-04-02-08

Guaman-quintanilla, S., Everaert, P., Chiluiza, K., & Valcke, M. (2022). *education sciences Fostering Teamwork through Design Thinking : Evidence from a Multi-Actor Perspective*.

Gustavo, L., Rolando, R., Salvador, D. F., Flavia, R., Rolando, R., Roberto, M., Pinto, M., & Luz, D. (2021). *TPACK for meaningful learning survey : " paths " for professional development of biology teachers in Brazil*. *20*(2), 169–181.

Hwee, J., Koh, L., Chai, C. S., & Tay, L. Y. (2014). TPACK-in-Action: Unpacking the Contextual Influences of Teachers' Construction of Technological Pedagogical Content Knowledge (TPACK). *Computers & Education*. https://doi.org/10.1016/j.compedu.2014.04.022

Hwee, J., Koh, L., Sing, C., Wong, C., & Hong, B. H. (2015). Technological Pedagogical Content Knowledge (TPACK) and Design Thinking : A Framework to Support ICT Lesson Design for 21st Century Learning. *The Asia-Pacific Education Researcher*. https://doi.org/10.1007/s40299-015-0237-2

Ibrohim, I., Purwaningsih, E., Munzil, M., & Hidayanto, E. (2022). *Possible links between Indonesian science teacher ' s TPACK perception and demographic factors : Self-reported survey*. *18*(9).

Ichsan, Suhaimi, Amalia, K. N., Santosa, T. A., & Yulianti, S. (2022). Pengaruh Model Pembelajaran Problem Based Learning Berbaisis TPACK Terhadap Ketrampilan Literasi Sains Dalam Pembelajaran IPA Siswa Tingkat SD Sampai SMA: Sebuah Meta-Analisis. *Jurnal Pendidikan Dan Konseling*, *4*(5), 2173–2181.

Ichsan, Yayat Suharyat, Tomi Apra Santosa, E. (2023). The Effectiveness of STEM-Based Learning in Teaching 21 st Century Skills in Generation Z Student in Science Learning : A. *Jurnal Penelitian Pendidikan IPA*, *9*(1), 150–166. https://doi.org/10.29303/jppipa.v9i1.2517

Jobst, B., Endrejat, P., & Meinel, C. (2011). DOES DESIGN THINKING MEDIATE CRITICAL INNOVATION SKILLS ? AN INTERVIEW APPROACH TO SYNTHESIZE FIVE COMPETENCIES TAUGHT AT THE D . SCHOOL. *INTERNATIONAL CONFERENCE ON ENGINEERING AND PRODUCT DESIGN EDUCATION*, *September*, 1–8.

Junior, W. G., Marasco, E., Kim, B., & Behjat, L. (2020). *SUPPORTING DESIGN THINKING THROUGH A GAME- BASED PEDAGOGY IN ENTREPRENEURSHIP EDUCATION*.

Kale, U., Yuan, J., & Roy, A. (2020). To design or to integrate ? Instructional design versus technology integration in developing learning interventions. In *Educational Technology Research and Development* (Issue 0123456789). Springer US. https://doi.org/10.1007/s11423-020-09771-8

Khan, N., Sarwar, A., Chen, T. B., & Khan, S. (2022). Connecting digital literacy in higher education to the 21st century workforce. *Knowledge Management and E-Learning*, *14*(1), 46–61. https://doi.org/10.34105/j.kmel.2022.14.004

Kusuma. (2022). How Does a TPACK-related Program Support EFL Pre- service Teachers ' Flipped Classrooms ? *LEARN Journal: Language Education and Acquisition Research Network*, *15*(2), 301–325.

Kwon, J., Choi, Y., & Hwang, Y. (2021). *Enterprise Design Thinking : An Investigation on User-Centered Design Processes in Large Corporations*.

Ladachart, L., Radchanet, V., & Phothong, W. (2022). *Design Thinking Mindsets Facilitating Students ' Learning of Scientific Concepts in Design-Based Activities*. *19*(1), 1–16.

Lin, W. (2021). *Design Thinking as an Educational Innovation Way : A Case Study of Design for Change Taiwan (DFC Taiwan)*. 333–348.

Littlefield, C., & Zimmerman, H. T. (2017). USING A DESIGN MODEL AS A SCAFFOLD TO CREATE LEARNING TOOLS : A CASE STUDY WITH WE ! CONNECT CARDS. *Internasional Journal of Design For Learning*, *8*(2), 1–13.

M. Karim , Syafrul Antoni2, Karlini Oktarina3, T. A. S. (2022). The Effect of Teacher Professionalism in Islamic Religious Education in the Era of Society 5.0 in Indonesia: A Meta-Analysis. *Jurnla Pendidikan Dan Konseling*, *5*(2), 1349–1358.

Matthee, M., Turpin, M., & Turpin, M. (2019). Teaching Critical Thinking , Problem Solving , and Design Thinking : Preparing IS Students for the Future Teaching Critical Thinking , Problem Solving , and Design Thinking : Preparing IS Students for the Future. *Journal of Information Systems Education*, *30*(December).

Maulida, N., Sa'adah, S., & Ukit, U. (2021). Peningkatan Keterampilan Berkomunikasi Siswa Melalui Pembelajaran Berorientasi TPACK Dengan Blended Learning Pada Materi Sistem Gerak. *Jurnal BIOEDUIN: Jurnal Program Studi Pendidikan Biologi*, *11*(2), 79–87.

Mcgann, M., Blomkamp, E., & Lewis, J. M. (2018). The rise of public sector innovation labs : experiments in design thinking for policy. *Policy Sciences*, *March*. https://doi.org/10.1007/s11077-018-9315-7

Meepung, T., & Pratsri, S. (2022). *Virtual Commerce Management Using Design Thinking Process to Promote Digital Entrepreneurship for Education Studies*. *15*(2), 73–88. https://doi.org/10.5539/ies.v15n2p73

Melles, G., Vere, I. De, & Misic, V. (2011). *Socially responsible design : thinking beyond the triple bottom line to socially responsive and sustainable product design*. *7*(December), 143–154.

Mohamad, O., & Ahmad, A. (2022). *Employment the Word Cloud in Brainstorming via the Web and Its Effectiveness in Developing the Design Thinking Skill*. *15*(1), 1045–1064.

Muhafidin, D. (2022). Policy strategies to reduce the social impact of stunting during the COVID-19 pandemic in Indonesia. *Journal of Social Studies Education Research*, *13*(2), 320–342.

MÜLLER, K. T. and R. M. (2011). UNDERSTANDING DESIGN THINKING: A PROCESS MODEL BASED ON METHOD ENGINEERING. *INTERNATIONAL CONFERENCE ON ENGINEERING AND PRODUCT DESIGN EDUCATION*, *September*, 1–6.

Mundia, L. (2010). *Implementation of SPN21 Curriculum in Brunei Darussalam : A Review of Selected Implications on School Assessment Reforms*. *3*(2), 119–129.

Nguyen THI-HUYEN, Pham XUAN-LAM, N. T. T. T. (2021). The Impact of Design Thinking on Problem Solving and Teamwork Mindset in A Flipped Classroom. *Eurasian Journal of Educational Research*, *96*(3), 30–50. https://doi.org/10.14689/ejer.2021.96.3

Oktarina, K., Santosa, T. A., Razak, A., & Ahda, Y. (2021). Meta-Analysis : The Effectiveness of Using Blended Learning on Multiple Intelligences and Student Character Education during the Covid-19 Period. *IJECA International Journal of Education & Curriculum Application*, *4*(3), 184–192.

Oktiningrum, W., & Hartono, Y. (2016). *DEVELOPING PISA- LIKE MATHEMATICS TASK WITH INDONESIA NATURAL AND CULTURAL HERITAGE AS CONTEXT TO ASSESS*. *7*(1), 1–10.

Oxman, R. (2017). Thinking difference: Theories and models of parametric design thinking. *Design Studies*, *52*, 4–39. https://doi.org/10.1016/j.destud.2017.06.001

Polat, S., & Bayram, H. (2022). An Investigation into Design Thinking Skills of Social Studies Teachers. *Pegem Egitim ve Ogretim Dergisi*, *12*(3), 208–219. https://doi.org/10.47750/pegegog.12.03.22

Pratomo, L. C. (2021). *The Effectiveness of Design Thinking in Improving Student Creativity Skills and Entrepreneurial Alertness*. *14*(4), 695–712.

Razak, Abdul, Santosa, Tomi Apra, Lufri., et al. (2021). Meta-Analisis: Pengaruh Soal HOTS (Higher Order Thinking Skill) Terhadap Kemampuan Literasi Sains dan Lesson Study Siswa Pada Materi Ekologi dan Lingkungan Pada Masa Pandemi Covid-19. *Bioedusiana*, *6*(1), 79–87.

Rodriguez, S. L., Doran, E. E., Rachel, E., Martinez-podolsky, E., Paul, S., Rodriguez, S. L., Doran, E. E., Friedensen, R. E., Martinez-podolsky, E., & Paul, S. (2020). *Inclusion & Marginalization : How Perceptions of Design Thinking Pedagogy Influence Computer , Electrical , and Software Engineering Identity To cite this article : Inclusion & Marginalization : How Perceptions of Design Thinking Pedagogy Influence Comput*.

Santos, J. M., & Castro, R. D. R. (2021). Social Sciences & Humanities Open Technological Pedagogical content knowledge (TPACK) in action : Application of learning in the classroom by pre-service teachers (PST). *Social Sciences & Humanities Open*, *3*(1), 100110. https://doi.org/10.1016/j.ssaho.2021.100110

Santosa, T. A., Razak, A., Anhar, A., & Sumarmin, R. (2021). The Effectiveness of the Blended Learning Model on Student Learning Outcomes in Zoology Subjects in the Covid-19 Era. *Pendidikan Biologi*, *7*(1), 77–83.

Santosa, T. A., Sepriyani, E. M., Lufri, L., Razak, A., Chatri, M., & Violita, V. (2021). Analisis E-Learning Dalam Pembelajaran Evolusi Mahasiswa Pendidikan Biologi Selama Pandemi Covid-19. *Edumaspul: Jurnal Pendidikan*, *5*(1), 66–70. https://doi.org/10.33487/edumaspul.v5i1.1027

SANTOSA, T. A., & YULIANTI, S. (2020). Pengaruh Pemberian Kuis Terhadap Peningkatan Motivasi Belajar Biologi Siswa Di Sma Negeri 7 Kerinci. *Edusaintek : Jurnal Pendidikan, Sains Dan Teknologi*, *7*(2), 1–18. https://doi.org/10.47668/edusaintek.v7i2.58

Schmid, M., Brianza, E., & Petko, D. (2021). Computers in Human Behavior Self-reported technological pedagogical content knowledge (TPACK) of pre-service teachers in relation to digital technology use in lesson plans. *Computers in Human Behavior*, *115*(May 2020), 106586. https://doi.org/10.1016/j.chb.2020.106586

Schmidt, D. A., Thompson, A. D., Koehler, M. J., & Shin, T. S. (2009). Technological Pedagogical Content Knowledge (TPACK): The Development and Validation of an Assessment Instrument for Preservice Teachers. *Journal of Research on Technology in Education*, *42*(2), 123–149.

Shi, L., & Jiang, L. (2022). *How EFL teachers perceive and self-evaluate the knowledge components in forming Technological Pedagogical Content Knowledge (TPACK)*. *5*(1), 1–15.

Sofianora, A., Suharyat, Y., & Santosa, T. A. (2023). PENGARUH PROFESIONALITAS GURU MATEMATIKA DALAM MENINGKATKAN KOMPETENSI SISWA ERA REVOLUSI INDUSTRI 5 . 0 DI INDONESIA : SEBUAH META-ANALISIS. *Jurnal MATH-UMB.EDU*, *10*(2), 49–58.

Solodikhina, A., & Solodikhina, M. (2021). Developing an innovator ' s thinking in engineering education. *Education and Information Technologies*, *0123456789*. https://doi.org/10.1007/s10639-021-10709-7

Soysal, Y., & Soysal, S. (2023). *Relationship Between a Teacher Educator ' s Questions and the Development of Prospective Teachers ' Critical Thinking*. *38*. https://doi.org/10.1177/20965311221107028

Studies, S., & Bilgiler, S. (2023). Thinking and Expression Skills Through Teaching Techniques Jehona Rrustemi 1 & Voglushe Kurteshi 2. *Journal of Social Studies Education Researc*, *14*(1), 1–16.

Suganda, E., Latifah, S., Irwandani, Sari, P. M., Rahmayanti, H., Ichsan, I. Z., & Rahman, M. M. (2021). STEAM and Environment on students' creative-thinking skills: A meta-analysis study. *Journal of Physics: Conference Series*, *1796*(1). https://doi.org/10.1088/1742-6596/1796/1/012101

Suhaimi, Santosa, T. A., & Aprilisia, S. (2022). Analisis Pendekatan Saintifik Dalam Pembelajaran IPA Selama Pandemi Covid-19 di Sekolah Dasar. *Jurnal Didika: Wahana Ilmiah Pendidikan Dasar*, *8*(1), 92–101.

Suharyat, Y., Santosa, T. A., Yulianti, S., & Amalia, K. N. (2022). *International Journal of Education and Literature (IJEL) Literature Review : TPACK-Based Science Learning in Supporting Teacher Quality in Indonesia*. 2014–2020.

Suprapto, N., Sukarmin, S., Puspitawati, R. P., Erman, E., Savitri, D., Ku, C., Mubarok, H., Programme, E., Surabaya, U. N., Programme, E., Surabaya, U. N., Programme, B. E., Surabaya, U. N., Programme, S. E., Surabaya, U. N., Programme, M., Surabaya, U. N., & Info, A. (2021). *Research trend on TPACK through bibliometric analysis (2015-*. *10*(4), 1375–1385. https://doi.org/10.11591/ijere.v10i4.22062

Supriyadi, A., Satria, E., & Santosa, T. A. (2022). International Journal of Education and Literature (IJEL) E-ISSN : 2829-6249 P -ISSN : 2829-6656 Meta-analysis : The Effectiveness of the Integrated STEM Technology Pedagogical Content Knowledge Learning Model on the 21st Century Skills of High School S. *International Journal of Education and Literature (IJEL)*.

Supriyadi, A., Suharyat, Y., Santosa, T. A., & Sofianora, A. (2023). The Effectiveness of STEM-Integrated Blended Learning on Indonesia Student Scientific Literacy : A Meta-analysis. *International Journal of Education and Literature (IJEL)*, *2*(1), 41–48.

Sutama, S. N. H. &. (2022). Pengembangan Perangkat dan Model Pembelajaran Berbasis TPACK Terhadap Kualitas Pembelajaran Daring Sari Nur Hayani 1 , Sutama 2. *Jurnal Basicedu*, *6*(2), 2871–2882.

Syahrul, Y., & Palcomtech, P. (2019). PENERAPAN DESIGN THINKING PADA MEDIA KOMUNIKASI VISUAL PENGENALAN KEHIDUPAN KAMPUS BAGI MAHASISWA BARU. *Jurnal Bahasa Rupa*, *2*(2), 109–117.

Todoroff, E. C., Shealy, T., Milovanovic, J., Godwin, A., & Paige, F. (2021). Comparing Design Thinking Traits between National Samples of Civil Engineering and Architecture Students. *J. Civ. Eng. Educ.*, *147*(2), 1–15. https://doi.org/10.1061/(ASCE)EI.2643-9115.0000037

Tramonti, M., & Dochshanov, A. M. (2023). *applied sciences Design Thinking as an Auxiliary Tool for Educational Robotics Classes*.

Umbara, U., & Suryadi, D. (2019). Re-interpretation of mathematical literacy based on the teacher's perspective. *International Journal of Instruction*, *12*(4), 789–806. https://doi.org/10.29333/iji.2019.12450a

Vallis, C., & Redmond, P. (2021). Introducing design thinking online to large business education courses for twenty-first century learning. *Journal of University Teaching and Learning Practice*, *18*(6), 212–232. https://doi.org/10.53761/1.18.6.14

Waidelich, L., Richter, A., Koelmel, B., & Bulander, R. (2018). *A systematic literature review of current Design Thinking models in practice*. *June*. https://doi.org/10.1109/ICE.2018.8436281

Wati, D. A., Pranawa, S., & Rahman, A. (2020). Upaya Pengembangan Soft Skill Siswa Sma Melalui Pramuka. *Perspektif Ilmu Pendidikan*, *34*(2), 117–124. https://doi.org/10.21009/pip.342.6

Wrigley, C., Mosely, G., & Tomitsch, M. (2018). Design Thinking Education : A Comparison of Massive Open Online Courses. *She Ji: The Journal of Design, Economics, and Innovation*, *4*(3), 275–292. https://doi.org/10.1016/j.sheji.2018.06.002

Wrigley, C., Wrigley, C., & Straker, K. (2015). *Design Thinking pedagogy : the Educational Design Ladder Design Thinking pedagogy : the Educational Design Ladder*. *November*. https://doi.org/10.1080/14703297.2015.1108214

Xiao, Y., & Watson, M. (2019). Guidance on Conducting a Systematic Literature Review. *Journal of Planning Education and Research*, *39*(1), 1–20. https://doi.org/10.1177/0739456X17723971

Yusuf, M., Witro, D., Diana, R., Santosa, T. A., Alfikri, A. 'Alwiyah, & Jalwis, J. (2020). Digital Parenting to Children Using The Internet. *Pedagogik Journal of Islamic Elementary School*, *3*(1), 1–14. https://doi.org/10.24256/pijies.v3i1.1277

Zulkifli, Z., Satria, E., Supriyadi, A., & Santosa, T. A. (2022). Meta-analysis : The effectiveness of the integrated STEM technology pedagogical content knowledge learning model on the 21st century skills

of high school students in the science department. *Psychology, Evaluation, and Technology in Educational Research*, *5*(1), 32–42.

Zulyusri el at. (2020). Problematika Dalam Pembelajaran Berbasis Virtual Learning Environmen t (VLE) Terhadap Siswa dan Guru SMA / MA Pada Materi Biologi. *Journal of Education*, *03*(01), 93–103.