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# Preparedness of the vocational higher-order thinking skills of pre-service teachers during internship program implementation

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## *ABSTRACT*

This research aims to analyze the vocational higher-order thinking skills (V-HOTS) of pre-service teacher interns at teacher education colleges during an internship at vocational high schools. The research employed mixed methods through (1) observation and evaluation of student preparations, (2) semi-structured interviews on the role of teachers in improving V-HOTS in schools, and (3) distributing questionnaires of students' perceptions to the tenth grade across six vocational high schools divided into two clusters. The results demonstrate that the intern teachers succeeded in mastering V-HOTS according to students' perceptions, where they achieved scores that far exceeded the previously set standards. Further statistical analysis revealed significant differences in perceptions between the two groups of intern teachers (Clusters I and II), indicating variations in the understanding or application of V-HOTS between the two groups. This implies that the pre-service teacher interns in Cluster II have better V-HOTS in implementing internship programs, although the schools in Cluster II are less supportive of information and communication technology (ICT). This research provides insights into the effectiveness of V-HOTS among pre-service teacher interns, suggesting that additional support and resources might be needed in schools that are less supportive of ICT to ensure consistent application of V-HOTS.

**Contribution/Originality:** This study contributes to the existing literature on teaching practices for prospective vocational teachers. It examines the impact of innovative learning models such as project-based learning (PjBL) on students' HOTS in Surakarta. It also aims to guide prospective vocational schoolteachers in implementing innovative learning models.

## 1. INTRODUCTION

The internship program is a job training system regulated by Indonesian employment law (*Undang-Undang* No. 13 of 2003), Article 9, which reads that job training is organized and directed to equip, improve, and develop professional competence that will increase capability, productivity, and welfare. This implies that every entrepreneur, including those in education institutions, is obliged to provide job training for prospective graduates through an internship program. In practice, the academic internship coordinators play a role in supporting the interns to gain real-world work experience (Del Rosario & Dela Cruz, 2022; Kramer-Simpson, 2018). However, for vocational graduates, there is an obstacle in the link and match relationship between schools and the workplace

(Suharno, Pambudi, & Harjanto, 2020). Although the government always voices this program, it is still only a slogan. This problem affects a large number of unemployed vocational high school graduates, contributing to Indonesia's high unemployment rate. According to the Central Statistics Agency (CSA), the number of unemployed people in February 2021 reached 10.38%, most of whom were vocational high school graduates.

Another component that contributes to the problem of unemployment is learning, which produces uncompetitive human resources in the workplace. The data on the achievement scores of the Program for International Student Assessment (PISA) shows that Indonesian students obtained low scores in the categories of reading, science, and math skills because they ranked 75$^{th}$ out of 81 countries.

This condition denotes that students received 21$^{st}$-century skills, including critical thinking, problem solving, decision making, collaboration (teamwork), communication, and creative thinking, which are important for solving high-level problems in the vocational field (Utama, Sajidan, Nurkamto, & Wiranto, 2020). Moreover, the students who continue to study at university will bring their learned habits, which have a significant impact in the long term, and higher-level competence comes from the better achievement of previous students (Song, Zeiser, Atchinson, & Reyes, 2021). The problems can be eliminated if schools and universities provide a higher-order thinking skills (HOTS) learning model.

HOTS are defined as the ability to apply knowledge, skills, and values through reasoning and reflection to solve problems, make decisions, innovate, and succeed in creating something (Hamzah, Hamzah, & Zulkifli, 2022). Lewis & Smith (1993) stated that HOTS occur as a student uses information stored in memory that are interrelated and rearranges and expands the information to achieve goals or find possible answers in confusing situations. The researchers concluded that a HOTS internship program teaches the ability, skills, and values to enhance something through new information, innovate, make decisions, and succeed as the product of learning outcomes.

Regarding the problems and the importance of HOTS explained above, this investigation analyzes the learning model integrated into the internship vocational teacher program to achieve HOTS through the independent program that has been implemented in Indonesia. The implementation of the Independent Learning-Independent Campus (ILIC) policy is outlined in the Ministry of Education and Culture Number 03 of 2020 concerning National Standards for Higher Education and the Decree of the Minister of Education and Culture of the Republic of Indonesia Number 754/P/020 concerning key performance indicators of State Universities (PISU). The regulation contains performance indicator IKU-2, for which students can receive 20 credits for off-campus learning. The institution makes the internship program one of the ILIC programs to achieve this performance indicator.

In higher education, primary and secondary education implemented independent learning through the Decree of the Ministry of Education, Culture, Research, and Technology, Number 56/M/2022, about Guidance Implementation of Curriculum According to Learning Recovery. This regulation is aimed at achieving learning outcomes.

The HOTS in this investigation refer to V-HOTS because vocational high schools have a special character, where the V-HOTS combines the scaffolding (Scf) and project-based learning (PjBL) with support from ICT (Sukatiman, Muhammad, Siswandari, & Roemintoyo, 2020) and can provide service interactions and enable students to access peer opinion (Yu, Lin, & Liao, 2017). The PjBL model provides students with the ability to construct real problems independently and face real industry problems (Sharma, Dutt, Naveen Venkat Sai, & Naik, 2020).

The successful integration of V-HOTS in the teaching and learning process has been carefully conducted in all aspects of teaching, including approaches, teaching strategies, and assessment. The research by Fan and Yu (2017) found that HOTS-based research ensures that teachers assist students in solving complex problems as the focus of learning objectives. The learning model offers to improve V-HOTS in students because the model has advantages in the vocational field to construct field problems independently (the process of learning) (Guo, Saab, Post, & Admiraal, 2020) and in groups facilitated by the teacher to obtain deep knowledge retention (Taylor, Atas, & Ghani, 2017).

Rujira, Nilsook, & Wannapiroon (2020) stated that vocational education universities are obliged to formulate guidelines for transformation toward digitalization so that they can work in a more efficient way. Some of the researchers' findings were used as benchmarks to implement V-HOTS in the internship program.

The attainment of HOTS in vocational students can be achieved with the Scf-PBL model; Figure 1 illustrates this model.

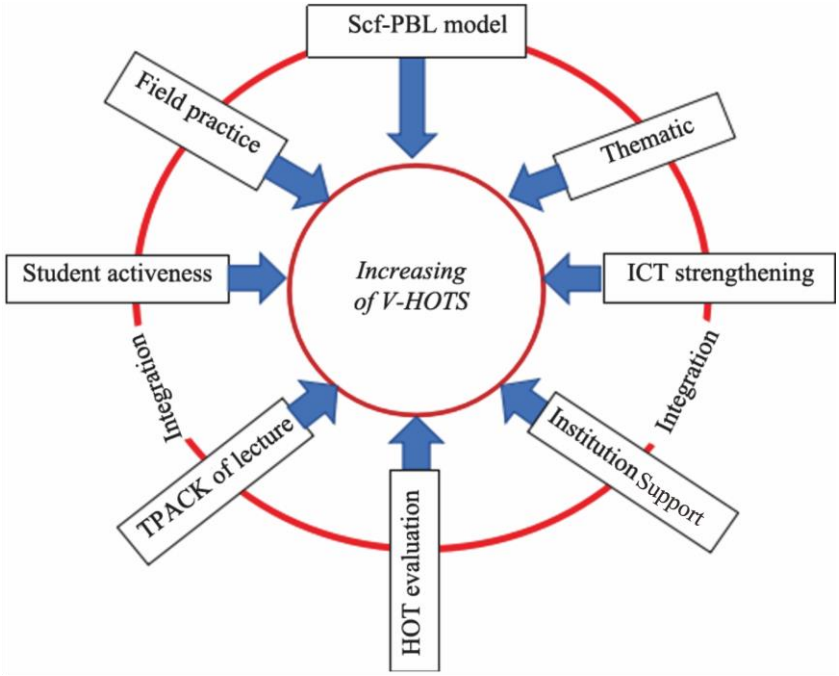


**Figure 1.** Attaining V-HOTS model.

The implementation of the Scf-PBL model with ICT strengthening can be described as follows:

1) Making lesson plans with real-life problems. Learning is planned with multilevel problems, from problems related to equipment operation with a structured solution method to implementing an unstructured model by giving more unknown problems, whereby students must actively construct knowledge in groups (collaboratively) to solve these problems in the field.
2) Students are given a stimulus in the form of material uploaded to an online-based application (learning management system or LMS) so that, before lectures start, they already have knowledge of the material to be discussed. Furthermore, the online application will allow the practice groups to have online discussions to complete practical reports.
3) Given the development of Industrial Revolution 4.0, which always requires students to improve their knowledge, students are given online evaluations based on V-HOTS, which will be very useful when working.
4) Well-planned learning supported by updated methods and media can encourage students to actively participate.
5) The developed model (Scf-PBL) supported by information and communication technology (ICT) has been proven to be effective in providing V-HOTS to Geomatics students.

This internship program offers an implementation design that integrates learning planning, the implementation of teaching practices, critical reporting, and the use of thematic course materials for collecting data on the final projects of internship students. This internship model is expected to be a solution to the problem of the ILIC internship program in Indonesia, which is still a polemic issue for universities and higher education due to the differentiation of linearity campuses.

The background explanation above leads to the following research hypotheses:

1) The target of V-HOTS has been achieved by students taught by mentor teachers using the integrated project-based learning model.
2) There are differences in the perceptions of students in Clusters I and II regarding V-HOTS.
3) The internship program implemented by Independent Learning-Independent Campus (ILIC) is utilized to accelerate pre-service graduation.

This research is considered highly important for the development of teacher education in vocational schools. The results of this study will provide a deeper understanding of higher-level thinking skills and the contribution of prospective teachers in enhancing them. Variables regarding environmental factors that support the development of higher-level thinking skills are raised in this research, making it beneficial in helping lecturers design more effective and contextual teacher training programs, as well as providing encouragement for schools to improve their ICT support.

## 2. LITERATURE REVIEW

### *2.1. TPACK in Vocational Learning Activities*

One of the most important frameworks in vocational education is the Technological Pedagogical Content Knowledge (TPACK) framework. In vocational school settings, the TPACK collaborates with the pedagogical and content knowledge of technology in ways that can yield the output and outcome of learning for a student (Anggraini, Zubaidah, & Susanto, 2023; Kusuma, 2021). The emerging demands of the digital workforce require the TPACK frameworks to be designed for vocational teachers. Studies have shown that while they demonstrate strong TPACK competence, vocational teachers still have room to improve further, especially in effectively implementing technology to carry out learning activities (Kovalchuk, Maslich, Tkachenko, Shevchuk, & Shchypska, 2022; Sutama, Yasa, Dewantara, & Saddhono, 2022). The above approach is expected to yield very good progress in vocational education, further encouraging increased motivation of students through more personalized learning experience tools and the creation of an interactive digital learning environment supported by an all-inclusive TPACK framework.

It has also been indicated that the TPACK framework involves the integration of three distinct forms of knowledge (technology, pedagogy, and content) for effective teaching in a concept-driven way. Evidently, many teachers do integrate TPACK knowledge, thereby improving the effectiveness of their strategies (Ebil, Salleh, & Shahrill, 2020; Scheiter, 2021). Based on these findings, it can be attested that the integration of technology with the help of TPACK has bred better instructional practices for teachers and student learning. The TPACK framework suggests that it offers lesson plan designs that present a possibility for students and then offer the integration of technology within the lesson, and most importantly, offer optimal learning experiences (Molotsi, 2022). The study also revealed how teachers implement ICT in the classroom based on their TPACK level. This underscores the cognitive roles that teachers play when integrating technology, further supporting the transformative potential of TPACK in education.

Recent research has emphasized the need to develop the TPACK framework, especially in the vocational education context, which articulates itself as valuable in the integration of networking and collaborative knowledge. Merging knowledge from the TPACK framework provides integrative vocational training knowledge to the inordinate enhancement of higher-order thinking skills (HOTS) for students (Absari, Priyanto, & Muslikhin, 2020; Sukatiman et al., 2020). Their study shows how TPACK strategies are implemented in Science, Technology, Engineering, and Mathematics (STEM) education with positive impacts on the development of HOTS in students; therefore, these trends are evidenced to increase in STEM and HOTS research (Nuangchalerm, Prachagool, Islami, & Abdurrahman, 2020). Moreover, research on vocational students' numeracy and literacy skills has established that the development of problem-solving skills in the domain of HOTS needs to be developed and has justified the

effectiveness of modern teaching models, such as TPACK (Tong, Rosli, & Saleh, 2022). TPACK greatly helps prepare vocational school students, and it helps teachers take approaches and strategies that enable them to develop their teaching and integrate technology to create innovative teaching approaches.

Furthermore, TPACK-based training is attended by educators in higher vocational institutions with a core need for deep fusion between content, pedagogical, and technological knowledge (Papanikolaou, Makri, Sofos, Tzelepi, & Zalavra, 2022). TPACK has become an important concept at the college, capturing the technology, pedagogy, and content knowledge needed to formulate effective learning in this type of vocational education. Vocational training teachers still need to design training in the use of technology to support interactive learning, but there are issues, such as a shortage of resources. On the other hand, the integration of appropriate TPACK strategies may bring significant benefits to vocational students for the development of higher-order cognitive skills, such as analysis and problem solving. With these skills, they will be better prepared for the complex world of professional activity.

### *2.2. Stimulating V-HOTS Utilizing ICT in Learning Activities*

ICT is a fundamental component in vocational education in line with the 4C framework of communication, collaboration, critical thinking, creativity, and problem solving (Hamida & Desnita, 2021). The incorporation of ICT in educational settings is crucial for nurturing digital skills among students, as evidenced by research focusing on its integration into school curricula. Recent studies underscore the importance of ICT in enriching the learning process, utilizing digital tools to stimulate critical thinking and creativity (Martines, 2021). Moreover, trials conducted in vocational schools have demonstrated that an ICT-rich learning environment, incorporating various resources such as learning management systems and simulation training facilities, greatly enhances students' professional capabilities (Riskasari, Roemintoyo, & Budiarto, 2022). Additionally, immersive technologies such as VR simulators are increasingly employed in vocational education to elevate learning experiences and practical competencies (Su, Cheng, & Lai, 2022).

It is in this line that vocational learning has taken upon itself to include ICT in learning activities, after the implementation of ICT recorded a positive influence on student skills. A study conducted by Roemintoyo, Miyono, Murniati, and Budiarto (2022) showed that the use of interactive multimedia in secondary vocational education has a significant positive effect on the attainment of skills. This means that ICT can be used to improve the practical skills generally required in today's world. This further supports the finding, asserting that ICT skills positively correlate with students' critical thinking, communication, collaboration, and creativity (4C skills) elements essential in the workplace. Similarly, Ghavifekr and Rosdy (2015) and Munje and Jita (2020) integrated ICT tools within secondary school-level geography education, exhibiting that ICT enhances performance and brings participatory skills that give students an engaging and effective learning experience. The study by Handayani, Hussin, and Helmi (2023) alludes that the integration of ICT in the Technological Pedagogical Content Knowledge (TPACK) framework for educators in vocational high schools has a favorable impact on teachers and their capability of providing appropriate learning assessments and responding to difficulties during online learning activities.

The importance of providing intensive ICT-based training for vocational skill providers is to enhance the quality of vocational education. Studies also suggest that the use of digital games, online applications, and other ICT tools can improve teaching efficiency and student performance (Lee et al., 2023; Sudrajat, Susilo, & Indriwati, 2018). Mahmod Eyadat (2023) advocates for further research on the role of educational technologies in vocational and technical education, recognizing their potential to develop essential workforce skills. Collectively, these studies provide evidence that integrating ICT into vocational learning activities can greatly improve student skills, making them an essential component of modern vocational education.

The use of ICT in diverse forms will provide students with a chance to acquire essential technical skills. Students' use of ICT tools in learning could help them understand and develop positive attitudes toward technology

and effective skills, and overcome difficult areas of the curriculum through e-gaming, online applications, and technical presentations (Su et al., 2022). This shift toward student-centered learning, inspired by ICT, empowers learners to be creative in problem solving and boosts their learning outcomes. In addition, the integration of ICT in teaching makes lessons more interactive and may increase the level of student interest, thereby increasing the level of student participation. It will also enable students to understand and remember information from visual materials (Merta Dhewa, Rosidin, Abdurrahman, & Suyatna, 2017; Zeng, Zhou, Hong, Li, & Xu, 2020). ICT applications used in education help students develop technical skills that allow them to compete and excel in the digital world.

Various challenges faced by educators make it difficult for them to make the best of ICT. These, in our view, include a lack of understanding regarding the reason for including the use of technology in teaching (Greene, Copeland, & Deekens, 2021) and institutional and technological challenges within higher education institutions that reduce the use of ICT. Other inhibiting factors include connectivity issues, deficient ICT hardware, and poor ICT skills (Bagde, Bagde, & Raisoni, 2021). Additionally, heavier teaching loads, lack of time, and barriers in relation to lack of adequate equipment impede the smooth integration of ICT in educational settings (McKnight et al., 2016). Attitudes toward ICT should be addressed, and support and relevant training are required to change school policies.

To maximize the effectiveness of ICT in enhancing higher-order thinking skills (HOTS) in vocational learning within the Technological Pedagogical Content Knowledge (TPACK) framework, teachers must concentrate on effectively integrating technology, pedagogy, and content knowledge. The use of learning media based on TPACK that integrates ICT will also be carried out in relation to HOTS to improve students' attitudes (Molotsi, 2022). There should also professional ICT support for teachers to further develop their capacities in teaching vocational students in preparation for a digital future (Prasojo, Habibi, Mukminin, Sofyan, & Anwar, 2020). It is through the amalgamation of simulated and learning methods, such as inquiry-based learning (IBL) methods, together with TPACK integration, that teachers are capable of setting up a learning environment that revolves around students, promoting activity and enabling students to successfully attain HOTS (Haryanti, Sapriya, Permana, Syaodih, & Kurino, 2022). TPACK also represents pedagogical ways to address the combination of different domains in teaching and applying an appropriate pedagogical approach for a given content with appropriate technology.

## 3. RESEARCH METHODOLOGY

The present study employed a mixed methods approach to introduce a novel concept known as an integrative strategy. The integrative strategy here refers to an approach that combines various research methods or techniques to obtain a more comprehensive understanding of a phenomenon. It also allows researchers to collect diverse data, explore different aspects of an issue, and verify findings through various data sources (Barbrook-Johnson & Carrick, 2022). This concept encompasses both quantitative and qualitative methodologies, focusing on the examination of specific integration practices and their underlying justifications. Consequently, this research aims to bridge the gap between methodological discourse and practical application (Åkerblad, Seppänen-Järvelä, & Haapakoski, 2021).

The investigation encompassed six vocational high schools in Central Java, Indonesia, known as *Sekolah Menengah Kejuruan* (SMK). These comprised four state schools, namely SMK N 2 Surakarta, SMK N 5 Surakarta (Ska), SMK N 2 Sukoharjo (Skh), and SMK N 4 Sukoharjo, and two private schools, namely SMK Ganeshatama Boyolali (Byl) and SMK Satya Karya Karanganyar (Kra). The total number of participants in this study was 361 students, with 191 samples in Cluster I and 170 samples in Cluster II. Throughout the semester, the pre-service teachers engaged in guided learning under the supervision of mentor teachers (in-service teachers), following a four-level approach. The pre-service teacher activities are explained in Table 1.

**Table 1.** Implementation of the internship program.

| Component of HOTS | Implementation of the internship program | Strategy |
|---|---|---|
| Observational | - Exploring the school's curriculum | - Observation of profiling schools' facilities (Wi-Fi, LMS, course syllabus, and others) |
| Teaching assistance | - Help the senior teacher arrange the lesson plan | - Assistance from the senior teacher (Entire TPACK, ICT, lab devices, and media simulation) |
| Independent teaching | Collaboration internship with the senior teachers | Intern absorbs learning experience from the senior teacher.<br>The intern practices independently. |
| Critical report | The intern arranges a critical report analysis on the experience during the internship | Under lecture and senior teacher assistance, the intern arranges critical experience reports. |
| Guidance with a lecture on the implementation of an online course for 20 credits | The internship program outcome continues with a research thesis | With the guidance of the lecturers, pre-service teachers take some course materials, including thesis research, to achieve 20 credits per semester to accelerate graduation. |

**Note:** The teacher and lecturer check all internship activities to see how HOTS is achieved.

Upon completion of the internship program, the vocational high school students instructed by pre-service teachers were required to provide feedback through a questionnaire. Nine questions gathered data on the effectiveness of the Scf-PBL models in facilitating intermediate learning (Scf) and higher-order thinking skills (HOTS) among students, and ten questions additional were related to the integration of ICT in learning, focusing on ICT-based tools aimed at enhancing student engagement in developing HOTS. Furthermore, there were four questions dedicated to assessing students' teamwork skills in achieving HOTS through collaborative efforts. Lastly, there were seven questions pertaining to HOTS-oriented assessments to evaluate the retention of student knowledge following the ICT-based Scf-PBL learning process, resulting in a total of 30 questionnaire items.

The questionnaire was tested for its validity and reliability levels to ensure its trustworthiness as a data collection tool. The reliability and validity testing using the Statistical Package for the Social Sciences (SPSS) program was conducted through Pearson correlation tests (Abdul Raof & Musta'amal, 2021). The first step in measuring the reliability and validity of an instrument is to select a sample to test the instrument. The sample for instrument testing was randomly selected based on the chosen cluster (Choiriyah., Mayuni, & Dhieni, 2022). A total of 30 students were randomly selected as validators. From the reliability test using the SPSS program, a Pearson correlation value > $r_{table}$ (0.361) was achieved.

For the validity assessment, 30 statements were tested and deemed valid, making them suitable for use as a data collection tool on the perception of HOTS among student teachers who had completed their internship. In addition, the examination of the questionnaire's reliability using Cronbach's Alpha revealed that the value of all questionnaire items was 0.788, exceeding the threshold of 0.60 (0.788 > 0.60). Therefore, all questions in the questionnaire could be used to evaluate creativity and innovation skills as research variables.

The response rating scale for the questions is: 5 = always, 4 = often, 3 = sometimes, 2 = rarely, and 1 = never. The data was analyzed statistically to obtain an overview of students' opinions on the level of the V-HOTS of the pre-service teacher interns. The data were then classified by cluster ranking, and the results of the questionnaire were compared to find the differences. To validate the results, the data were checked through semi-structured interviews and critical reports of the internship students during field study.

This research used two different data analysis techniques to process the qualitative and quantitative data. For the qualitative data, this research used focus group discussion (FGD) as the main method. FGD was chosen because of its ability to elicit in-depth information from participants regarding their experiences and perceptions of internship activities. Through structured group discussions, it is possible to gain valuable insights into aspects

beyond the reach of quantitative data, such as the emotional and contextual nuances of participants' internship experiences. For the quantitative data, t-test analysis was used to compare views between samples from Clusters I and II. The focus of this analysis was to measure and compare their perceptions of internship activities and their understanding of higher-order thinking skills. This t-test helped determine whether there was a statistically significant difference between the views of the two clusters on the variables studied, which was important in assessing the effectiveness of the internship experience in developing higher-order thinking skills among the participants.

## 4. RESULTS

The first investigation was conducted with a focus group discussion (FGD) about the initial conditions of the student learning process and lesson planning in microteaching guided by the lectures. The microteaching program is the initial phase of pre-service teachers and provides experience through face-to-face activities to become professional teachers (Sithole, 2023). At this stage, the lecturer played an active role in preparing students to have teaching practices. Microteaching is also a practical course that gives the students holistic competence consisting of technological, pedagogical, and knowledge integration (TPACK). This model was used as a success standard in vocational education before the internship performed at vocational high schools. By implementing TPACK in class, the interns learn the vocational competence of higher-order thinking skills. The HOTS principle developed by Bloom and revised by Krathwohl consists of remembering, understanding, analyzing, evaluating, and creative thinking (Krathwohl, 2002; Muhayimana, Kwizera, & Nyirahabimana, 2022). In the vocational field, the researcher developed V-HOTS, which has a specific purpose: the teacher is responsible for assisting the students (scaffolding) in mastering the operational devices, particularly those that contribute to sustainability in schools.

The pre-service teacher interns were provided with V-HOTS before commencing their teaching duties at vocational high schools. The FGD utilized the supporting material tracer in Geomatics to conduct the session. Each of the 73 productive subjects taught to building engineering students was examined to determine its correlation with the Geomatics course. These thematic materials served as a guide for the pre-service teacher interns in developing the lesson plan for microteaching.

To determine the success of the pre-service interns' teacher, the students' perceptions of the teacher were evaluated through questionnaires and processed through SPSS.

### *4.1. Data on the Characteristics of Vocational High Schools for Internships*

The research started with a review of school documents. The main data from these schools can be seen in Table 2.

**Table 2.** Data of vocational high school observation.

| No. | Reviewed item | Cluster 1 | | | Cluster 2 | | |
|---|---|---|---|---|---|---|---|
| | | SMK N 5 Ska | SMK N 2 Ska | SMK N 2 Skh | SMK N 4 Skh | SMK Ganesatama Byl | SMK Satya Karya Kra |
| 1 | Accreditation | A | A | A | C | (Not accredited) | (Not accredited) |
| 2 | ISO quality control | 9001:2008 | 9001:2008 | 9001:2008 | 9001: 2008 | 9001:2008 | No |
| 3 | Curriculum application | K-13 | K-13 | K-13 | KTSP | K-13 | K-13 |
| 4 | Availability of computer labs | 40% | 40% | 30% | 20% | 10% | 10% |
| 5 | Availability of cell phones | 100% | | | | | |
| 6 | Availability of Wi-Fi | No | Yes | No | Yes | No | No |

**Note:** SMK N = *Sekolah Menengah Kejuruan Negeri.* K-13 = *Kurikulum* – 2013.
SMK = *Sekoah Menengah Kejuruan.* KTSP = *Kurikulum Tingkat Satuan Pendidikan.*

The data presented in Table 2 regarding the schools' conditions serve as a valuable resource for assessing the potential of schools to offer V-HOT competencies to students. There are two distinct criteria used to categorize school conditions: Cluster I includes schools with A accreditation (SMK N 2 Surakarta, SMK N 5 Surakarta, and SMK N 2 Sukoharjo), while Cluster II comprises schools with B accreditation or those that are not accredited (SMK N 4 Sukoharjo, SMK Ganesatama Boyolali, and SMK Satya Karya Karanganyar). Schools in Cluster I demonstrated readiness by providing laboratory equipment and learning management systems to facilitate flipped learning classrooms. Moreover, to maintain quality standards, schools in Cluster I underwent quality assurance processes accredited by the International Organization for Standardization (ISO). On the other hand, schools in Cluster II faced limitations in terms of online learning support, leading them to rely on traditional face-to-face methods, such as project-based or problem-based simulations, for the teaching and learning process.

### *4.2. T-Test*

The data for the difference test (t-test) were processed using SPSS v 23, which analyzed two independent sample variables. A parametric independent sample t-test was conducted to confirm that the homogeneity and normality requirements were met before proceeding with further analysis.

The decision-making criteria for the hypothesis are:

1) If the p-value is < 0.05, students have positive and significant perceptions about the HOTS of the pre-service teacher interns (Clusters I and II).
2) If the p-value is > 0.05, students do not have positive and significant perceptions about the HOTS of the pre-service teacher interns (Clusters I and II).

**Table 3.** Statistical data for Clusters I and II.

| Cluster | N | Mean | Std. deviation | Std. error mean |
|---|---|---|---|---|
| Cluster I | 191 | 79.1 | 11.2 | 0.81 |
| Cluster II | 170 | 82.8 | 10.7 | 0.82 |

Table 3 shows that the statistical data mean score for Cluster I was 79.14 and 82.85 for Cluster II. The deviation standard for Cluster I was 11.2, and 10.7 for Cluster II.

**Table 4.** Independent sample T-test.

| Variable | | Levene's test for equality of variances | | T-test for equality of means | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | F | Sig. | t | df | P-value | Mean difference | Std. error difference | 95% confidence interval of the difference | |
| | | | | | | | | | Lower | Upper |
| Student perception | Equal variances assumed | 0.318 | 0.573 | -3.188 | 359 | 0.002 | -3.694 | 1.159 | -5.97 | -1.415 |
| | Equal variances are not assumed | 5.197 | 0.002 | -3.197 | 357.35 | 0.002 | -3.694 | 1.155 | -5.97 | -1.4216 |

The results of the t-test presented in Table 4 indicate notable differences in the perceptions of vocational high school students residing in Surakarta, Central Java, Indonesia (Clusters I and II) toward pre-service teacher interns. The statistical analysis revealed a significant difference (p-value = 0.002 < 0.05), suggesting that the perceptions of Cluster II students significantly varied from those of the pre-service teacher interns.

## 5. DISCUSSION

The mission of the Building Engineering Education Study Program is to create professional teachers in the field of building construction, so teaching and learning with link and matching models on campus and at school must be conducted collaboratively to produce better HOTS (Braathen, 2022). HOTS in the internship is attained through the following four steps:

### *5.1. Observation Stage*

The students undertook a study on the educational program at the vocational school with the aim of fostering an environment conducive to academic internships. The study involved gathering information on the school curriculum, including resources, such as syllabi, media and laboratories, which support the learning process, as well as curricular and co-curricular activities. The findings of the study were then compared to the ideal requirements of a vocational school. During the study of the school environment, the interns were guided by key individuals within the school community, such as the principal, vice principal, and administrative staff, to assess their critical thinking abilities and immerse themselves in the academic atmosphere of the school in preparation for their upcoming responsibilities.

### *5.2. Preparedness of the Lesson Plan Based on ICT*

After the observation stage was completed, the internship program continued by assisting senior teachers in preparing for teaching. The program implementation involved assisting teachers in developing lesson plans or teaching modules and observing them during teaching sessions. The lesson plans are useful in achieving the school curriculum goals and assisting teachers in determining the types of resources needed (Hatch & Clark, 2021). At this stage, the supervisor, who was a senior teacher, played a role in guiding and monitoring student activities while also assisting the mentor teacher in preparing instructional media using new technologies that senior teachers rarely use to achieve higher-order thinking skills (Wijnen, Walma van der Molen, & Voogt, 2022).

Regarding the results of the student perception questionnaires on the intern teachers, it was found that in Cluster I, the school accelerated the use of technology-based equipment and simultaneously utilized internet-based media (Turnbull, Chugh, & Luck, 2021) such as PowerPoint presentations, e-modules, and multimedia, as well as the use of learning management systems such as WhatsApp, media platforms, and flipped learning, which offer advantages as rapidly evolving media (Kerssens & Dijck, 2021) that can be used more flexibly in terms of time and place for learning. Through these ICT-based facilities, the level of higher-order thinking skills among students can be enhanced (Yusuf, Widyaningsih, Prasetyo, & Istiyono, 2021). The study findings indicated that Cluster I was more inclined toward implementing ICT-based learning, which is currently in progress. This involved utilizing Google Classroom for task assignments, the K-Zoot application for assessments, and digital platforms such as WhatsApp for simple tasks. The school's long establishment and sufficient student enrollment have enabled the development of better facilities. The data analysis of students' perceptions toward intern teachers yielded a score of 79.14, signifying that students' satisfaction with intern teachers surpassed the success threshold ($> 75$). Nevertheless, when comparing the two clusters, Cluster I's rating was still lower than that of Cluster II, as intern teachers in Cluster I had not engaged students in utilizing the school's laboratory equipment for practical purposes, such as learning to operate theodolites for mapping, or stationary tools for woodwork practice.

This finding was corroborated by semi-structured interviews with the interns in Cluster I, who noted that intern teachers were hesitant to demonstrate the operation of laboratory equipment. Therefore, mentor teachers should offer comprehensive support to intern teachers to enhance higher-order thinking skills (HOTS) (Han & Sa, 2022). The research results also highlight a favorable aspect, with the interns in Cluster I demonstrating proficiency in ICT-based education through the utilization of computer programs such as Automatic Computer-Aided Design (AutoCAD), Sketchup, and Building Information Modeling (BIM) applications. This enhanced the

interactivity of the learning experience. This research result is consistent with the findings of Bicalho, Coll, Engel, and Lopes de Oliveira (2023) who found that to overcome student barriers, the integration of ICT in the learning practice is necessary, as implementing ICT allows teachers to simplify the concept of the subject matter, resulting in more efficient learning. Apart from that, research on the use of ICT devices in learning activities was also carried out by Molotsi (2022) who highly recommended that schools establish policies for teachers to incorporate ICT as one of their planning activities. This is aimed at enabling teachers to transform their teaching by utilizing ICT resources. Referring to several previous research findings, it is known that preparing learning is crucial for teachers. This study emphasizes that ICT is one of the tools and components that need to be prepared before the learning activity begins. The integration process should be designed so that it can produce a successful and optimal learning process.

### *5.3. Teaching Practice Stage, Self-Reflection Journal, and Follow-Up*

The teaching practice data in Cluster II consisted of data from two newly established public schools and three private schools with limited student numbers. Since socioeconomic factors may have presented difficulties for online learning among students (Yeung & Yau, 2022) these schools focused on using instructional aids/mockups-based media that allowed students to interact through simulation-based learning combined with the use of job sheets (Mawardi, Rusiani, & Yani, 2020). At this stage, the emphasis was on preparing students to be communicative, collaborative, creative, innovative, critical, and analytical thinkers and to solve real-world problems effectively (Živkovic, 2016) which are the main components of higher-order thinking skills. The survey data indicated that student satisfaction with the intern teachers' instruction in these vocational schools was 82.84, suggesting that in vocational schools, it is advisable to implement more student–teacher interactions using instructional aids combined with teaching modules to facilitate changes in behavior and effective collaboration (Živkovic, 2016).

The main goal of the teaching practice stage was for pre-service students to implement the experience gained during microteaching training on campus, as well as the initial observation stage and assistance with senior teachers in schools, which had been conducted previously. The teaching practice was carried out by implementing a project-based learning model (PjBL) to achieve higher-order thinking skills among vocational students, and it also fostered higher-level thinking by the intern teachers in their preparation.

The project-based learning provided deeper learning experiences to intern students through actual practice and simulation using instructional aids. To achieve higher-level competencies (V-HOTS), schools preferred actual practice, such as using theodolites for mapping, constructing door and window frames, and reinforcing foundations, among others. The results of this research demonstrated that the study program in teaching practice courses has implemented the PjBL model. This model not only facilitates the development of higher-order thinking skills (V-HOTS) among students but also encourages the growth of the cognitive capacities of in-service teachers. Previous research shows that PjBL effectively increases students' creativity and analytical skills (Guo et al., 2020). In line with that, Lubis, Jalinus, Abdullah, and Hayadi (2019) confirmed that PjBL helps in the application of theory to practice, which is in accordance with the findings of this research that intern teachers experience improvements in critical thinking and problem-solving abilities. Therefore, based on empirical evidence and relevant literature, it can be said that the implementation of PjBL in vocational teaching practice provides multifaceted benefits, both for the intellectual development of intern teachers and the professional competence of students.

The perception of the students according to the perception questionnaire regarding pre-service teachers in Cluster II scored 82.4, which is higher compared to Cluster I. This indicates that the intern teachers in Cluster II were more understood in their teaching, especially in the use of interactive media for their group projects. Through critical reporting, intern teachers shared ideas that they had employed in their quest to enable higher-order learning for the students. These included the development of media, the utilization of models, and increasing learners' involvement. The creative ideas generated by the intern students could be classified as higher-order

thinking skills. After completion of the ILIC internship, students joined campus-based learning tasks in schools. Online students participated in a semester's worth of course-based project-centric learning activities totaling 20 credits. This internship program adjustment consisted of mentoring the teacher and academic supervisor, who gave direction to the students in carrying out the research for their final assignment in the following semester. This has transformed the internship program into thematic coursework so that students can complete academic tasks more quickly. This stage deals with metacognition, where intern teachers will have to apply their metacognitive skills by integrating research that has previously been done in their teaching practices and gain higher-order thinking skills that are conducive.

## 6. CONCLUSION

Vocational-higher order thinking skills meets the standards for prospective teacher candidates from higher education students to internship implementation in schools. The internship program implementation produces V-HOTS at level two, where students gain new experiences and learn how to produce lesson plans. At this level, senior teachers receive the latest innovative technology from prospective teacher candidates to complete lesson plans. At level three, students acquire HOTS through independent teaching experiences. At level four, prospective teacher candidates acquire HOTS through critical reports, where they gain HOTS through metacognitive creativity in reports during the internship program.

## 7. IMPLICATION

The research revealed that the V-HOTS internship program for teacher candidates has to be enhanced with innovativeness in technology and the practicality of lesson planning. Research findings have established that the intergenerational collaboration witnessed during the internship and the practice of independent teaching enhance the professional readiness and independence of prospective teachers. At a higher level, the development of metacognitive creativity further stresses the importance of critical thinking in teacher education. Good internship programs should support teaching skills by stressing critical thinking and innovativeness to ultimately produce competent teachers in the face of current educational challenges.

## 8. SUGGESTION

It is recommended that higher-order thinking skills be incorporated into the pre-service education curriculum, specifically during the learning process on campus, to implement the internship program in schools effectively. On campus, students should be equipped with cognitive abilities, hands-on skills, and pedagogical knowledge. This comprehensive competence will adequately prepare pre-service teachers for the vocational internship program, enabling them to acquire V-HOTS.

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**Transparency:** The author states that the manuscript is honest, truthful, and transparent, that no key aspects of the investigation have been omitted, and that any differences from the study as planned have been clarified. This study followed all writing ethics.
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