Perceptions of Industry and Education Practitioners Regarding the Implementation of Digital Learning in Automotive Engineering

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ABSTRAK

Pembelajaran digital (DL) pada pendidikan vokasi menjadi isu krusial yang terus dikembangkan untuk inovasi, termasuk pada jurusan teknik otomotif. Namun permasalahannya terkait dengan relevansi kompetensi yang ingin dicapai sesuai dengan kualifikasi industri. Selain itu, tahapan DL belum sepenuhnya dipahami oleh berbagai praktisi pendidikan. Penelitian ini bertujuan untuk menganalisis persepsi industri dan praktisi pendidikan mengenai penerapan DL pada bidang teknik otomotif (DL-AE). Enam belas informan kunci dilibatkan dalam pengumpulan data melalui teknik wawancara semi terstruktur. Data kualitatif dianalisis secara tematik dengan bantuan Software NVivo 12 Plus. Temuan dalam penelitian ini diklasifikasikan menjadi tiga aspek utama, yaitu kegiatan sebelum penerapan DL-AE (Pra-implementasi DL-AE), kegiatan pada saat penerapan DL-AE, dan evaluasi program DL-AE. Namun, kurangnya alat aksesibilitas dan kurangnya pemantauan intensif selama DL-AE menjadi kendala yang harus diselesaikan. Dalam pelaksanaan DL-AE diperlukan peran dan tanggung jawab yang meliputi aspek fasilitasi, pembinaan dan pengajaran materi sesuai porsinya. Evaluasi mengenai penyesuaian atau perubahan metode dan menjamin pemerataan aksesibilitas juga menjadi pertimbangan khusus dalam meningkatkan efektivitas dan efisiensi DL-AE di masa depan. Hasil tersebut mempunyai implikasi penting dalam pengembangan pembelajaran digital yang memperhatikan aspek-aspek yang ditemukan dalam penelitian ini..

ABSTRACT

Digital learning (DL) in vocational education has become a crucial issue that continues to be developed for innovation, including in the automotive engineering department. However, the problem is related to the relevance of the competencies to be achieved in accordance with industry qualifications. In addition, the stages of DL have not been fully understood by various educational practitioners. This study aims to analyze the perceptions of industry and education practitioners regarding the implementation of DL in automotive engineering (DL-AE). Sixteen key informants were involved in data collection through semi-structured interview techniques. Qualitative data were analyzed thematically with the help of the NVivo 12 Plus Software. The findings in this study are classified into three main aspects, namely activities prior to DL-AE implementation (Pre-DL-AE implementation), activities during DL-AE implementation, and evaluation of the DL-AE program. However, the lack of accessibility tools and the lack of intensive monitoring during the DL-AE was an obstacle that had to be solved. During the implementation of DL-AE, roles and responsibilities are needed which include aspects of facilitating, guiding and teaching material according to the portion. Evaluations regarding adjustments or changes to methods and ensuring equitable accessibility are also special considerations in increasing the effectiveness and efficiency of DL-AE in the future. These results have important implications in the development of digital learning that takes into account the aspects found in this research.

1. INTRODUCTION

The increasingly intensive digital transformation is very interesting to discuss in more depth, bearing in mind that its impact is increasingly widespread and unstoppable (Lee, 2018; Schwab, 2016; Xu et al., 2018). For the education sector, there is no other choice but to create adaptive power for human resources which is part of the purpose of its existence (Hussin, 2018; Sharma, 2019). If not, competency disruption that ends in job disruption will haunt graduates from education. As is feared, various related studies reveal the great potential for technological disruption in the education sector (Mubarak & Petraite, 2020; Mutohhari, Sutiman, et al., 2021; Xu et al., 2018). This has indirectly hinted at competency transformation in human resources through education. Education is an important aspect that must be developed in the implementation of learning to achieve more comprehensive competencies and skills (Pavlova, 2009; Tūtlys & Spöttl, 2021). This is not easy to do, especially with vocational education which must equip students with competencies in three domains, namely cognitive,

affective and psychomotor (Astuti et al., 2021; Billett, 2011; Clark & Winch, 2007). They must strive for learning development and innovation that is able to respond to developments in digital transformation.

DL is commonly used as an umbrella term that describes a set of instructional practices supported by technology-based methods to enhance teaching and learning experiences. Moreover, referring to the use of information and communication technology in open and distance learning (Candra et al., 2022; Marcus-Quinn & Hourigan, 2017).. The fundamental purpose of DL is as a response to digital transformation which is considered scientifically capable of offering better learning effectiveness and efficiency (Akins et al., 2004; Mutohhari, Sudira, et al., 2021). The specific goal is to facilitate the learning process by students, especially in terms of the availability of digital learning resources and how to manage them to achieve learning goals. The immediate advantage is that learning becomes more flexible and does not have to be present in a real class (Candra et al., 2022; Goggins et al., 2013). The most important thing is an understanding of clear procedures and regulations regarding the roles of students and teachers in DL. In short, DL is a solution for developing innovative technology-based learning models that are currently developing to help boost competency achievement (Cox & Prestridge, 2020; Lapitan et al., 2021).

On the other hand, the potential use of digital learning also offers great opportunities to support students with special educational needs. However, this form of learning is also a challenging task especially for students with learning and/or behavioral difficulties for at least two reasons, considering first, digital learning is very demanding of students regarding self-regulation, metacognitive skills and learning motivation (Goggins et al., 2013; Marcus-Quinn & Hourigan, 2017). Students with learning and/or behavioral difficulties exhibit considerable problems in this area. Second, DL requires the resources and support of parents at home. However, many students with learning and/or behavioral difficulties often grow up in environments characterized by a low socioeconomic background, due to a lack of financial means to purchase the appropriate technical equipment required for a digital learning environment. In addition, especially children and adolescents with learning and/or behavioral difficulties do not receive adequate social, emotional and academic support from their parents (Mutohhari, Sofyan, et al., 2021; Rufaidah et al., 2021; Yusof et al., 2020). Therefore, their learning success is highly dependent on adapted and appropriate implementation of digital learning.

The main characteristic of implementing vocational education is the involvement of schools in implementing competency-based learning (CBL) (Billett, 2011; Clark & Winch, 2007). CBL can be interpreted as learning that is carried out with the orientation of achieving the competence of students in accordance with their respective competency standards. CBL is oriented towards developing competence in the cognitive, affective and psychomotor domains as a whole. Through DL, these three competency domains can be achieved through interactive and collaborative learning which is also a special feature of it (Billett, 2010; Hussain et al., 2021; Pavlova, 2009). In addition, students in doing practice or understanding theory are trained to develop ways of thinking creatively through exploring digital learning resources. Instruction in the DL environment can be designed to help students identify important information, understand how the material fits together and see how the material relates to prior knowledge adapted to their competency standards. In the DL environment, teaching shifts from the traditional environment that is controlled by the teacher or system, to education according to competency needs based on technological developments (Goggins et al., 2013; Kummanee et al., 2020). Instruction by teachers who are dominated online must encourage students to be active cognitively, affectively and psychomotor simulation. Instructions in DLs can also be delivered using instructional clips, which display instructional messages to learners both auditory and visually. Each clip includes a brief statement about an important step in the math process. Sound clips reveal and reason relationships between various elements of domain-specific knowledge (Marcus-Quinn & Hourigan, 2017; Roodt & Ryklief, 2019).

Digital learning (DL) has become an aspect of the subject that continues to grow in technology education or vocational education in the last decade (Beer & Mulder, 2020; Hamburg, 2021). Automotive is one of the majors in vocational education at the secondary level which also continues to concentrate on developing it (Jovanovic & Hartman, 2013; Kurnia et al., 2020; Sütőová et al., 2020). The difference is that the competencies achieved are in accordance with the competency standards of the graduates. DL is implemented in automotive vocational learning, both in theoretical and practical learning (Jovanovic & Hartman, 2013; Kurnia et al., 2020). The main goal is to get a broader learning experience through the help of digital technology. This is because digital technology is known to be able to facilitate the exploration of learning resources that are so broad and useful to support the achievement of automotive competence. In addition, DL will open up a high potential for creativity in students and teachers, so that it will also open up innovations in the context of implementing automotive learning (Haryanto et al., 2021; Pawar et al., 2020). In fact, several studies agree that DL is able to develop students' ways of collaborating and communicating in learning, thereby opening up a better breadth of thinking and student attitudes. Although it needs an exception that not all competencies in automotive can be accommodated by DL, especially some competencies that are practical in nature.

However, until now the implementation of DL in vocational education in general has presented many important problems that are felt by students and teachers as learning practitioners. From the perspective of students,

they still feel less competent in their fields after attending DL. They also feel that the context that must be studied is too broad, thus reducing efficiency in learning (Cox & Prestridge, 2020; Rasmitadila et al., 2020). This also seems to be confirmed by the teacher concerned that they also have problems related to the specifications of learning content to achieve work competencies in accordance with industrial world qualifications. In addition, practical procedures that should be mastered through DL are not well absorbed by students due to minimal digital literacy (Astuti et al., 2022; Mutohhari, Sudira, et al., 2021). In accordance with the essence of vocational learning which must be oriented to work skills according to industry, DL should be adapted to the world of work (Goggins et al., 2013; Thaheem et al., 2022).. In this regard, formulating it does not only involve learning practitioners, but also industry practitioners. This aims to synchronize the competency needs in the world of work with the DL concept, resulting in efficiency and effectiveness of learning.

Thus, industry perceptions regarding the implementation of DL through vocational learning are very important to be investigated and interpreted clearly regarding how to fulfill the achievement of effective work competencies. Education practitioners together with industry practitioners in the automotive sector can uncover phenomena that have occurred as a vocational experience. Collaboration in developing concepts carried out between learning providers and related industries will strengthen the implementation of DL and minimize the risk of potential losses. This qualitative research aims to analyze the experiences of learning practitioners and industry practitioners to develop DL concepts in order to improve current industry-based work competencies. The novelty of this study laid on the perspective of Vocational Education practitioners is involved in discussing findings in the field and integrating them into learning activities. While the perspective of industry practitioners is involved in providing the relevance of procedures, the scope of competence, the infrastructure used in learning. The results of this study are used as an important guideline for improving DL practice in vocational education, especially DL in the automotive engineering department (DL-AE) which has special specifications.

2. METHOD

This research is qualitative research that is used to explore perceptions related to the DL concept in the automotive engineering department in vocational education from learning practitioners and related industry practitioners. Some teachers who have good experience and competence in organizing learning become involved education practitioners. Then, several automotive industries representing several brands of motorized vehicles were appointed to involve the head of the workshop and representatives of the internal training division. Several representatives, both from educational practitioners and industry practitioners, are ensured to have their competence certified by the authorized institution therein. Figure 1 presents the procedures performed in this study.
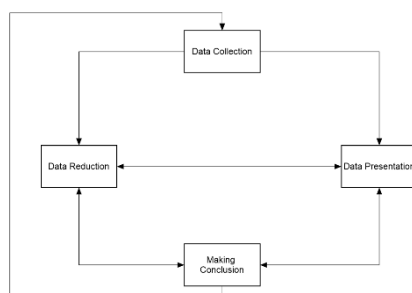

Figure 1. Research Procedure

Key informants who will be involved from both parties are decided using a purposive sampling technique. In particular, the characteristic of key informants in the study is show in Table 1.

Table 1. Profile of Key Informants

Pseudonym	Role	Age	Work Experiences	Short backgrounds
FM	Education practitioner	31	7 years	The teacher is certified in the automotive department, and serves as the head of the department
HAS	Education practitioner	32	7 years	The teacher is certified majoring in automotive, and serves as the head of the repair shop
RM	Education practitioner	29	6 years	The teacher is certified majoring in automotive, and serves as the head of the repair shop

Pseudonym	Role	Age	Work Experiences	Short backgrounds
YB	Education practitioner	44	26 years	Civil servant teacher majoring in automotive, and serving as curriculum representative
MN	Education practitioner	33	11 years	Civil servant teacher majoring in automotive, and serving as head of the department
HRN	Education practitioner	40	17 years	Civil servant teacher, and served as the head of the department
AC	Education practitioner	32	10 years	The teacher is certified majoring in automotive, and serves as the head of the repair shop
STM	Industry practitioner	47	19 years	Branch manager of garages and motor vehicle dealers
ZA	Industry practitioner	43	12 years	Workshop mechanic head
SOL	Industry practitioner	38	10 years	Workshop mechanic head
NTT	Industry practitioner	44	18 years	Branch manager of garages and motor vehicle dealers
HSM	Industry practitioner	35	7 years	Workshop mechanic head
PP	Industry practitioner	47	16 years	Branch manager of garages and motor vehicle dealers
RBM	Industry practitioner	42	17 years	Workshop mechanic head
SYT	Industry practitioner	47	23 years	Branch manager of garages and motor vehicle dealers
WRS	Industry practitioner	38	12 years	Workshop mechanic head

Base on Table 1, criteria for selected key informants for industry practitioners are 1) the area of expertise in the industry is automotive; 2) cooperate with vocational education for a minimum period of five years; and 3) has positions as manager, workshop director, training division and workshop head. In comparison, the criteria for key informants for education practitioners are teachers in vocational education with more than 5 years of teaching experience and who already have a teaching professional certificate. The goal is to obtain accurate information regarding the limitations and challenges of the DL that has been implemented, so that existing phenomena can be revealed, and be able to improve the effective DL concept.

Sixteen key informants, including seven automotive engineering vocational education practitioners and nine industry practitioners, were involved in providing the data. The number of informants was decided by considering the opinion of Cresswell that the qualitative informants were at least three (Cresswell, 2009). So, this study has met the criteria to consider data triangulation techniques. The work experience of key informants in this industry is 7-19 years, while education practitioners in the automotive department are 6-26 years. Based on age, key informants from industry were in the range of 35-47 years, while teachers were in the range of 29-44 years. The length of work in a certain position and the current age indicate that the informant can fully disclose the phenomenon and can explain the information.

Data collection was carried out in two stages, which began with interviews and continued with Focus Group Discussions. The interview phase was further divided into two stages as well. The first interview was conducted with nine key informants from industry practitioners. Interviews were conducted in August-September 2022 with a duration of ±60-90 minutes. The interviews used interview guidelines that had been validated by DL experts and vocational learning practitioners. Interviews were conducted to explore the experiences and opinions of industry practitioners regarding procedures and vocational competencies that are adapted to the conditions of the world of work in the implementation of DL. The research guidelines contain research questions that pilot study examiners have also carried out to ensure the accuracy and rationality of the data generated from the informants. The research questions focus on the outline of the digital learning implementation experience carried out by the automotive department, where the experience includes planning, implementation, and evaluation that has been carried out. In the next stage, interviews were conducted with seven key informants from educational practitioners who came from automotive engineering teachers. Interviews were conducted in September-October 2022 with a duration of ± 60-90 minutes. DL experts and vocational learning practitioners have validated the interview guide. In the final stage, industrial practitioners and educational practitioners have FGDs to discuss findings and evaluate the concept of DL implementation. Thus, a new formulation was made between the two parties to recommend that

DL organizers be more professional and effective in supporting learning. The instrument was reviewed based on a review of relevant literature and was reviewed by members to check the credibility of 16 key informants.

The data obtained during data collection then we perform data transcription. Furthermore, the data obtained was processed using the NVivo 12 Plus Software. Data were analyzed thematically to identify, evaluate, and describe concepts/themes based on the responses of key informants. The stages of data analysis consist of open coding, axial coding, and selective coding. Systematically, the stages of the research are as follows: first, the transcribed interview data is entered into a container file and read repeatedly, then nodes are created based on descriptive coding, coding in NVivo 12, and process coding. Furthermore, the data is grouped by category and theme to generate DL concepts. Second, the research team discussed the results of selective coding, including code simplification and integration between themes. The next step is presenting the data, which will be discussed in detail. The stages in data analysis are provided in Figure 2.
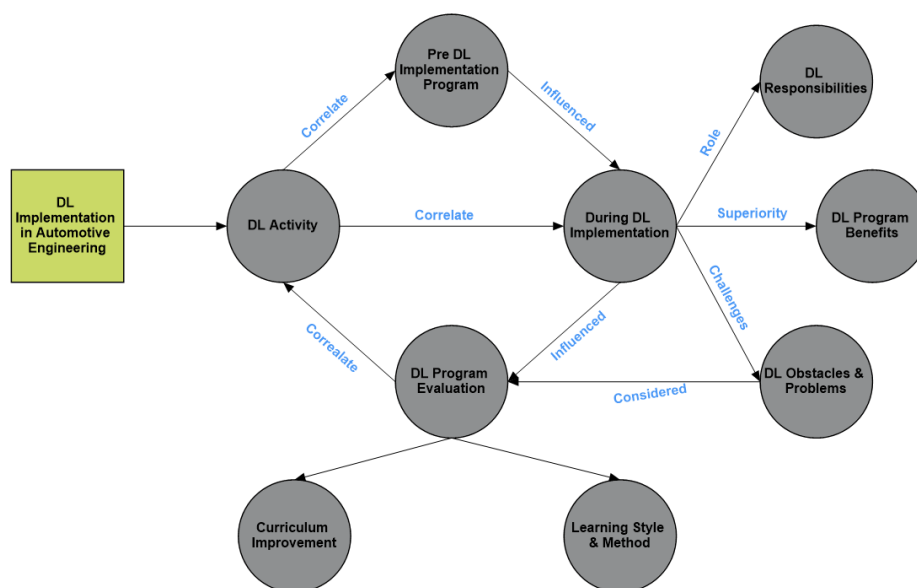

Figure 2. Data Analysis Framework

3. RESULT AND DISCUSSION

Result

The field findings that have been analyzed are in accordance with the previous concept mapping, as a guideline for presenting power. The results of the study show that the perceptions of learning practitioners and automotive industry practitioners regarding the application of Digital Learning (DL) in automotive engineering learning reveal three main themes, namely pre-DL activities, activities during DL. Themes related to pre-DL found include planning, ensuring readiness, understanding procedures, and analyzing challenges. Then, activities during DL include findings covering the roles and responsibilities of teachers and industry, DL activities in automotive learning, problems in implementing DL, and advantages of DL. Evaluation of the DL program reveals aspects of changing learning methods, and guaranteeing equal accessibility. DL evaluation is carried out based on problems or challenges during DL implementation to optimize learning in automotive engineering through DL effectively.

Activities in Pre-DL-AE Implementation

Learning activities prior to implementing DL are very important to support its success. The teacher's experience while implementing DL assisted by collaboration from industry is needed to align needs, strategies and learning outcomes. As stated by industry practitioners [STM, NTT, HSM, RBM, and WRS], that learning in automotive engineering is very important to make various adjustments to the needs and developments of the current automotive industry in order to achieve related industry work qualifications. Even though DL is an aspect that is not very familiar to the industry, the industry as a partner provides full support to DL organizers in vocational education, especially the automotive major. In the aspect of pre-DL implementation, industry practitioners have a main focus on understanding related to learning procedures. The main focus is divided into three sub-themes that must be strengthened before the DL is implemented, where the first is that students must understand and master the systematic steps in the production or repair process in automotive. Then the second is the emphasis on the role of students, teachers, and industry in working together to carry out DL. Finally, the industry thinks about

strengthening digital literacy, bearing in mind that now many learning resources are available electronically, the visualization is show in Figure 2.
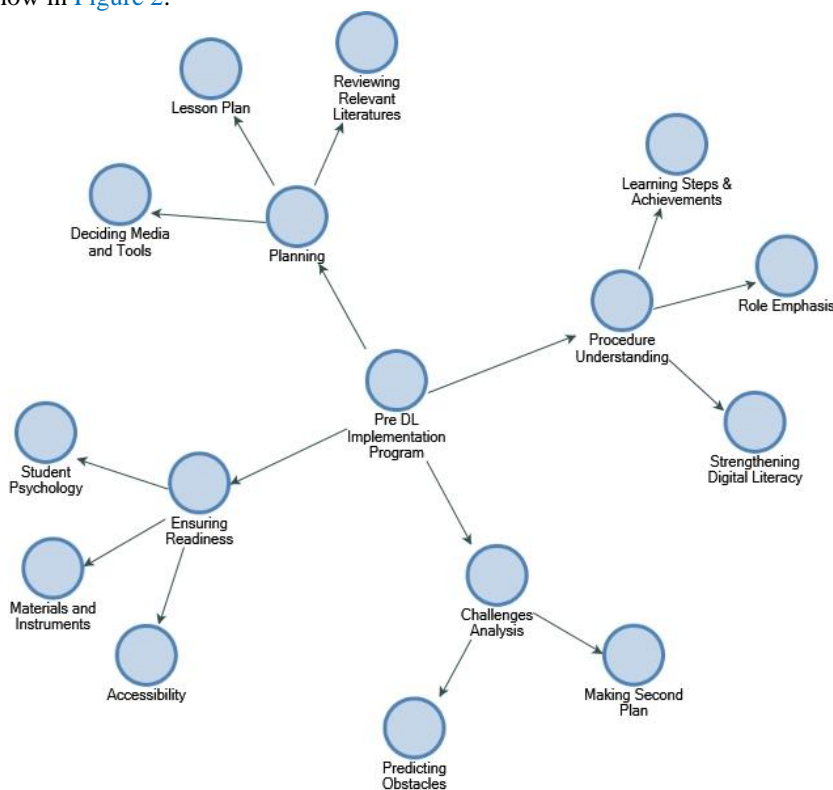

Figure 2. Activities of pre-DL-AE

Base on Figure 2, shifting to teacher perceptions, DL is seen as a response to the very rapid development of digital technology in the employment and education sectors. Based on the experience of implementing the previous DL, most of the teachers stated that the activity prior to implementation was the most important aspect. They think success or failure can actually happen from the start before the implementation of DL, but neither the teacher nor the students realize it. [FM, MN, and YB] who have implemented DL for more than 3 years revealed their failure in implementing DL for the first time. These failures include the lack of readiness of students and unexpected problems. Student readiness includes psychological conditions, material and instrument readiness from the teacher, and accessibility. While the unexpected problems refer to a lack of challenge analysis, so there is no second plan option. This perception was further expressed by [HAS, RM, and HSN] who explained that careful planning had to be carried out by teachers together with industry, considering that previous DL implementation experiences were constrained by careful planning. The planning in question includes selecting media and materials for making a study plan, and reviewing the literature to get a comprehensive picture regarding the implementation of DL.

Activities During DL-AE Implementation

We collected perceptions from teachers regarding experience in managing DL. The findings of activities during the implementation of DL resulted in important sub-themes, namely DL activities in the automotive field, the responsibilities of teachers and students as DL practitioners, and problems that arise to be resolved. During the implementation of DL in automotive learning, it has been revealed that important activities are carried out especially by students. According to the statements of the teachers, namely [FM, HAS, YB, and HRN], there was a development in students' learning behavior. The activity during the first DL activity that was seen was a case study, where students observed automotive problems that occurred in the field using virtual media. The two students are also active in conducting data mining in various digital learning resources that are in accordance with the context studied in automotive. Students are also directed and able to design and develop several automotive-related products or services. Finally, DL provides virtual-based theoretical and practical simulations, so that it has the benefit of increasing direct practical readiness. Activities during DL-AE implementation is show in Figure 3.

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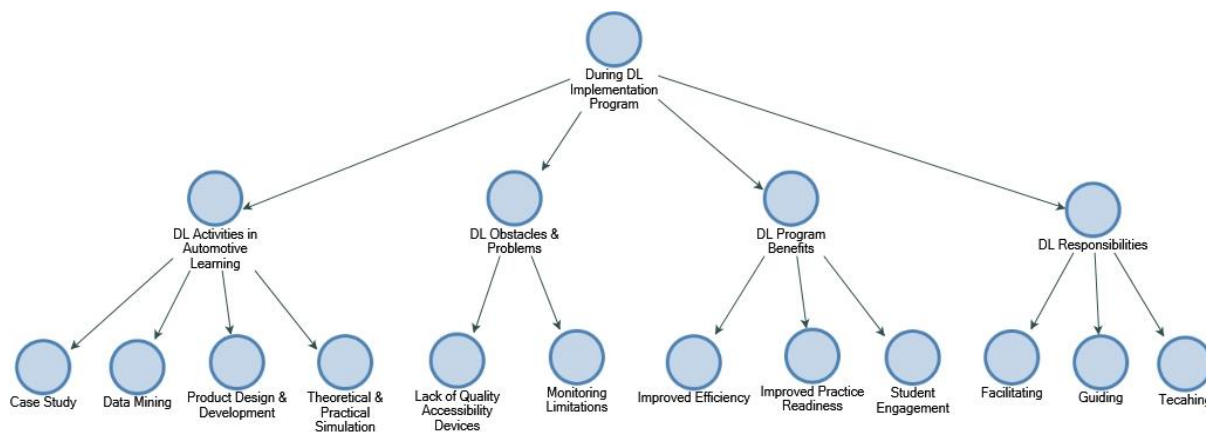
Figure 3. Activities During DL-AE Implementation

Meanwhile, in terms of strengths and weaknesses during the implementation of DL, it can be seen that increased efficiency, readiness for practice and student involvement are the advantages as show in Figure 3. Meanwhile, students are still constrained by the quality of accessibility tools and limited monitoring from teachers. This was expressed directly by [RM, MN, and YB]. Although dominance was shown in the aspect of excess DI in several SMKs, the five informants highlighted problems that had the potential to develop and reduce the effectiveness of DL. In the following we detail direct quotations from these informants:

DL-AE Program Evaluation

The automotive industry, which is a school partner, has been given an explanation and has understood the implementation of the DL. From their point of view, there is one big theme that must be improved by teachers in managing DL. Changes in learning methods that are oriented towards increasing monitoring and interaction between students or students and teachers (see Figure 4). Monitoring is very important to be carried out intensively, because in automotive learning there are many basic competencies that must receive intensive assistance from competent people. In addition, the production process or just in the automotive industry currently places more emphasis on collaborative work processes, so that learning must also be oriented towards digital-based collaborative learning. This was disclosed by [STM, ZA, and RBM] as industry partners who helped formulate the DL. DL-AE evaluation program is show in Figure 4.
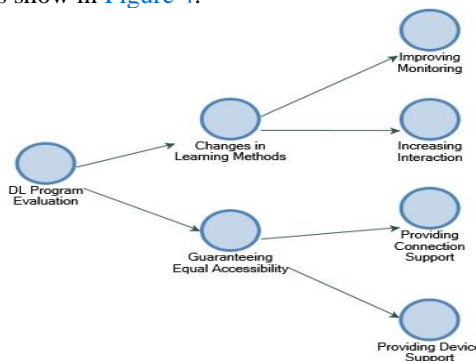

Figure 4. DL-AE evaluation program

Base on Figure 4, it seems to have been realized by several teachers who also revealed that increasing the intensity of monitoring and interaction during the DL was ongoing. But on the other hand, as a learning practitioner, the teacher also criticizes the distribution of accessibility. Teachers must guarantee this by providing connection support and providing device support. This is very important to do amid the limitations of some students in that aspect [HAS, MN, AC].

Discussion

Implementation of the DL-AE program is an effective and efficient strategy for students, especially in improving their vocational competence. In addition, student involvement during learning and student readiness in practice can also be improved. Without proper implementation of DL-AE, students have a great potential to lose their learning orientation, including competency achievement according to work qualifications. In addition, without the DL-AE program, the responsiveness of students and teachers regarding the development of digital

technology is weak. This is relevant to developments currently being faced by the world of work and education, namely digital transformation (Masdoki et al., 2021; Schwab, 2016). Where, vocational education that has a close relationship with technology and industry must seek various learning activities that are oriented towards mastery of digital technology to support the achievement of work competencies according to industry qualifications (Pavlova, 2009; Rujira et al., 2020). This study reveals three major aspects for ideal DL-AE implementation, namely "activities in Pre-DL-AE implementation, activities during DL-AE implementation, and DL-AE program evaluation.

Prior to the implementation of the DL-AE, automotive industry practitioners expressed their opinion that it was very important for teachers and students to understand learning procedures related to the mastery of work competencies. The first is an understanding regarding what competencies must be achieved and what are the stages in achieving them. This is important considering that several studies have revealed their research results which state that learning orientation is very important to provide students with an understanding of their learning needs and how to meet these needs (Aboobaker & K.A, 2020; Kayode & Adeyemi, 2016; Sutiman, Sofyan, Arifin, et al., 2022). The second is related to the role emphasis on the involvement of teachers, students, and industry in organizing DL-AE. This is very important because all three are required to be able to work together to build more effective and efficient learning to achieve work competencies in accordance with industry qualifications (Astuti et al., 2021; Made Sudana et al., 2019). The emphasis on this role must be clear from the start, so that each has a task that must be carried out. For example, the teacher as a learning facilitator and mentor, students as subjects who carry out the learning process independently using a digital platform with teacher instruction guidelines, and industries that play a role in providing up-to-date competency qualifications and facilitating conducting field case studies (Goggins et al., 2013; Snell, 2019). Then the third is about strengthening digital literacy which is a major requirement in digital learning. Industry parties revealed that technology in the automotive industry has also shifted towards digital, so digital literacy is needed in addition to learning, it is also needed in the industry.

Meanwhile, teachers also have important perceptions regarding activities prior to implementing DL-AE. They revealed the importance of the initial activity prior to the implementation of DL-AE, considering they already have quite complete experience regarding its implementation. Based on this experience, it is very important to ensure student readiness which includes psychological conditions, material and instrument readiness from teachers, and accessibility. Psychological and mental conditions are indeed important to ensure readiness, considering that in learning, the effectiveness of competency achievement depends on this readiness (Kurniawati et al., 2022; Sutiman, Sofyan, Soenarto, et al., 2022). Then the second is about the analysis of challenges that have the potential to hinder the implementation of DL-AE later. This is important considering that in the midst of the rapid development of digital technology it is very possible for a shift in learning patterns and learning qualifications to occur, so several plans are needed to anticipate the first plan failing (Cox & Prestridge, 2020; Roodt & Ryklief, 2019). Nevertheless, they explained that careful planning had to be carried out by teachers together with industry, considering that previous DL implementation experience was constrained by careful planning. The planning in question includes selecting media and materials for making a study plan, and reviewing the literature to get a comprehensive picture regarding the implementation of DL (Marcus-Quinn & Hourigan, 2017).

Shifting into the identified DL-AE implementation stage includes four important aspects, namely activities during learning, responsibilities, problems and advantages of DL. In terms of activity, there are four important activities carried out by students, namely exploring data collection, conducting case studies, simulating their cognitive and psychomotor processes, and designing and developing products. It makes perfect sense that digital technology is very possible to accommodate students in finding various materials and learning resources that can be used as a reference in finding and studying problems, designing and developing products, and being able to stimulate cognitive and psychomotor stimulation as a result of the case study process in an active way virtual (Kummanee et al., 2020; Roodt & Ryklief, 2019). Then the roles and responsibilities especially of teachers and industry in facilitating, guiding, and teaching automotive material during DL-AE. Previous relevant research has confirmed that vocational learning in order to achieve work competence requires the role of intensive schools and industries in organizing learning (Made Sudana et al., 2019; Sutiman, Sofyan, Arifin, et al., 2022). Then, with regard to the benefits of implementing DL-AE, of course it can increase learning efficiency, readiness to do the original work, and student involvement also increases, as stated by previous research (Dobricki et al., 2020; Zwart et al., 2020). Likewise, accessibility problems and lack of monitoring intensity are indeed the weaknesses of online learning (Adams et al., 2021; Rasmitadila et al., 2020).

The last is related to the discussion of industry practitioners and learning practitioners related to evaluating the implementation of DL-AE. The first evaluation is related to changes in learning methods based on the problems that occur and the importance of new methods. This relates to methods that are able to increase interaction, both between students and students and teachers during the implementation of DL-AE. This is consistent with previous research which underlines the importance of teacher learning methods that are able to build interaction and collaboration in an online learning environment (Alphonce & Mwantimwa, 2019; Hamburg, 2021). In addition, an increase in monitoring intensity as reported by several teachers as evaluation material is also

an important aspect, as revealed by previous research as well. Then the last is the problem related to ensuring equal accessibility by providing access device support and internet connection. This is very important considering that this is the challenge of online learning, because it is very much influenced by the level of accessibility that varies between regions of each person (Cox & Prestridge, 2020; Rasmitadila et al., 2020).

This research has important implications, especially for developing digital learning, which is very urgent. It is important for VEs in general, to carry out careful planning with the involvement of industry practitioners who know the appropriate training content to clarify the direction of digital technology integration in DL-AE. Another important thing is the adequacy of infrastructure and increasing the intensity of monitoring must be fulfilled to implement DL-AE. In addition, this research also has a contribution to clarify the direction of further research, especially in developing strategies for the success of DL-AE for the achievement of more optimal learning. However, this research is limited to more than just a few practitioners in certain industries and educational practitioners in certain institutions, so their views still need further exploration.

4. CONCLUSION

The perceptions of education practitioners and industry regarding the implementation of DL-AE in vocational education have made fundamental changes in increasing the effectiveness and efficiency of learning to achieve work competencies in accordance with industry qualifications. In implementing DL-AE, it is very important to finalize activities prior to implementing DL-AE (pre-DL-AE implementation) which includes understanding procedures, planning, and ensuring student readiness. Furthermore, four important aspects, namely activities during learning, responsibilities, problems and advantages of DL are important things to pay attention to. The important thing is DL activities in automotive learning which consist of data mining, case studies, product design & development, and theoretical & practical simulations. However, the lack of accessibility tools and the lack of intensive monitoring during the DL-AE was an obstacle that had to be solved. On the other hand, during the implementation of DL-AE, roles and responsibilities are needed which include aspects of facilitating, guiding and teaching material according to the portion. Finally, evaluation related to adjusting or changing methods and ensuring equitable accessibility is a special consideration in increasing the effectiveness and efficiency of DL-AE in the future. The increasing importance of DL in vocational education, especially in the automotive major, reinforces that in the future there is a great need for comprehensive involvement from industry practitioners in providing curriculum input and learning methodologies with the aim of achieving work competence in students according to related industry qualifications.

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