Bridging Theory and Practice through Vocational Apprenticeships among Students of Civil Engineering Program in Indonesia

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Abstract. This research explores how vocational apprenticeships help civil engineering stu-dents in Indonesia link classroom learning with real-world application. Using qualitative research methods, we delve into this process, guided by Activity The-ory. This theory helps us understand the different factors that influence how ap-prenticeships support learning and skill development. Activity Theory involves several key elements. The subject refers to the students involved in the appren-ticeship. The object is the specific goal they aim to achieve through their work. Mediating tools are the resources, techniques, or technologies that help students complete their tasks. The community includes everyone who participates in the apprenticeship, such as mentors and peers. Rules are the guidelines and norms that govern how tasks are performed and interactions are managed. In our re-search, we examine how these elements come together during apprenticeships. We investigate how students use tools, follow rules, and engage with their com-munity to meet their goals. By looking at these interactions, we aim to show how apprenticeships effectively bridge the gap between theoretical knowledge and practical experience. This study highlights the crucial role of apprenticeships in helping civil engineering students apply what they learn in the classroom to real-life situations, enhancing their professional growth.

Keywords: vocational apprenticeship, civil engineering, real-world application, professional growth

1. Introduction

1.1. Background and Research Problem

Apprenticeships provide a crucial link between education and employment by allow-ing individuals to acquire practical skills while receiving theoretical instruction [1]. The topic of apprenticeships involving college students has been discussed in many previous studies in Indonesia. Apprenticeships are discussed in terms of their influence on students' job interest and work readiness [2]. Apprenticeships are also discussed as a learning activity that can improve student competencies [3] [4] [5]. Some previous studies focused on mentoring efforts in the implementation of internship activities [6] [7] [8].

C. D. M. Putri et al. (eds.), *Proceedings of the International Joint Conference on Arts and Humanities 2024 (IJCAH 2024)*, Advances in Social Science, Education and Humanities Research 879,
https://doi.org/10.2991/978-2-38476-317-7_200

Based on some of these previous studies, there is still a research gap on how intern-ships can be a bridge between theory and practice. The link between theory and prac-tice is important in effective learning because theory provides the knowledge base while practice offers the context needed to apply that knowledge [9]. Understanding theory is crucial and through practice, individuals can easily understand and even improve skills [10]. The integration of theoretical and practical matters can improve critical thinking and problem-solving skills, and prepare learners for future challenges [11]. Thus, internship activities as a connector between theory and practice, is an interesting issue to be researched and discussed further.

1.2. Research Aim Related to Theoretical Review

This study aims to investigate the integration of theoretical knowledge and practical activities that occur within the apprenticeship framework.

1.3. Literature Review

To answer the research question, this study relies on Activity Theory. Such includes subject, object, mediating tools, community, rules. Subject within an activity system is defined as the individual as well as a group that engage in purposeful actions to achieve particular objectives [12]. The object, in an activity system, is the end goal that motivates and directs the subject to act [13]. Mediating tools are both physical and conceptual instruments that facilitate the subject's interaction with the object, shaping the process and outcomes of the activity [14]. The community encompasses all individuals who are involved in or affected by the activity, contributing to its collective goals and practic-es [15]. The community in an activity system as a network of individ-uals who share common goals and norms, impacting and being impacted by the activity's outcomes [16]. Rules, within an activity system, include both formal and informal norms that govern interactions between subject, object, and such mediating tools [17]. Using Activity Theory helps us look at how apprenticeships mix what students learn in class with real-world experience. By looking at the people involved, what the apprenticeships aim to achieve, the tools and methods used, the various groups involved, and the rules they follow, we can figure out if the apprenticeships are doing a good job of connecting classroom learning with actual engineering work.

2. Method

2.1. Research Design

This inquiry applies qualitative procedures, with specific attention to narrative exam-ination to reveal the depth of personal narratives. Qualitative methods are employed to discover multifaceted phenomena by examining data that is descriptive and interpretive, whereas narrative inquiry specifically investigates into how individuals con-struct and convey their stories to deliver understandings into their individual experi-ences and meanings [18] [19].

2.2. Research Participant

In this investigation, informants are identified and involved through purposive selec-tion. By using purposive sampling, investigators purposely select participants who are probable to have focused knowledge or experiences that will provide a deep and comprehensive understanding of the research topic, thus enhancing the significance and deepness of the study's outcomes [18].

2.3. Data Collection

This research employs interviews, particularly semi-structured interviews. The interview method in qualitative research is designed to gather comprehensive information through direct interaction with participants, and semi-structured interviews precisely allow investigators to track a guide of crucial queries while allowing flexibility to in-vestigate into developing subjects and responses [20] [21].

2.4. Data Analysis

This study used a descriptive analysis method. Descriptive analysis includes a thorough summary of qualitative data, by sorting data into thematic categories that reflect explicit content and apparent patterns [22].

3. Result and Discussion

3.1. Result

Students are directly involved in an activity during the internship.

1. Assistant surveyor, in this case students assist surveyors in operating tools such as total stations and waterpasses that are used for determining building ass, marking column loan axes, pinning piling points, determining the elevation of the *bouwplank* excavation and making reports and minutes in every job done in the field. Operate the drone to control the work. shooting the ace point on the bow-plank in the Sloof work and installation of the Angkur. Leveling the depth of the U-Gutter channel excavation.
2. Assistant field executor, in this case students assist the executor in checking the excavation checklist, pile cap concreting and pile cap casting. As well as taking stock of work every day and helping to make daily weekly monthly progress reports. checking the checklist of columns, beams and plates before casting. In ad-dition, it also helps monitor Half Slab production and Half Slab Installation.
3. QC Assistant, checking the quality of ceramic pairs.
4. Logistics. In this case, students are responsible for material inventory in the tms project. Make material stock reports every day and collect data in and out of ma-terials.
5. Quantity surveyor. the task of students is to calculate the backup volume for a building, for example, the calculation of the volume of bricks, plaster, aci, practi-cal concrete work, ceramics, paint, ceramic *plint*, and *sekonengan*.

6. Assistant site engineer I was given a jobdesc to create an implementation method with sketchup software and render the SKP file,
7. Assistant BIM engineers, students in the BIM team are given the task of revising items such as facade colors and making progress presentations to be presented to the owner.

Students feel helped by the courses that have been studied in lectures because the material is very relevant to what is needed or needed during the field. During the in-ternship, the application of these theoretical concepts helps students develop a deeper understanding of how theory works in the real world. This process also allows stu-dents to adapt to the challenges and dynamics of the real work environment. In addi-tion, this experience provides insight into the technical and non-technical skills need-ed to succeed in a career, such as critical thinking, time management, and teamwork. Internships are also an opportunity for students to evaluate their careers and deter-mine their professional interests based on hands-on experience in the field.

Students can implement theoretical concepts that have been learned in lecture ed-ucation during internship activities. For example, land measurement is used to meas-ure and map the area used for the project. Then there is the S Curve used for project planning and control, this is used to track progress and ensure that work is carried out on schedule. Not only that, the use of software applications such as AutoCAD and SAP200 which are used to assist in the design and simulation of structures is part of the work experience in the field. During the internship, students have the opportunity to apply these skills in real projects. Internship activities provide hands-on experience that is very important in connecting between the theory learned in class and practice in the field, while honing students' abilities in various aspects of work in the field of Civil Engineering.

Students found several contradictions during the internship period. The contradic-tion in question is the striking difference between what is learned in lectures and its implementation in the field. Some examples are:

1. There are some work items that are not done in order, which is common because the work order has been adjusted to the conditions in the field.
2. Work safety (wearing PPE) which is within the scope of OHS is not fully imple-mented and tends to be underestimated by workers.

Students can analyze the differences that occur in the field and lectures are very reasonable because there are x factors in the field that have never been thought of during lectures. However, the simplification of theory in lectures is needed to be more efficient at work. Here is one quote related to the topic “Regarding occupational health and safety, I try to keep reminding workers that the importance of PPE (Per-sonal Protective Equipment) in carrying out work, besides that I also routinely partic-ipate in TBM activities before work starts every morning”.

Students found some middle ground in overcoming contradictions. These include:

1. Understanding deeply what is at the core of both sides of the contradiction. -Finding common values or goals held by both sides. This can be the basis for building win-win solutions.

2. Develop a range of alternative solutions that can meet the interests of both par-ties. not afraid to think creatively and look for solutions outside the box.
3. Encourage open and constructive dialog between the two parties. Make sure each party feels heard and understood.

Students can operate tools and technology in the field of civil engineering. The tools and technology used are as follows:

1. Waterpass,
2. Total station,
3. Sipatan,
4. Drone,
5. Laser meter,
6. Measuring signs,
7. Prism,
8. Meter,
9. Yalon,
10. Pilox,
11. Brush,
12. Stationery,
13. Autocad software,
14. Sketchup,
15. Revit,
16. ETABS, and
17. SAP 2000.

Here are some related quotes about the tools and technology used during the in-ternship: “During the internship I used the following tools and technologies: CAD applications (Autocad, Sketchup, Revit, Sap 2000, ETABS), Total Station, Waterpass, Measuring signs, Prism, Meter, Yalon, Pencil, Duct tape, Pilox, brush, etc”. And “In the internship activities the tools and technology I used in surveying work are as follows: Waterpass, total station, sipatan, drone, autocad, laser meter, measuring signs, prism, stationery”.

Students feel the impact of the use of tools is very influential in the efficiency of work, the more sophisticated and updated tools and technology make it very easy to work in the field. The use of tools and technology in internships greatly helps the learning process of students and their understanding of Civil Engineering activities or projects. Students realize the great influence of these tools in increasing productivity and speed of work in the field. Modern measuring tools such as total stations and theodolites allow for much more accurate and quick measurements compared to manual methods, which helps in completing land surveys more efficiently. In addi-tion, software such as AutoCAD and SAP200 enhance students' understanding of load analysis and structural design, allowing them to visualize more detailed designs and predict the performance of structures before they are built, which is crucial to reducing the likelihood of design errors. In addition, increasingly sophisticated and up-to-date technology makes field work easier.

Students felt the contribution of project tools and technology as a means of add-ing new insights and improving technical skills in operating these tools. Some of the tools

that are used and contribute to students' understanding of theory include total stations, CAD applications, measuring tanks, prisms, and others. In addition, these tools also affect the efficiency of workers so that they can facilitate the work being done. By using this technology, students can learn the concepts of measurement and design better. In addition, the use of these tools improves students' technical skills in the operation of equipment and technology.

Students improve their abilities, theoretical knowledge, and practical skills in sev-eral ways according to their projects. The majority have experienced mentors, supervisors, or field supervisors who can provide feedback and criticism during their work. One student shared her experience, “During my internship, my friend and I kept col-laborating on everything to get to the center, so I really gained experience in honing my practical and theoretical skills.”

Students are greatly helped by the people in the internship site environment. the role of the people in the internship site is as follows:

1. Provide direct guidance, helping to understand how theory is applied in the project field.
2. Are often involved in project work that requires the application of theoretical concepts.
3. Work in teams that allow for learning from the experiences and perspectives of others.
4. Daily interaction with people in the workplace can help students improve com-munication and interpersonal skills.
5. During breaks, students and their mentors always have theoretical discus-sions in the field case studies used.

Students face socio-cultural issues such as language differences between individu-als (students and employees), differences in the background of each individual, the length of working hours in the field and the diversity of campus origins of each intern. In addition, there is also the problem of differences in work culture in the project. This makes it difficult for students and they experience culture shock at the beginning. Here is a quote from one of the students regarding the problems faced during the in-ternship, "Many differences occur when the internship process is carried out, such as the technology and innovation used, this occurs due to different campus back-grounds. In addition, the diversity of cultures held or owned by each individual and that is an interesting thing in the internship process."

Students gain experience or moments during the internship activities:

1. During the implementation of casting in waterlogged excavations due to swampy soil conditions with a high level of water content, the casting process uses various casting methods so that the concrete meets the specifications.
2. When working on steel planning, I was told about sap2000 software, it turns out that the software can run at the same time when determining the steel profile, I was impressed and amazed when I was told that.
3. When students begin to understand the complex dynamics between theory and practice in the world of construction directly. This happens when students know the soil conditions at the project site which are classified as a type of clay soil that

requires special methods and attention in determining the foun-dation plan to be used. so as not to experience a decline in the building due to a foundation that is not strong enough to support the load of the building.

During the internship activities, students get an evaluation of themselves for self-improvement, including the following:

1. At the beginning of the internship, there may be difficulties in applying the theories learned in lectures to situations in the workplace. with time the ability of students to understand the work very quickly and can apply the logic of the work and can determine the methods suitable for the work so that the work can run according to the RKS.
2. At the beginning of the internship students experienced a lot of difficulty and confusion in doing something, but over time students were told by colleagues and coaches how to complete the task, students continued to learn and discuss with colleagues and coaches until they mastered the job.
3. At the beginning of the internship, students had some confusion in doing certain jobs such as mapping progress, daily work lists, helping the sur-veyor team, and the field team. but over time students tried to understand how to do this by collaborating with internship colleagues who had done internships long before and asking things that they did not understand to mentors in the field or office.

Students argue that through the internship experience, students can see how theo-retical concepts in college are applied in the field directly. In addition, some of these theoretical concepts are not applied raw, but are adjusted to the specific conditions that exist in each project. An example of such adjustments is scheduling adjustments in a project. This experience strengthens students' understanding that theory is only a foundation and that flexibility and in-depth understanding of field situations are required for its application. Therefore, the internship taught students more about how innovation and adaptation are essential to tackle problems in the real world of work. This hands-on experience not only teaches them technical knowledge, but also helps them to better analyze and make decisions based on the project situation.

4. Conclusion

Students explain the relationship between internship activities, other courses, and overall teaching and learning activities in an effort to become professionals in the field of Civil Engineering. Students apply theoretical concepts learned in courses to practical activities they experience during the internship. Students explain examples of contradictions between theories learned and real-world experiences during the internship. Students explain their thoughts and attitudes in responding to and dealing with contradictions between theory and real-world experiences. Students explain the middle ground or meeting point they found despite the contradictions between theory and real-world experiences. Students explain tools or technologies related to their field of study that they saw and might use during the internship. Students explain the contribution of tools and technologies in their learning process to understand activities during the internship. Students explain the contribution of tools and technologies in understanding theories or lecture materials that have been studied in class. Students explain how the internship environment affects their ability to integrate theoretical knowledge with practical skills. Students explain the role of people at the internship location in improving their understanding of the application of theoretical concepts in the workplace. Students explain social and cultural issues that affect their learning experiences during the internship. Students share the most memorable moments of their internship journey, where they felt a sense of accomplishment in understanding the connections between theory and practice and the contradictions between them. Students evaluate their progress in integrating theory and practice from the beginning to the end of the internship. Students describe what was most valuable about the internship experience in developing their understanding of the application of theory in a practical context.

Acknowledgments. This study was partly funded by the Study Program of D4 Civil Engineering, Faculty of Vocational Studies, State University of Surabaya, Indonesia. We extend our gratitude to faculty and staff for their invaluable support and resources, which were essential to the completion of this study**.**

Disclosure of Interests. The authors have no competing interests to declare that are relevant to the content of this article.

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