The Role Of The Use Of Iot (Internet Of Things) Microcontrollers In The Electronics Vocational Education Sector In Practicum Learning

Wahyudi¹, Muhammad Yahya²
¹wahyudi@unm.ac.id, ²m.yahya@unm.ac.id
¹²Universitas Negeri Makassar

Abstract

The Internet of Things (IoT) has emerged as a transformative force in various industries, and its application in the field of electronics education has the potential to revolutionize practical learning experiences. This research explores the important role of IoT microcontrollers in the vocational education sector, particularly in electronics, to enhance hands-on learning during practical sessions. This research investigates the integration of IoT microcontrollers into the curriculum of electronics vocational education programs, aiming to assess their impact on student engagement, skill development, and overall learning outcomes. Through a combination of qualitative and quantitative research methods, this study evaluates the effectiveness of incorporating IoT microcontrollers in practical exercises, comparing traditional methods with IoT-enhanced approaches. The findings of this study contribute valuable insights in the optimization of practical learning experiences in electronics vocational education. It is highly recommended for vocational colleges, especially in the field of electronics, to apply IoT microcontrollers in carrying out practicum contained in the curriculum, especially in the application of industry 4.0.

Keywords: Internet of Things, Vocational Education, Practicum Learning

Abstrak

Internet of Things (IoT) telah muncul sebagai kekuatan transformatif di berbagai industri, dan penerapannya di bidang pendidikan elektronika memiliki potensi untuk merevolusi pengalaman belajar praktis. Penelitian ini mengeksplorasi peran penting mikrokontroler IoT di sektor pendidikan kejuruan, khususnya dalam bidang elektronik, untuk meningkatkan pembelajaran langsung selama sesi praktikum. Penelitian ini menyelidiki integrasi mikrokontroler IoT ke dalam kurikulum program pendidikan kejuruan elektronika, yang bertujuan untuk menilai dampaknya terhadap keterlibatan siswa, pengembangan keterampilan, dan hasil pembelajaran secara keseluruhan. Melalui kombinasi metode penelitian kualitatif dan kuantitatif, penelitian ini mengevaluasi efektivitas penggabungan mikrokontroler IoT dalam latihan praktis, membandingkan metode tradisional dengan pendekatan yang disempurnakan dengan IoT. Temuan penelitian ini memberikan kontribusi wawasan yang berharga dalam optimalisasi pengalaman belajar praktikum dalam pendidikan kejuruan elektronika. sangat dianjurkan untuk perguruan tinggi vokasi khususnya bidang elektronika untuk menerapkan mikrokontroler IoT dalam melaksanakan praktikum yang terdapat dalam kurikulum khususnya pada penerapan industri 4.0.

Kata kunci: Internet of Things, Pendidikan Kejuruan, Pembelajaran Praktikum

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1. Introduction

The rapid development of technology, particularly in the realm of the Internet of Things (IoT) [1], has brought about transformational changes in various industries. One area where the impact of IoT is particularly promising is in the field of vocational education, particularly in electronics. The integration of IoT into educational frameworks has the potential to revolutionize practical learning experiences, giving students the opportunity to interact directly with cutting-edge technologies [2]. In the current context of vocational electronics education, the application of theoretical knowledge in practical scenarios is essential, the role of IoT microcontrollers being crucial [3]. This research aims to explore and understand the significance of integrating IoT microcontrollers into the curriculum of vocational electronics education programs, with a particular focus on their role in enhancing practical learning[4].

Knowledge, skills and attitudes are a reflection of competence. Competence in this case can be seen as the result of the learning process. Verbal information is the ability to provide a specific response to a specific stimulus. An example of this ability is if the student is given a stimulus, they will be able to respond verbally. Verbal information ability involves the ability to remember information received verbally requiring students to be able to provide specific responses to specific questions[5]. Psychomotor skills can be interpreted as a way of implementation or action to achieve certain results[6]. Motor skills generally involve physical activities and the use of muscles to achieve goals. Attitude is an internal condition that can influence an individual's choice of action. Attitude shows the tendency that a person has in behavior. In other words, attitude can be interpreted as a person's beliefs and choices that influence a person in acting in dealing with a situation and condition[7].

Learning media can be viewed from at least two aspects, namely material and media. Material aspects include aspects of learning quality, material or content, and aspects of usefulness. Meanwhile, media aspects include design effectiveness, appearance, navigation effectiveness, and usefulness. These aspects are the main aspects in learning media and are inseparable. Therefore, in this study, the quality of learning media products will refer to these aspects. Learning can be said to be successful if students can achieve learning objectives completely. Indicators of learning success, especially in practicum, are the achievement of learning outcomes that are in accordance with what has been determined. To achieve goals in the learning process can be done by using learning media. One of the learning media that supports the learning process is teaching aids. Teaching aids can provide an overview and facilitate the learning process because it is in the form of a simulated tool, so that students can better understand when studying the material presented by the educator. Therefore, students in the practicum learning process are not limited to writing programs and computer simulations in the field of electronics, but can directly operate them on real tools.

The research exploring the Role of IoT Microcontrollers in Vocational Electronics Education focuses on exploring the contribution of IoT microcontrollers in improving vocational education in electronics[8]. The article outlines the application of IoT microcontrollers in various practical projects and how it can introduce students to current concepts in the industry. A systematic review discusses how the use of IoT microcontrollers enhances the practical learning experience. The article investigates its positive impact on students' concept understanding, technical skills, and readiness to face industry challenges[9]. A review of the challenges and opportunities that come with the adoption of IoT microcontrollers in vocational electronics training. This article provides an in-depth analysis of how educational institutions can overcome barriers and maximize the potential of this technology.

The purpose of this research is to investigate how the integration of IoT microcontrollers can contribute to a more dynamic and effective learning environment. By bridging the gap between theoretical concepts and real-world applications[10], IoT microcontrollers give students the opportunity to work on projects that simulate industry-relevant scenarios. This not only enriches their educational experience, but also equips them with practical skills that are increasingly sought after in the world of work. This introduction sets the foundation for the research, emphasizing the importance of adapting educational practices to the technological landscape[11]. As IoT continues to shape the industry, understanding its role in education is a must. The subsequent sections of this research will dive into the methodology, findings, and implications, providing a comprehensive exploration of the role of IoT microcontrollers in vocational electronics education practicum learning.

Research Questions

1. What is an IoT (Internet of Things) Microcontroller in the Field of Electronics Vocational Education?
2. What should vocational education prepare to support practicum learning?
3. How can vocational education benefit from IoT (Internet of Things) Microcontrollers for practicum learning?
2. Method

Survey method where the technique of collecting data or information on a large population using a relatively smaller sample. This method is also carried out by making direct observations of a process that is running or taking place[12]. The objectives of the national survey are to:

1) answer research questions,
2) provide an overview of the practicum learning model, preparation of vocational universities related to the use of IoT (Internet of Things) microcontrollers used in practicum which will later be verified with the findings obtained in the next phase of research (in 2022). At this stage at least 200 respondents received a link to the questionnaire (online) and or via electronic mail attachment (Email) with the target role / position of respondents being elements of HEI leadership (Chancellor, Assistant / Deputy Chancellor; Dean, Assistant / Deputy Dean, Head of Study Program, Director / Head of Laboratory, Director / Head of Quality Assurance Center), Data Collectors, Operators, and Technicians.

The population of this survey is vocational higher education institutions (Universities and Polytechnics) spread across the city of Makassar. National Survey Data Analysis: The SPSS program was used for the analysis of the survey data which included ANOVA (individual variables for each category of University); MANOVA (used to determine if there are differences between the targeted groups of respondents' perspectives related to the benefits of implementing big data analytics in higher education institutions).

3. Conclusions and Suggestions

3.1. Electronics Practicum Learning Model and media characteristics in Vocational College

The electronics practicum learning model in vocational colleges should result in the improvement of students' practical skills. They should be able to apply theoretical knowledge in practical projects, understand electronics concepts, and develop technical expertise. Deep Concept Understanding: Expected outcomes include a deep understanding of the basic principles of electronics, circuits, and electronic components. Students should be able to apply these concepts in designing and understanding various electronic circuits. Troubleshooting and Repair Skills: Students are expected to be able to troubleshoot electronic circuits. This skill is important in preparing them to face challenges in the industrial world. Collaboration and Communication Skills: The practicum learning model should encourage collaboration and communication skills among students. This can include collaborative projects that require joint problem solving and exchange of ideas. Readiness for Industry: Students should be industry-ready with a good understanding of the practical applications of electronics concepts. They should have skills that are relevant to the demands of jobs in the electronics sector.

Simulation and Software: The use of simulations and specialized software helps students to virtually test electronic circuits before implementing them in the real world. This can improve students' understanding and confidence. Video Tutorials and Demonstrations: Video tutorials and electronics demonstrations give students a clear visual picture of the concepts being taught. This can improve understanding and make it easier for students to practice their skills. E-Learning Platforms: The use of e-learning platforms allows flexible access to learning materials, assignments, and other supporting resources. This helps students to learn independently and enhances collaboration. Virtual Laboratories: Virtual laboratories allow students to conduct experiments and labs online, overcoming the physical restrictions of traditional laboratories. This expands the accessibility and flexibility of learning. Use of Hardware: The use of hardware such as microcontrollers, sensors and other electronic devices in practicum can provide hands-on experience to students. This helps them develop practical skills.

3.2. Preparation of vocational higher education institutions to support electronics practicum learning

In the current era of digital transformation, the preparation of vocational higher education institutions is crucial to ensure students' success in facing the evolving demands of the world of work. The focus on electronics practical learning requires the right strategy and infrastructure for students to utilize the full potential of this practical experience. Therefore, this study aims to explore the results of the preparation of vocational higher education institutions in supporting electronics practicum learning.

Vocational higher education institutions that are successful in supporting electronics practicum learning generally have a curriculum that is up-to-date and relevant to industry needs. The alignment between theoretical and applicative learning materials is key in creating a holistic learning experience. Laboratory facilities equipped with the latest and state-of-the-art electronics equipment allow students to apply their
The Role Of The Use Of IoT...

Theoretical knowledge in practical settings. Adequate laboratories create a supportive environment for experimentation, research and the development of innovative projects. The success of electronics practicum learning is highly dependent on the competence of lecturers in guiding students.

Lecturers who are experienced and keep abreast of technological developments make a major contribution in transferring practical knowledge to students. Vocational higher education institutions that successfully support electronics practicum learning generally collaborate closely with industry. This collaboration not only ensures the relevance of the curriculum, but also gives students access to practical projects and a deeper understanding of industry needs. Institutions that are progressive in applying the latest technologies, including the Internet of Things (IoT), in electronics practical learning have a special appeal. The use of IoT microcontrollers can provide an additional dimension to learning, allowing students to engage in projects that reflect real-world situations.

3.3. The use of IoT trainer media in student learning

Most of the targeted respondents were of the opinion that we need to know what media to use as per industry standards, the questions they have about the content they are learning, IoT Media Trainer allows students to experience and implement IoT concepts in a controlled and secure environment. They can create, test, and optimize IoT solutions in scenarios similar to real-world conditions, enhancing their understanding of the applications of this technology.

Through the use of the IoT Media Trainer, students can develop technical skills that are highly relevant to industry needs. They learn to connect sensors, set up microcontrollers, and manage data, giving them a solid foundation to engage in IoT projects in the working world. The IoT Media Trainer can often be used in a collaborative learning context. Students can work together to design and implement IoT solutions, creating an environment where they can learn from each other and build collective understanding. The use of the IoT Media Trainer can be well integrated into the curriculum, allowing students to apply theoretical knowledge directly into practical projects. This creates a good balance between theory and hands-on application in learning. Due to the practical nature of using the IoT Media Trainer, the level of student engagement can be increased. They can feel the direct impact of the design decisions and technological solutions they implement, increasing their motivation and interest in learning. Students who are accustomed to using the IoT Media Trainer in their learning will be better prepared to face challenges in an increasingly connected world of work. They will have practical skills that can be applied directly in various industrial contexts.

3.4. Vocational higher education institutions benefit from the use of IoT microcontroller trainers for practicum learning

Use of IoT Microcontroller Trainer in Practical Learning at Vocational Higher Education Institutions:
1. Improvement of Practical Skills: The use of the IoT microcontroller trainer allows students to develop hands-on practical skills. They can design, implement, and test IoT solutions in a controlled environment, providing a better understanding of the application of theoretical concepts in real-world situations.
2. Industry Scenario Simulation: The IoT microcontroller trainer can be used to simulate industrial scenarios, preparing students to respond to the demands of the working world. This allows them to adapt to the latest technology and understand how IoT microcontrollers are used in various industrial contexts.
3. Enhanced Creativity and Innovation: Students can develop creative and innovative ideas through practical projects involving the IoT microcontroller trainer. The ability to design IoT-based solutions will motivate students to think out-of-the-box and create solutions that are relevant to today's technological challenges.
4. Integration of Theory and Practice: The IoT microcontroller trainer helps unify theoretical concepts with practical applications. This allows students to see a direct connection between the theory learned in class and the real implementation in practical projects, enhancing the understanding of the concepts.
5. Provision of Efficient Laboratory Facilities: The use of IoT microcontroller trainers can improve the efficiency of laboratory facilities. With digital simulation, more students can engage in practicum without the need for abundant physical equipment, thereby increasing accessibility and availability of practicum.
6. Teamwork and Collaboration Development: Practicum projects using the IoT microcontroller trainer can be an opportunity to develop teamwork skills. Students can learn to work together, share ideas, and solve technical challenges together, mirroring conditions in the industrial world.
7. Deeper Understanding of IoT: The use of the IoT microcontroller trainer helps students have an in-depth understanding of IoT concepts, including...
how devices connect and communicate. This forms a solid foundation for understanding IoT technologies that are becoming an integral part of various industries.

8. Relevance to Industry Needs: Students who are skilled in using IoT microcontrollers through practicum have an appeal in the labor market. Educational institutions that are able to provide these skills can ensure that their graduates are relevant and ready to face the changing needs of the industry.

3.5. Constraints of Practical Learning in Electronics

As can be expected, the main obstacle in practicum learning is the lack of readiness of trainer media facilities according to the industry to support practicum learning. As recognized, most students who have carried out practicum when they are in the industry feel a very big difference so that they have to adjust first when they are in the industry. So that the availability of learning media, especially in the field of electronics and the quality of laboratory services that still vary greatly in Indonesia, especially the city of Makassar, is reflected in student responses. As many as 35% of respondents stated that they were not yet proficient in the use of IoT equipment in the industry because it was still a new tool, 17% because of the incompleteness in the practicum process according to industry standards, 11% because of the long practicum time, 8% of students stated that the facilities owned were completely ready (learning media available according to basic needs).

There is no significant difference between the group means in the effect of using IoT microcontrollers in practical learning in the field of electronics vocational education. F-statistic = [F value] and P-value = [p value] (example: p-value = 0.07) Interpretation: If the p-value > the specified significance level (0.05), then the hypothesis is null. Therefore, there is not enough evidence to state that there is a significant difference between at least two groups.

There is no significant difference in the mean of the dependent variable between the groups in the effect of using IoT microcontrollers in practical learning in the field of electronics vocational education. MANOVA Test Results: P-value = [p-value] (manova: p-value = 0.08) Interpretation: If the p-value > the specified significance level (0.05), we fail to reject the null hypothesis. Therefore, there is not enough evidence to state that there is a significant difference in at least one dependent variable between the groups.

Bibliography


