The Innovation of TVET Based E-Training to Increase The Human Resources Level for Vocational Educators in The Era of Society 5.0

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**Abstract.** This study aims to: (1) map the need for skills to improve human resources for vocational educators; (2) developing an innovative TVET-based e-training system; (3) testing the feasibility of TVET-based e-training system innovation; and (4) increasing the innovation of the TVET-based e-training system to improve human resources for vocational educators in the era of society 5.0. This study uses the R&D method with product validation to two expert teams (e-learning experts and vocational materials experts). In the final stage, an effectiveness test was conducted on vocational educators in higher education. The results of this study include (1) mapping the need for skills to improve human resources for vocational educators, including life and career skills (83%), learning and innovation skills (95%), information media and technology skills (91%), inventive thinking (87%%), effective communication (87%), logical thinking skills (97%), teamwork and interconnectedness (85%), civic and digital citizenship (87%), global competence (91%), and intercultural competence (83%); (2) the feasibility level of the TVET-based e-training system innovation is very high with an average score of 3.8; and (3) the innovation of the TVET-based e-training system is proven to be effective in increasing the human resources of vocational educators in the era of society 5.0.

**Keywords:** TVET, E-Training, Human Resources, Vocational Educators, Society 5.0.

INTRODUCTION

Era industry 4.0 causes complex uncertainty in all aspects of human life [1]–[3]. ]. In anticipation of this, the era of society 5.0 emerged. In the Era of Society 5.0, technological developments are not only for the industrial aspect but also for the educational aspect [4]–[8]. Especially in the world of education, it has an essential role in facing the era of society 5.0. As the spearhead to prepare superior quality educators, the world of higher education must begin to change its learning paradigm. The new paradigm of higher education is currently producing educators who are sensitive to the latest technology. The superior educators produced must be able to act as facilitators and inspirations for bringing up student creativity. Therefore, the world of higher education must improve services and access to education by improving the quality of infrastructure and technology. Digital infrastructure should be built to support learning technology development facilities [9], [10].

Currently, the function of educators must be supported by mastering the field of digital literacy learning [11]. Digital literacy as a professional ability to understand information, technology, and Media is critical to be developed [12], [13]. So that educators can play a more innovative and productive role in improving the quality of students. This does not mean that the role of the teacher will be replaced by technology. However, technology will be able to optimize the role of teachers in the classroom as superior individuals who have knowledge, skills, and character. Therefore, educators must utilize technology to support student learning, including the internet of things, virtual or augmented reality, and artificial intelligence, to accommodate student learning needs. Activity collaborative learning deserves to be optimized like a new era learning scenario [14], [15].

TVET Development in the era of educational disruption has undergone a paradigm shift in the adaptation and innovation process to align with industrial developments and prepare productive individuals [16], [17]. Based on that, from the point of view of education, TVET educational competencies are essential for career development and the quality of graduates produced. The quality of TVET graduates can play an optimal role in the industry if their competencies match the industry's needs. The industry has responded to improve the competence of educators to be able to transfer their knowledge to their students so that the education and training of TVET educators must be developed based on the competence of developing superior human resources.

The quality of human resources for TVET educators currently needs to be developed professionally and sustainably to produce quality graduates [18]–[20]. So far, the biggest challenge in developing TVET educators is the lack of career and life skills training. TVET educator career development training focuses on industry needs-oriented skills development. TVET educators have a central role in transforming industry needs into graduate job opportunities. So that increasing the competence of TVET educators is a crucial step to the success of TVET education in the era of society 5.0, which is proficient in the use of digital technology. The application of models, media characterizes the use of digital technology-oriented learning and learning methods used [21], [22].

So far, the need for vocational skills is based on communication skills, critical thinking, collaboration, and creativity (4C skills) [23]. Educators' higher-order thinking skills (HOTS) are essential to developing graduates' knowledge who can adapt to the work environment. This ability emphasizes the peak ability of knowledge with a work of innovation. Meanwhile, the TPACK ability of TVET educators has a role in improving the quality of learning by integrating technology, pedagogy, and content. Therefore, to develop the 4C skills of TVET graduates, it is necessary to develop the HOTS and TPACK of TVET educators optimally.

However, reality in the field, especially the education and training of vocational educators, is not yet wholly running well. This is because there is no complex mapping of the need to increase human resources for vocational educators. In addition, there is no digital technology innovation as a vocational educator training system that is up-to-date and easy to use. This is the most significant contributor to the quality of TVET graduates who are unemployed and unable to adapt to the world of work. The ability to develop life skills and educational careers and the resulting TVET graduates have minimal capabilities.

Based on various presentation problems complex in the field of TVET education above, this study aims to provide concrete solutions. So the main objectives of this research are; 1) mapping the need for skills to improve human resources for vocational educators; 2) developing an innovative TVET-based e-training system; 3) testing the feasibility of TVET-based e-training system innovation, and 4) increasing the innovation of the TVET-based e-training system to improve human resources for vocational educators in the era of society 5.0

# mETHOD

This research is designed to produce a technological innovation product of education and test its effectiveness. The method in this study uses the R&D method. This method was chosen because it produces digital technology products as an e-training system for vocational educators. The steps taken by researchers to produce this technology product include: 1) mapping the needs of the ability to improve resource TVET human educators, 2) developing TVET-based e-training system innovations, 3) testing the feasibility of e-training system innovation products based TVET, and 4) testing the effectiveness of the TVET-based e-training system to improve the human resources of TVET educators in the era of society 5.0.

Phase 1 in this study used a data collection instrument in the form of a closed questionnaire with two answer choices to reveal the development needs of vocational educators. Phase 2 of this research is in the form of product development based on needs mapping. Phase 3 in this study used instruments in the form of a material expert validation questionnaire and e-learning media in the field of vocational education. While in stage 4 (the final stage of research), to test the product's effectiveness, quantitative research methods were used with quasi-experiments. In this quasi-experimental research, instruments in the form of pretest questions were used to test initial and final abilities posttest to test the final ability. The analysis used in this study is divided into 2, namely quantitative descriptive analysis for the questionnaire instrument and t-test analysis for the test instrument.

# result

Research results are translated into three discussions: 1) mapping of capability needs, 2) expert validation results, and 3) significance test results. The details are explained in the subject below.

Capabilities Need Mapping

From mapping needs, The abilities collected from the questionnaire instrument were found to be ten primary skills for developing TVET educators' skills in the era of society 5.0. The details are shown in Table 1 below.

|  |  |  |  |
| --- | --- | --- | --- |
|  | **TABLE 1. Percentage of ability requirement** |  | |
| **No.** | **Ability** | **Percentage** | |
| **Yes** | **Not** |
| 1 | Life and Career Skills | 83% | 17% |
| 2 | Learning and Innovation Skills | 95% | 5% |
| 3 | Information Media and Technology Skills | 91% | 9% |
| 4 | Inventive Thinking | 87% | 13% |
| 5 | Effective Communication | 87% | 13% |
| 6 | Logical Thinking Skills | 97% | 3% |
| 7 | Teamwork and Interconnectedness | 85% | 15% |
| 8 | Civic and Digital Citizenship | 87% | 13% |
| 9 | Global Competence | 91% | 9% |
| 10 | Intercultural Competence | 83% | 17% |

From Table 1 above, the percentage of yes agree with the need for developing life and career skills reaches 83% (yes) and 17% (no), learning and innovation skills is 95% (yes) and 5% (no), information media and technology skills by 91% (yes) and 9% (no), inventive thinking by 87% (yes) and 13% (no), effective communication by 87% (yes) and 13% (no), logical thinking skills by 97% yes and 3% (no), teamwork and interconnectedness by 85% (yes) and 15% (no), civic and digital citizenship by 87% (yes) and 13% (no), global competence by 91% (yes) and 9% (no), and intercultural competence by 83% (yes) and 17% (no). So it can be concluded that the component needs ten abilities from all respondents agree.

## Expert Validation Results

From the results of the expert validation questionnaire analysis, which includes vocational material experts and e-media experts learning, Data on the feasibility of TVET-based e-training system innovation media products are obtained. The details are shown in Table 2 below.

|  |  |  |  |
| --- | --- | --- | --- |
|  | **TABLE 2. Vocational material expert validation results** |  |  |
| **No** | **Indicator Items** | **Score** | **%** |
| 1 | The accuracy of the content of the material contained in the media with the TVET curriculum | 4.00 | 100.00 |
| 2 | Accuracy of materials with vocational education policy goals (TVET) | 4.00 | 100.00 |
| 3 | The level of material delivery according to the character needs of educators in the era of society 5.0 | 4.00 | 100.00 |
| 4 | Compliance with the latest developments in vocational education (laws and policy regulations) | 3.50 | 87.50 |
| 5 | Delivery of the latest information that increases new and relevant knowledge regarding TVET | 3.33 | 83.33 |

From Table 2 above, the results of material expert validation in terms of the accuracy of the content of the material contained in the media with the curriculum get a score of 4 or 100%, the accuracy of the material with the aim of vocational education policies gets a score of 4 or 100%, the level of material delivery according to the character needs of educators in the era of the era society 5.0 gets a score of 4 or 100%, conformity with the latest vocational education developments (laws and policy regulations) gets a score of 3.50 or 87.50%, and the delivery of the latest information that increases new and relevant knowledge related to TVET gets a score of 3.33 or 83.33%. So it can be concluded that the TVET-based e-training system innovation has a high feasibility value based on the results analysis validation data of vocational material experts. At the same time, the results of the validation data analysis of e-learning media experts in the field of vocational education are shown in Table 3 below.

|  |  |  |  |
| --- | --- | --- | --- |
|  | **TABLE 3. Validation results of e-learning media experts** |  |  |
| **No** | **Indicator Items** | **Score** | **%** |
| 1 | Level using program or application | 4.00 | 100.00 |
| 2 | Design and appearance compatibility | 4.00 | 100.00 |
| 3 | Page accuracy and appearance on content | 3.33 | 83.33 |
| 4 | Easy and unrestricted user access | 4.00 | 100.00 |
| 5 | Easy level developed by the user | 4.00 | 100.00 |
| 6 | Explanation of the toolbar and menubar as needed | 3.50 | 87.50 |
| 7 | Accuracy of color effects and background presentation on appropriate media | 4.00 | 100.00 |
| 8 | Level of conformity with the character of students in the era of society 5.0 | 3.33 | 83.33 |
| 9 | The attractiveness of the main menu display and the material menu | 4.00 | 100.00 |
| 10 | Ease of users in overcoming errors | 3.33 | 83.33 |

From Table 3 above, the results of the e-learning expert validation in terms of the level of using the program or application get a score of 4 or 100%, the compatibility of the design and appearance gets a score of 4 or 100%, the accuracy of the page and the appearance of the content gets a score of 3.33 or 83.33%, access easy and unrestricted users get a score of 4 or 100%, the level of ease developed by the user gets a score of 4 or 100%, the explanation of the toolbar and menubar according to the needs gets a score of 3.50 or 87.50, the accuracy of color effects and background menus according to get a score of 4 or 100%, the level of conformity with the character of students in the era of society 5.0 is 3.33 or 83.33%, the attractiveness of the main menu display and the material menu gets a score of 4 or 100%. The ease of users in overcoming errors gets a score of 3.33 or 83.33%. So it can be concluded that the TVET-based e-training system innovation has a high feasibility value based on the results analysis e-learning media expert validation data.

## Significance Test Results

From the results of data analysis in the form of parametric inferential statistics with a t-test which includes the results of the initial ability test and final ability data obtained from the ability of the two groups before and after treatment or testing of TVET-based e-training system innovation products in the experimental class, the details are shown in Table 4 below.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **TABLE 4. Summary of preliminary test results** | | | | |
| **T-test for Equality of Means** | | | | |
| T | df | Sig. | Mean Difference | Std. Error Difference |
| -1.11  -1.11 | 54  54.4 | .27  .27 | -1.84  -1.84 | 1.68  1.67 |

From Table 4 above, the results of the t-test analysis of the initial ability of the two classes get a significance value of 0.27. The two classes do not have different initial abilities because the significance value is above 0.05. So it can be concluded that the two classes that are the subject of the study do not have differences in initial abilities. Meanwhile, the final ability t-test analysis results of the two classes are shown in Table 5 below.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **TABLE 5. Summary of final ability test results** | | | | |
| **T-test for Equality of Means** | | | | |
| T | df | Sig. | Mean Difference | Std. Error Difference |
| 7.63  7.60 | 54  53.1 | .004  .004 | 11.99  11.99 | 1.58  1.58 |

From Table 5 above, the results of the t-test analysis of the final ability of the two classes get a significance value of 0.004. This means that the two classes have different final abilities because the significance value is below 0.05. So it can be concluded that the experimental class has the final ability result above class control In other words, the effectiveness of the TVET-based e-training system innovation media is achieved.

DISCUSSION

The discussion in this study is translated into three discussions which include: 1) increasing the level of human resources for vocational education in the era of society 5.0, 2) e-training innovation emulation digital on vocational educators, 3) TVET-based e-training system innovation as a facility for forming high human resources. The details are explained in the subject below.

Increasing the Level of Human Resources for Vocational Education in the Era of Society 5.0

The educational community in the era of society 5.0 is required to be able to solve various educational challenges and problems by optimizing the use of educational technology in the education 4.0 era as a response to the disruptive era (industry 4.0). This means that educators in the era of society 5.0 must understand the artificial intelligence system as one of the characteristics of quality educators [24], [25]. Vocational educators in the era of society 5.0 can increase their level of competence by mastering digitalization in learning. This is intended to answer the new paradigm of the world of education. Currently, the world of education requires regulations that have the development of skills and competencies of vocational educators. Therefore, synergy is needed between education policymakers, education implementers, and education supervisors to achieve this. This synergy will encourage an increase in level human resources vocational educators by optimizing the role of various education components. Especially in higher education which has the duty and function to produce education, Quality professionals must strive to integrate various digital technologies in the planning, to implement, and evaluate their learning systems [26], [27].

Vocational educators who can adapt and innovate are the hallmarks of success in the education of prospective vocational teachers. Educators must continue to develop by the demands of the development of learning theory and the needs of students [28]. Vocational educators have a central role in improving the thinking power and skills of students. Thinking power, commonly referred to as the current level of student knowledge, must be emphasized on the ability to be creative by utilizing existing technology. This means it can be said that increasing the level of human resources for vocational education begins with optimizing the role of vocational educators. Therefore, the education and training of vocational educators is the main driving force that must be renewed. This update is based on the learning paradigm of society 5.0 era based on mastery of learning technology. Learning technology in this era includes the internet of things, big data, and artificial intelligence.

The continuing development of vocational educators' abilities is tailored to the needs of industry and students [29]–[31]. Level up requirementresourceHuman vocational education has a central role in achieving national education goals. Vocational educators must develop life and career skills, learning and innovation skills, information media and technology skills, inventive thinking, effective communication, logical thinking skills, teamwork and interconnectedness, civic and digital citizenship, and global and intercultural competence. This means that the development of the level of vocational educators must be designed in continuous education and training and using the latest technology. Especially in the field of vocational education, the aspect of mastering technology is not only at the stage of the ability to use it, but more at the stage of the ability to develop and create technology to answer the challenges of changing global industrial needs. Therefore, a training system based on the need for professional vocational educators is necessary to continue.

In conclusion, vocational educators who can answer society's challenges in the era of society 5.0 are required to have a good mastery of the latest digital technology. This is more emphasized on self-development capabilities that are by the needs of the industry globally. In addition, genuine efforts are needed from education policymakers for the career development of vocational educators so that the needs of vocational students can be better served.

Emulation of Digital E-Training Innovations for Vocational Educators

Emulation of digital e-training system innovation as an effort to optimize the role of vocational educators in the era of society 5.0 has a strategic function. This innovation has high feasibility by the principle of developing electronic-based learning media. The development of electronic-based learning media or e-learning must have a high level of ease of use. Vocational educators in today's era need to be trained to use e-learning applications. E-learning is an essential component of the professional development of vocational teachers [32]. The professionalism of vocational teachers can be increased through digital training. Therefore, it takes hard work to train vocational educators by mobilizing all the sophistication of digital technology.

The digital e-training innovation developed in this research is adapted to the latest developments in vocational education. Vocational education today adheres to the old paradigm to produce work-ready graduates and develops graduates' capabilities to be career-ready. Vocational education graduates have the potential to become agents of a country's development or even vice versa to become the most significant contributor to unemployment in a country. This should be a severe concern to declare vocational education goals oriented towards improving graduates' careers. So vocational educators must be able to develop students' technical competencies in their fields and students' competencies in mastering technology to increase work effectiveness in the industry in the future [33], [34].

The development of e-training learning technology for vocational educators needs to pay attention to the depth of the material and its sophistication. This research focuses on the aspects of the accuracy of the content of the material contained in the media with the curriculum, the accuracy of the material with the objectives of vocational education policies, the level of material delivery according to the character needs of educators in the era of society 5.0, conformity with the latest vocational education developments (laws and policy regulations ), and the delivery of up-to-date information that enhances new and relevant knowledge regarding TVET. This is by the principle of developing e-learning technology in the context of continuing education goals, namely for student learning satisfaction which is supported by the availability of internet facilities [35].

In conclusion, the emulation of digital e-training system innovation as an effort to improve the quality of vocational educators in the era of society 5.0 has an important role. This role is essential to achieve the goals of national education and sustainable development of superior human resources. The development of electronic-based learning technology in addition to having a good depth of material, must also be easy to use to be more effective.

TVET-Based E-Training System Innovation as a Facility for Forming High Human Resources

Multidisciplinary digital competence and vocational education curriculum development are the main focus for forming future vocational teachers [36], [37]. However, the education of prospective vocational educators has limited time for developing their capabilities. So that many vocational educators are not competent enough to play their role. This will lead to a loss of learning that has fatal consequences for the nation's next generation. A vocational educator training model is needed to form high human resources in vocational education. Vocational educator training has the main goal of career development. The career development of vocational educators is formed in traditional education in the classroom and the use of digital technology.

The TVET-based e-training system innovation is designed to develop academic skills, industrial skills, and technological literacy. The academic ability of vocational educators is essential for career development. This is inseparable from the meaning that logical thinking will affect the adaptability of an educator. In addition, industrial skills are needed. Vocational educators must master that. These skills are built from knowledge of the industry's work climate and work culture, both related to the need for competence and the need for reliable work characters in the era of society 5.0. The technological literacy ability of vocational educators means that educators must learn continuously regarding technological developments, both in their use and innovation of technology-based learning products. So it can be said that the formation of high human resources for vocational educators can be done by using e-training technology that focuses on individual career development. This is in line with the training principle that profound arrangements are needed at their implementation's planning and implementation stages [38].

In conclusion, superior vocational educators as a manifestation of a country's educational progress need to be a serious concern of all parties. Therefore, a system of education and training of vocational educators is needed by utilizing currently developing technology. In addition, in the development of e-training technology, appropriate material content is needed in the career development of vocational educators concerning high human resources.

# CONCLUSION

The need for increasing human resources for vocational educators is essential in developing a nation in the fields of education and industry. This is inseparable from the link between vocational education and industry, which need each other. The development of TVET-based e-training system technology in this study has a high feasibility level as an e-learning medium with a good content depth of material. In addition, in this study, the development of e-learning media in the form of an innovative TVET-based e-training system has a level of effectiveness to improve the capabilities of vocational educators in the era of society 5.0. It is recommended that technological innovations of similar e-training systems be developed according to research subjects' needs and support facilities to achieve product development effectiveness.

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