

F.4 A Metacognition-Based Digital Worksheet for Automotive Fault Diagnosis: a Needs Assessment

Research

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Abstract. This study aims to define the problems and potential theoretical solutions to the problems in an automotive vocational teacher department. This study is part of a comprehensive study about the potential benefits of using the metacognition concept. Metacognition as the concept of learning-how-to-learn is needed for prospective automotive vocational teachers to conduct sustainable learning. This study is a qualitative study using semi-structured interviews (SSI) and a focus group discussion (FGD) to collect the data. Firstly, the SSIs were conducted twice, before and after the FGD. The first SSI explores the problems, while the second SSI was conducted after the FGD to gain a possible contextual solution to the problems based on the result of FGD. Secondly, an FGD was conducted to explore the theoretical solutions to the problems. The findings of the first SSI stated that teaching communication skills and sustainable learning are necessary to be equipped since the automotive technologies in industries have been being developed rapidly from time to time. Those skills were not facilitated well in the teaching and learning activities in the department. The integration into courses of teaching communication and habit of sustainable learning could be the possible solution. The FGD findings stated that the metacognition concept could be brought into teaching and learning to deal with those problems. The second SSI findings said that automotive fault diagnosis learning was chosen as the subject since this is a problem-solving and higher-order thinking subject. Also, the learning tool kit for this subject is still conventional, so it needs to be improved with the metacognition concept.

1 Introduction

Learning in vocational education has many essential roles in equipping students with the desired skills needed in the workplace. This phenomenon happened because vocational education is an educational type for preparing students to work in particular expertise (Rösch, 2013). Through learning activities, vocational students could try to learn and master the desired skills to do specific jobs with special expertise. Hence, vocational education needs to provide learning with meaningful skills that benefit the students for future working life (Gough, 2010; Rösch, 2013).

In Indonesia, vocational education still needs improvement in this research context. There are many problems that this education faces. 27.26% of almost 10 million unemployed people are vocational graduates (Badan Pusat Statistik Indonesia, 2020). Furthermore, the average score for the 2019 national examination on expertise subject was in a low category which was 44.12 from 100 (Kemdikbud, 2019). Moreover, the performance index of vocational teachers is also in a low category, which was 77.12 (Kemdikbud, 2016). Additionally, the study by Rita Adriani Sitorus in 2016 stated that Indonesia's vocational education has irrelevant curriculums, low-quality graduates, a low quantity and quality of teachers, and outdated infrastructures (Sitorus, 2016).

Preparing qualified vocational teachers could become a solution to the vocational education problems. Teachers are the key persons and the key figures in education (Van Den Branden, 2016). Moreover, they have many vital roles in succeeding educational programs (Nielsen, 2010). Additionally, many studies prove that teachers as the key players in improving students' achievements (Fryer, 2011; Keller et al., 2017; Kunter et al., 2013; Miller et al., 2017; Westley, 2011) whereas teacher motivation is considered a decisive factor influencing students' interest. So far, however, most research either focused on knowledge or motivation (both on the students' as well as the teachers' side). Therefore, improving the quality of vocational teachers could improve the quality of vocational education.

Vocational teacher education institutions are needed to be paid attention to in preparing qualified prospective vocational teachers. Teacher education institutions focus on delivering two elements: teaching particular subjects and teaching how to teach the subjects (Kennedy, 1999). Ultimately, students in vocational teacher education not only need to master the provided expertise subjects, but they also need to master the ways to teach the subject. Therefore, they would become qualified vocational teachers in their future working life.

As teaching and learning activities are essential for equipping students with desired competencies, many studies have been conducted to improve the quality of vocational teacher education graduates. Firstly, Husain, Army Auliah, and Halimah 2015 developed a learning model based on entrepreneurship to improve prospective vocational teachers' life skills (Husain, 2015). Secondly, Nurhadi et al. in 2019 developed a learning model as well to equip the students as prospective vocational teachers with technological skills (Nurhadi et al., 2019). Furthermore, the e-learning model (Tuwoso et al., 2020), the teaching skill learning model (Putra et al., 2020), the internship learning model (Gunadi et al., 2020), and the explaining skill learning model (Findeisen et al., 2021) are several studies that have developed learning models for improving the quality of prospective vocational teachers.

Although there are many studies on improving prospective vocational teachers' quality, little attention is given to developing a learning model to equip students with learn-how-to-learn skills. This skill is essential to continuous learning (Uzunboylu & Hürsen, 2011). This skill is necessary to be mastered since vocational teachers need to stay updated along with many things in the workplace to give their students meaningful teaching and learning activities (Abdullah et al., 2019; Diep & Hartmann, 2016; Hunde & Tacconi, 2014; Nurtanto et al., 2020; Subarno & Dewi, 2019). The learn-how-to-learn skills could be taught by implementing the metacognition concepts into teaching and learning activities (Al-jarrah et al., 2019; Chiaburu et al., 2015; Devika & Singh, 2019; Pennock, 2020).

This study explored the contextual problems and the potential theoretical solutions to the problems in an automotive vocational teacher education department. A qualitative approach was used in this study through semi-structured interviews and a focus group discussion. This paper presents the method, the results, and the discussion of the findings. The paper said that, eventually, it is necessary to develop a learning tool kit based on the metacognition concept in automotive fault diagnosis. The results of this study could contribute to the practical aspect of preparing prospective vocational teachers since they always need to stay updated with their knowledge and skills along with the development of science and technology in the workplace.

2 Research Motivation

Exploring problems and gaining the theoretical solution to the problems in teacher education institutions is necessary for the educational context. This is mainly because teachers are key educational figures with many important roles (Van Den Branden, 2016). Vocational teachers, particularly, become essential players in facilitating students to gain desired skills for their future working life. The skills should be relevant to the needs of the particular workplace. Hence, vocational teachers need always to stay updated on their knowledge and skills along with the development of science and technology in the particular field (Abdullah et al., 2019; Diep & Hartmann, 2016; Hunde & Tacconi, 2014; Nurtanto et al., 2020; Subarno & Dewi, 2019). Especially for automotive vocational teachers, problem-solving is an essential skill that needs to be mastered since this expertise focuses on automotive aftersales service and repair (Wu et al., 2018). Hence, a study for analyzing problems and gaining theoretical solution on the vocational teacher education context is crucial.

Metacognition concept, as the findings of the theoretical solution to the problems in this research context, has essential roles for problem-solving ability and self-control as a way of self-instruction (Flavell, 1979). This concept also could facilitate learn-how-to-learn ability (Al-jarrah et al., 2019; Chiaburu et al., 2015; Devika & Singh, 2019; Lumpkin, 2020; Ottenhoff, 2011; Pennock, 2020).

The learn-how-to-learn ability is an essential skill for conducting sustainable learning (Uzunboylu & Hürsen, 2011). Therefore, the metacognition concepts are expected to bring many beneficial effects in vocational teacher education for preparing candidates who are ready to conduct an important activity, sustainable learning.

3 Research Method

A qualitative approach was used for this study with two data collection methods: the semi-structured interview (SSI) and focus group discussion (FGD). The SSI method was used to explore the problems and deficiencies in the teaching and learning activities in an automotive vocational teacher education department. Also, this method was used to gain the possible contextual solution after conducting the FGD. Meanwhile, the FGD discussed the possible conceptual solution to the problems. The explanation of those methods is as follows.

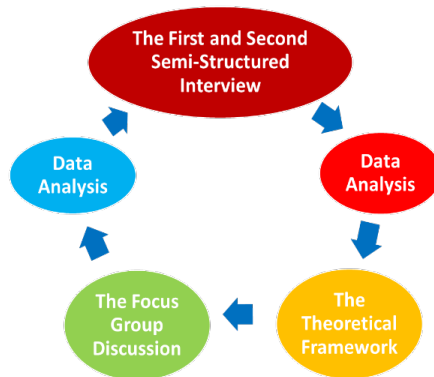


Figure 1: The Iterative Research Method

3.1 Semi-Structured Interview (SSI) Studies

The first SSI was used to learn and explore the problems and deficiencies in the automotive vocational teacher education department. Then, the second SSI was used to gain a possible contextual solution. As the department's representative, the chairman was invited to these SSI studies. The interview protocols adapted from the guideline created by Steinar Kvale in 2011 (Kvale, 2011) were used in these studies. There were two main questions in the first SSI, which are; 1) what are the problems? 2) what are the deficiencies?. In the second SSI, there were also two main questions which are; 1) what is the subject that is relevant to be chosen based on the results of the FGD? 2) in that subject, what aspects need to be improved?

The content analysis technique was used in these interview studies based on the guideline from the study of Mariette Bengtsson in 2016 (Bengtsson, 2016). There were four stages in this analysis which are; 1) decontextualization to identify codes as meaning units, 2) contextualization to include and exclude contents, 3) categorization to identify homogeneous groups, and 4) compilation to conclude the answers to the questions (Bengtsson, 2016).

3.2 A Focus Group Discussion (FGD) Study

This FGD study invited ten people: vocational learning experts at higher education levels, educational psychology experts, educational media and technology experts, automotive vocational teachers, and practitioners from automotive industries. An FGD protocol was made based on the guideline from Margaret Harrell and Melissa Bradley in 2009 (Margaret C. Harrell; Melissa A. Bradley, 2009). There were four main questions in this FGD which are; 1) what are the needed competencies of being automotive vocational teachers? 2) what are the criteria for the vocational learning approach that need to be accommodated? 3) What criteria of educational media and technology need to be accommodated? 4) what are the criteria of educational psychology of metacognition that need to be accommodated?

The thematic analysis technique adapted from the study of Asley Castleberry and Amanda Nolen in 2018 (Castleberry & Nolen, 2018) was used. This analysis was based on vocational learning, educational media and technology, educational psychology, and automotive vocational teacher competencies. There were five stages in the thematic analysis which are; 1) compiling for transcribing the interview, 2) disassembling for coding the transcription, 3) reassembling for categorizing based on the determined themes, 4) interpretation for writing the analytical conclusion, and 5) concluding for answering to the specific questions (Castleberry & Nolen, 2018).

4 Research Findings

The main objectives of this study are to explore the problems and deficiencies in teaching and learning implementation in a department of automotive vocational teacher education and to gain the potential theoretical solution. The problems and the deficiencies were explored by having the first SSI. Meanwhile, the possible theoretical solution was achieved from the FGD, followed by the second SSI study.

4.1 The Findings from the first Semi-Structured Interview (SSI)

There are four stages of the content analysis to gain the answers to the first SSI questions; 1) decontextualization to identify codes as meaning units, 2) contextualization to include and exclude contents, 3) categorization to identify homogeneous groups, and 4) compilation to answer the first SSI questions.

Table 1: Recontextualization result of the first SSI.

No	Questions	Included Codes	Transcription of the codes
1	What are the problems?	Graduate Profiles	<i>We have the first profile is as a prospective teacher; secondly, we also prepare prospective instructors, both industrial instructors and instructors in training centres; third, we also prepare expert technicians or supervisors; we can also produce aspiring technopreneurs; there our core in prospective teachers;</i>
		Problems	<i>The first related problem is how we teach, how to transfer knowledge, form teachers who can transfer knowledge, skills and transfer attitudes, attitudes needed by industry. How do we teach industrial attitudes and industrial culture?</i>
2	What are the deficiencies?	Measures and Deficiencies	<i>We have lessons or courses that we call microteaching. The credit is still very small, so how to transfer it is also very limited; microteaching should be integrated into every course. Microteaching learning is carried out in several cycles. At the beginning of the cycle, students are indeed unprepared. Supervising lecturers or lecturers in microteaching courses, then they provide input.</i>
		Suggestion	<i>I say we enter a new civilization. We are forced to change the way we think and the way we teach. Also, we are forced to change the way we communicate. Teachers are required to be ready to learn and continue to learn. Now the challenge is in addition to how we transfer and to be prepared to keep learning.</i>

After having the first SSI transcription and identifying the codes as meaning units in the stage of decontextualization, several contents were included in the stage of contextualization. Table 1 above explains the codes and contents had to answer the interview questions. The contents were then categorized in the stage of categorization based on the questions so that the answers to the questions could be gained in the compilation stage. Table 2 below explores the answers as the findings of the first SSI.

Table 2: The Findings of the first SSI.

No	Questions	Compilation/ Conclusion
1	What are the problems?	The main problem is how to teach students as teacher candidates for transferring knowledge, skills, and work attitude. Additionally, the competencies to conduct sustainable learning must be equipped.
2	What are the deficiencies?	The problem has been measured by having a microteaching course in the sixth semester. However, this program has low credit, so there is insufficient time to teach students how to teach. The integration into courses of teaching communication and habit of sustainable learning with learning many references could be the possible solution.

The Findings from the Focus Group Discussion (FGD)

There were five stages in the thematic analysis to gain the findings of this FGD study which are; 1) compiling for transcribing the interview, 2) disassembling for coding the transcription, 3) reassembling for categorizing based on the determined themes, 4) interpretation for writing the analytical conclusion, and 5) concluding for answering to the specific questions. Below is the explanation and the results of those stages.

Firstly, the compiling stage aimed to analyze the data from the FGD by making a transcription. The transcription results in 18346 works for the three-hour FGD. Secondly, the disassembling stage aimed to notice the transcription result's codes on every participant. Several gained codes from every FGD participant were relevant as the information to answer the FGD questions. Table 3 below is the table that explains the results of this stage.

Table 3: The results of disassembling stage of the FGD.

Participants	
Numbers	Codes
1	<i>Bibliography, theory-building, content-correctness, table 5, worksheet characteristics, technology as a tool, digital technology, flexible, Mayer's multimedia book.</i>
2	<i>Content-valid correctness, user interface, the purpose of content, digital platforms, animation and text, sequential learning</i>
3	<i>Learning trajectory, cognitive strategy instruction (CSI), executive function, higher-order thinking, mindfulness and trajectory learning, higher-order thinking materials, tasks, and questions.</i>
4	<i>Metacognitive knowledge; declarative, procedural, and conditional; metacognitive experience practices involving all senses, focus on worksheets and one material.</i>
5	<i>Complete theory, theory, learning philosophy, learning theory, learning model, project-based learning, the characteristics, the criteria.</i>
6	<i>Focus on metacognitive or project-based learning? Teachers as partners and project consultants, complete references, practical elements, hands-on practice, and theory-building.</i>
7	<i>Four teacher competencies, pedagogical abilities, personality abilities, professional abilities, and students' ability to speak and express opinions.</i>
8	<i>Four teacher competencies; personality competencies, personality and social competencies, low, project-based learning, teaching factory, and religious competencies.</i>
9	<i>Vocational high school, direct experience practice, competitive and continuous learning.</i>
10	<i>The management of body repair, accepting technological updates, maintaining old patterns, and educating workers must be severe, consistent, and willing to follow the development and extensive job opportunities.</i>

Thirdly, reassembling stage was done to categorize the transcription result from the FGD into themes or aspects; vocational learning, educational media and technology, educational psychology, and needed competencies of being vocational teachers. Table 4 below is the explanation table of this stage's findings. Fourthly, the interpreting stage was used to build an analytical conclusion from the previous stage data to find the answers to the needed aspects. Lastly, the concluding stage provided the answers to the FGD questions. Based on the analyzed data, it could be concluded that the metacognition concept could be brought into teaching and learning in automotive vocational teacher education. This implementation needs to pay attention to the learning trajectory. This concept needs to be implemented in a subject with high-order thinking characteristics, such as problem-solving. It also needs to be implemented in a practical hands-on lesson. ICT technology could be used to accommodate the concepts into learning activities. These results would be beneficial since the concept of metacognition supports the needed competencies being vocational teachers to conduct continuous learning.

Table 4: The Findings of the FGD.

Aspects	Participants Numbers	Opinions
Vocational Learning	5	<i>Complete theory. Project-based learning (multidisciplinary learning experience and producing work according to problems), PjBL characteristics (driving question, investigation, artefact, collaboration, technological tool), PjBL criteria (centrality, driving question, constructive investigation, autonomy, realism)</i>
	6	<i>Focus on metacognitive or project-based learning?. Teachers as partners and project consultants. References are pretty complete and heavy but need to be considered practical elements. Vocational must be hands-on practice.</i>
Educational Media and Technology	1	<i>Bibliography complete, theory-building good, content-correctness, worksheet characteristics must be paid attention to, technology as a tool. Digital technology is appropriate and flexible. Pay attention to Mayer's multimedia book.</i>
	2	<i>Content-valid correctness is number one. Sequential learning (design-learning-objectives-pretest-material-supervised-posttest).</i>
Educational Psychology	3	<i>Learning trajectory to metacognition. Cognitive strategy instruction (CSI). Agrees with many references. The first thing to pay attention to is the executive function – how the person thinks in their thinking process. The second is higher-order thinking. The third is the learning trajectory.</i>
	4	<i>Entering material and assessment in the platform's metacognitive knowledge (declarative, procedural, and conditional). Metacognitive experience – discussions accompanied by friends and teachers, metacognitive experience – not digital but practices involving all senses</i>

Automotive Vocational Teacher Competencies	7	<i>Four teacher competencies (pedagogy, personality, professional, and social), pedagogical abilities – assessment of results rather than processes, personality abilities – touching the heart to students, professional abilities – theory using flash players when practising using videos, social skills (conditioning the class, interacting with students) students, awaken students' ability to speak and express opinions, become role models and be imitated).</i>
	8	<i>Agree with the four teacher competencies, personality competencies – teachers are role models, personality and social competencies of prospective teachers are still low.</i>
	9	<i>Vocational High School – direct experience practice, competitive and continuous learning, competitive – spirit to face the challenges of the times, continuous learning – fighting spirit for high learning, attitude.</i>
	10	<i>Workers find it difficult to accept technological updates and maintain old patterns. Workers must be severe, consistent, and willing to follow the development of all kinds.</i>

4.2 The Findings from the second Semi-Structured Interview (SSI)

There are four stages of the content analysis to gain the answers to the second SSI questions; 1) decontextualization to identify codes as meaning units, 2) contextualization to include and exclude contents, 3) categorization to identify homogeneous groups, and 4) compilation to conclude the answers of the questions. Below is the table of the compilation result for answering the questions of the second SSI.

Table 5: The Findings of the second SSI.

No	Questions	Compilation/ Conclusion
1	What is the subject?	Automotive fault diagnosis learning becomes a subject in this research study. This subject is a high-order thinking subject and a problem-solving subject suitable for the concept of metacognition.
2	What aspects need to be improved?	The deficiency in this subject is the learning tool kit that still uses conventional observation sheets. This sheet could not guide students effectively during the learning process and allow students to conduct trial and error stages during that learning activity.

4.3 The Summary of the Findings

Based on the qualitative approach of this study, it could be concluded that the teaching ways to teach and equip students with essential skills of sustainable learning become the problems. The experts and practitioners suggested that the metacognition concept could be used in vocational teaching and learning to accommodate the teaching ways to teach, learn-how-to-learn, and problem-solving concepts. The ICT technology could be utilized to integrate those concepts into a learning tool kit. An automotive fault diagnosis subject was chosen since this subject is high-order thinking. Also, the learning tool kit was still in a conventional form and needed to be developed to avoid students conducting trial and error stages during the learning processes.

5 Discussion

The findings of this study proved that conducting continuous learning is indispensable to be done by vocational teachers. This is mainly because they always need to update their knowledge and skill along with workplace needs. In this context, the metacognition concept has an essential role in problem-solving ability and self-control as a way of self-instruction (Flavell, 1979). This concept also could facilitate learn-how-to-learn ability (Al-jarrah et al., 2019; Chiaburu et al., 2015; Devika & Singh, 2019; Lumpkin, 2020; Ottenhoff, 2011; Pennock, 2020). The learn-how-to-learn ability is an essential skill for conducting sustainable learning (Uzunboylu & Hürsen, 2011). Hence, this concept could be implemented to deal with the findings of this study.

The learn-how-to-learn as one of the essential skills of sustainable learning needs to be taught by implementing the concept of metacognition. Moreover, problem-solving ability in the automotive field becomes a critically needed competency since the field focuses on aftersales automotive products. Automotive vocational teachers need to teach their students as automotive mechanic candidates how to diagnose faults in vehicles effectively (Wu et al., 2018). Students could not do so with trial and error stages because it would tend to make inefficient and ineffective work in their future careers. Hence, the teachers should teach the students the correct procedure for diagnosing the automotive fault.

Generally, the ability to conduct continuous learning becomes the needed competency of being a vocational teacher (Abdullah et al., 2019; Diep & Hartmann, 2016; Hunde & Tacconi, 2014; Nurtanto et al., 2020; Subarno & Dewi, 2019). Vocational teachers need to learn continuously during their working life to ensure that their teaching and learning activities are relevant to the workplace's needs. The relevant teaching and learning activities with the workplace's needs could benefit students in mastering relevant skills they could use in their future work. Ultimately, this could equip students with meaningful skills that could eventually reduce the unemployment of vocational graduates.

Vocational education, the education to prepare the students to work in their future life, needs to provide meaningful teaching and learning activities relevant to the workplace's demands (Gough, 2010; Rösch, 2013). Vocational teachers, in this context, play many vital roles in achieving the objective of vocational education. The teachers have a critical role in equipping students with needed skills relevant to the demands of the workplace (Owais et al., 2020). Furthermore, they become vital figures in determining and achieving educational objectives (Van Den Branden, 2016), making their roles increasingly important (Nielsen, 2010).

To solve several problems in Indonesia, especially unemployment, improving vocational education quality could become one of the possible solutions. Since teachers become key figures in education, improving the quality of vocational teachers could affect the quality of vocational education. As vocational teachers need to conduct continuous learning, it is necessary to equip prospective vocational teachers with essential skills to perform such learning. Learn-how-to-learn skill is an important skill to perform sustainable or continuous learning. Hence, this skill needs to be equipped for vocational teacher candidates in vocational teacher education institutions. The results of this study strengthen the theoretical perspective of those aspects. In the context of automotive vocational education, problem-solving skills become critical skills that need to be mastered.

6 Conclusion and Limitation

This study stated that facilitating students as vocational teacher candidates with learn-how-to-learn activities in learning and teaching is necessary. Since they are vocational teacher candidates, teaching communication and learning with many resources also need to be accommodated in the teaching and learning. This is because they not only need to master the subjects, but they also need to master the ways to teach the subjects. In the automotive context, problem-solving skills become a critically required skill. Integrating metacognition concepts with ICT technology as the learning toolkit becomes the potential theoretical solution in this context. These findings are limited to the automotive vocational teacher education context. However, those findings could benefit preparing prospective vocational teachers since they need to conduct sustainable learning during their future working life.

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Literature

- Abdullah, S. A., Saud, M. S., & Kamin, Y. (2019). M-learning for technical and vocational education training (TVET). *International Journal of Recent Technology and Engineering*, 8(3), 7236–7239. <https://doi.org/10.35940/ijrte.C6291.098319>
- Al-jarrah, T. M., Mansor, N., Talafhah, R. H., & Al-jarrah, J. M. (2019). The application of metacognition, cognitivism, and constructivism in teaching writing skills. *European Journal of Foreign Language Teaching*, 3(4).
- Badan Pusat Statistik Indonesia. (2020). *Pengangguran Terbuka Menurut Pendidikan Tertinggi yang Ditamatkan 1986–2020*. <https://www.Bps.Go.Id/Statictable/2009/04/16/972/Pengangguran-Terbuka-Menurut-Pendidikan-Tertinggi-Yang-Ditamatkan-1986---2020.html>. <https://www.bps.go.id/statictable/2009/04/16/972/pengangguran-terbuka-menurut-pendidikan-tertinggi-yang-ditamatkan-1986---2020.html>
- Bengtsson, M. (2016). How to plan and perform a qualitative study using content analysis. *NursingPlus Open*, 2. <https://doi.org/10.1016/j.npls.2016.01.001>
- Castleberry, A., & Nolen, A. (2018). Thematic analysis of qualitative research data: Is it as easy as it sounds? In *Currents in Pharmacy Teaching and Learning* (Vol. 10, Issue 6). <https://doi.org/10.1016/j.cptl.2018.03.019>
- Chiaburu, D. S., Cho, I., & Gardner, R. (2015). Authenticity matters more than intelligence and personality in predicting metacognition. *Industrial and Commercial Training*, 47(7), 363–371. <https://doi.org/10.1108/ICT-05-2015-0037>
- Devika, & Singh, R. (2019). Influence of metacognitive awareness on engineering students' performance: A study of listening skills. *Procedia Manufacturing*, 31. <https://doi.org/10.1016/j.promfg.2019.03.021>
- Diep, P. C., & Hartmann, M. (2016). Green Skills in Vocational Teacher Education – a model of pedagogical competence for a world of sustainable development. *TVET @ Asia@Asia*. <https://doi.org/10.1002/ISSN>
- Findeisen, S., Deutscher, V. K., & Seifried, J. (2021). Fostering prospective teachers' explaining skills during university education—Evaluation of a training module. *Higher Education*, 81(5). <https://doi.org/10.1007/s10734-020-00601-7>
- Flavell, J. H. (1979). Metacognition and cognitive monitoring: A new area of cognitive-developmental inquiry. *American Psychologist*, 34(10). <https://doi.org/10.1037/0003-066X.34.10.906>
- Fryer, R. G. (2011). TEACHER INCENTIVES AND STUDENT ACHIEVEMENT. *Education*.
- Gough. (2010). *Technical and vocational education and learning: an investment-based approach*. the MPG Books Group, Bodmin and King's Lynn.
- Gunadi, Alias, M., Herminarto, S., & Mochammad, B. T. (2020). Designing industrial internship model to improve the skills of prospective vocational teachers. *Journal of Technical Education and Training*, 12(1 Special Issue). <https://doi.org/10.30880/jtet.2020.12.01.015>

- Hunde, A. B., & Tacconi, G. (2014). Teacher Educators' Practices from the View of Building Lifelong Learning Capabilities in Student Teachers. *Procedia – Social and Behavioral Sciences*. <https://doi.org/10.1016/j.sbspro.2014.05.363>
- Husain, A. A. dan H. (2015). Pengembangan Model Perkuliahan Berwawasan Kewirausahaan untuk Meningkatkan Kecakapan Hidup (Life Skill) Mahasiswa Calon Guru Development of Lectures Insightful Entrepreneurship Model to Improve Life Skills of Prospective Student Teacher. *Jurnal Chemica*, 16(1).
- Keller, M. M., Neumann, K., & Fischer, H. E. (2017). The impact of physics teachers' pedagogical content knowledge and motivation on students' achievement and interest. *Journal of Research in Science Teaching*. <https://doi.org/10.1002/tea.21378>
- Kemdikbud. (2016). *Analisis Sumber Daya Manusia Pendidikan Dasar dan Menengah 2015/2016*. http://publikasi.data.kemdikbud.go.id/uploadDir/isi_C3E61ED4-94A4-4C8E-AFEE-091C89F6BF53_.pdf
- Kemdikbud. (2019). *Laporan Hasil Ujian Nasional*. <http://puspendik.kemdikbud.go.id/hasil-un/>
- Kennedy, M. M. (1999). The role of preservice teacher education. *Teaching as the Learning Profession: Handbook of Teaching and Policy*.
- Kunter, M., Klusmann, U., Baumert, J., Richter, D., Voss, T., & Hachfeld, A. (2013). Professional competence of teachers: Effects on instructional quality and student development. *Journal of Educational Psychology*. <https://doi.org/10.1037/a0032583>
- Kvale, S. (2011). Planning An Interview Study. In *Doing Interviews*. <https://doi.org/10.4135/9781849208963.n4>
- Lumpkin, A. (2020). Metacognition and its Contribution to Student Learning Introduction. *Coll. Stud. J.*, 54(1), 1–7. <https://www.ingentaconnect.com/content/prin/csj/2020/00000054/00000001/art00001>
- Margaret C. Harrell; Melissa A. Bradley. (2009). Data Collection Methods Semi-Structured Interviews and Focus Groups. In *Distribution*.
- Miller, A. D., Ramirez, E. M., & Murdock, T. B. (2017). The influence of teachers' self-efficacy on perceptions: Perceived teacher competence and respect and student effort and achievement. *Teaching and Teacher Education*. <https://doi.org/10.1016/j.tate.2017.02.008>
- Nielsen, S. (2010). Vocational education and training teacher training. In *International Encyclopedia of Education*. <https://doi.org/10.1016/B978-0-08-044894-7.00808-3>
- Nurhadi, D., Purwaningsih, E., Masjkur, K., & Nyan-Myau, L. (2019). *Using TPACK to Map Teaching and Learning Skills for Vocational High School Teacher Candidates in Indonesia*. <https://doi.org/10.2991/ictvet-18.2019.9>

- Nurtanto, M., Sofyan, H., Sudira, P., Kholifah, N., & Triyanto, T. (2020). Professional vocational teacher skills in 21st century Indonesia. *Solid State Technology*, 63(6). <https://solidstatetechnology.us/index.php/JSSST/article/view/8594>
- Ottenhoff, J. (2011). Learning How to Learn Metacognition in Liberal Education. *Lieberal Education, Summer/fall 2011*, 28–33. <http://icagames.comm.msu.edu/vgu%26g.pdf>
- Owais, A. K., AlAbidi, S. M., Hatamleh, Z. M., & Hussein, E. T. (2020). Technical and vocational education and training in the UAE. *International Journal of Emerging Technologies in Learning*, 15(13), 264–288. <https://doi.org/10.3991/ijet.v15i13.13801>
- Pennock, A. (2020). Open-Inquiry Course Design in the Public Policy Classroom. *PS – Political Science and Politics*, 53(4). <https://doi.org/10.1017/S1049096520000475>
- Putra, A. B. N. R., Mukhadis, A., Ulfatin, N., & Subandi, M. S. (2020). Innovation of Learning Model SA'I with Web-Application to Improve Teaching Efficacy and Teaching Skills for Prospective Vocational Education Teachers. *Proceedings – 2020 6th International Conference on Education and Technology, ICET 2020*. <https://doi.org/10.1109/ICET51153.2020.9276609>
- Rösch, et al. (2013). *Through Competence-Based to Employment-Oriented Education and Training: A Guide for TVET Practitioners*. Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH.
- Sitorus, R. A. (2016). Tantangan Dan Harapan Pendidikan Kejuruan Di Indonesia Dalam Mewujudkan Sekolah Menengah Kejuruan Yang Memiliki Daya Saing Ketenagakerjaan. *Sistem Informasi UKM*.
- Subarno, A., & Dewi, A. S. (2019). *The Challenge of Vocational High School Teachers in Indonesia*. <https://doi.org/10.2991/icebef-18.2019.147>
- Tuwoso, T., Putra, A. B. N. R., Mukhadis, A., Mahamad, A. K. B., & Sembiring, A. I. (2020). Development of MOOCs synchronized life-based learning to improve the quality of outcomes in prospective vocational teachers in the era of education 4.0. *Journal of Physics: Conference Series*, 1456(1). <https://doi.org/10.1088/1742-6596/1456/1/012051>
- Uzunboylu, H., & Hürsen, Ç. (2011). Lifelong learning competence scale (Llcs): The study of validity and reliability. *Hacettepe Üniversitesi Eğitim Fakültesi Dergisi*, 41(41).
- Van Den Branden, K. (2016). The Role of Teachers in Task-Based Language Education. *Annual Review of Applied Linguistics*. <https://doi.org/10.1017/S0267190515000070>
- Westley, K. E. (2011). Teacher quality and student achievement. In *Teacher Quality and Student Achievement*. <https://doi.org/10.14507/epaa.v8n1.2000>
- Wu, M. J., Huang, C. Y., Kao, Y. S., Lue, Y. F., & Chen, L. C. (2018). Developing a professional performance evaluation system for pre-service automobile repair vocational high school teachers in Taiwan. *Sustainability (Switzerland)*, 10(10). <https://doi.org/10.3390/su10103537>