Profile of Electrical and Informatics Teacher Prospective Pedagogic Competence in the Industrial Revolution 4.0 Era

(Studies at the Department of Electrical Engineering and Informatics FT-UM)

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ABSTRACT

This study aims to obtain profiles of the pedagogic competence of undergraduate students in Electrical Education and Informatics Engineering Education Study Programs before they become teachers in the Industrial Revolution 4.0 era. The research design used is descriptive. The sample in this study were students in both study programs who had graduated from the teacher training course, with a total of 116 students. Data was collected using interviews and a 5-scale Likert model questionnaire. The pedagogical competence variables studied included: (1) Understanding of students; (2) Learning design; (3) Insights and educational foundations; (4) Implementation of learning; (5) Assessment and evaluation; (6) Develop the potential of students; (7) Curriculum and syllabus development; and (8) Utilization of learning technology. The results of the study show that the two samples have statistically different descriptions of pedagogical competences and averages. But overall, both have average pedagogic competence which tends to be on a moderate scale.

Keywords: Pedagogic competence, Industrial revolution 4.0., Teacher Profile

1. INTRODUCTION

Currently the world is in the 21st century or commonly referred to as the era of the Industrial Revolution 4.0 (4IR). There are five technologies that are the main pillars of 4IR, namely: Internet of Things, Big Data, Artificial Intelligence, Cloud Computing and Additive Manufacturing. 4IR is a phenomenon that collaborates cyber technology and automation technology. The concept of its application is cantered on automation in collaboration with information technology [1]. The impact of change due to 4IR is unavoidable, including in the educational environment, which makes Education 4.0 a well-known keyword among educators [2]. In the 21st century, teacher learning will experience changes, from conventional methods to digital learning [3]. Teachers will form knowledge and skills that enable students to master digital technology and use it to carry out academic tasks ethically, safely and responsibly [4].

There are elements that can represent learning in the 21st century, namely: creativity and innovation, collaboration, communication, critical thinking and problem solving (4C). Students who are the z generation tend to want freedom in learning, like new and practical things, need an internet connection, prefer visuals rather than verbal displays, have short attention spans, interact using many media, and like collaboration and sharing [5].

The impact of technological developments, as well as changes in demand for skills and student characteristics, have implications for teacher competence in teaching. In current conditions, students can access content on the internet, knowledge is available in digital form, jobs change rapidly, people become lifelong learners, and not all jobs can be easily taken over by computers. In addition, educational orientation, among other things, focuses on how to deal with student diversity through different pedagogical practices, as well as student-

centered learning so it is necessary to identify how students learn [6]. The implication of this is that student teacher candidates besides having to master competence in their field of expertise, they must also have teaching (pedagogic) experience before carrying out their duties as teachers in the classroom. In fact, classroom teachers have two significant obstacles, namely those related to the integration of technology in classroom learning activities and the lack of pedagogical knowledge and skills [7].

One of the visions of the Department of Electrical and Informatics Engineering FT-UM is to become a superior department and become a reference in the development of education and science, especially in the field of Electrical and Informatics Engineering Education. Implicitly the Department of Electrical and Informatics Engineering FT-UM organizes education and produces prospective teachers in the field of Electrical and Informatics Engineering. In line with the 4IR wave in the educational environment, prospective teachers produced by the Department of Electrical and Informatics Engineering FT-UM must meet certain competencies/skills in accordance with the demands of the 4IR era. This is in line with research conducted by Ocampo [8] regarding the importance of developing teacher competencies/skills in the 21st century, where the use of student skills by students (prospective teachers) will have an impact on teacher skills in the 21st century. The formulation of teacher competence in RI Law no. 14 of 2005 concerning Teachers and Lecturers [9], which includes: pedagogic competence, personal competence, social competence, and professional competence. Pedagogic competence is the ability to manage learning. Personal competence is the ability of a stable personality, has a noble character, is wise and authoritative and can be a role model. Professional competence is the ability to master the subject matter. While social competence is the ability to communicate and interact effectively and efficiently. Related to this research, competence is focused on the pedagogic competency profiles possessed by students, both in the Electrical Engineering Education Study Program and Informatics Engineering Education Study Program as prospective teachers.

2. PEDAGOGIC COMPETENCE

Pedagogic competence will influence forming students who are able to compete and win the competition in the job market exchange. Basically, pedagogic competence is the ability to manage learning activities, which include understanding students, designing, and implementing learning activities, evaluating learning outcomes, using technology in learning activities, developing student potential, and developing learning tools. Pedagogical competence is important to study, because the pedagogical knowledge possessed by teachers will create an effective learning environment for their students. In addition, pedagogical competence also has more influence on student achievement compared to teacher professional competence and will have a broad impact on the quality of learning [10]. In line with this, Birtwistle and Wagenaar [11], argue that a good pedagogical approach to learning has the potential to guide teaching and change learning. The pedagogical sub-fields include pedagogical skills and mastery of the educational process, which reflects mastery of learning and educational concepts and theories [12].

Describing and evaluating the pedagogical competence of prospective teachers is difficult and complex, because pedagogical competence is acquired through many procedures, qualifications and content [13]. Identification of the level of development of pedagogical competence (high, medium, and low) will be related to the components of pedagogical competence and their development methods [14]. Pedagogic competence will involve at least 5 (five) things, namely: (1) Subject matter; (2) pedagogical approach; (3) Subject management; (4) Class management; (5) and student ability [15]. Meanwhile Suciu and Mâţă [16], state that conceptual pedagogic competence will at least involve components: (1) Learning content; (2) Capacity to conduct assessments; (3) Adaptability; (4) Ability to handle skills and resources; and (5) Ability to use skills to the fullest.

On the other hand, Pujiriyanto [5], describes pedagogic competence including: (a) Mastering the physical, moral, social, cultural, emotional, and intellectual characteristics of students; (b) Mastering learning theory and learning principles; (c) Develop curriculum in the subjects taught; (d) Organizing educational learning; (e) Utilizing ICT for learning, (f) Facilitating the development of students' potential; (g) Communicate effectively, empathetically and politely; (h) Carry out assessment and evaluation of learning processes and outcomes; (i) Utilizing the results of assessment and evaluation for learning; and (j) Perform reflective actions to improve the quality of learning. Referring to Law no. 14 of 2005 concerning Teachers [9] and Lecturers and Duniadosen.com. [17], the pedagogic competencies used in research include: (1) Understanding of students/students; (2) learning design; (3) Insights and educational foundations; (4) Implementation of learning; (5) Assessment and evaluation; (6) Develop the potential of learners/students; (7) Curriculum and syllabus development; and (8) Utilization of learning technology.

Table 1. Details variables, indicators, and descriptors questionnaire.

No.	Sub Variable	Indicator	descriptor
1.	1. Understanding of the participants educate / students	1.1 Characteristics	Can identify characteristics intellectual, social, and moral participants educate / students
		1.2 Background	Can reveal background behind participant educate / students
		1.3 Advantages and disadvantages	Can identify advantages and disadvantages participant educate / students
		1.4 Psychological	Can identify problem psychological participant educate / students about learning
2.	2. Design learning	2.1 Syllabus	Able to design syllabus
		2.2 RPP (Plan Implementation Learning)	2.2.1 Able to design Plan Implementation Learning (RPP)
			2.2.2 Apply principles compile Plan Implementation Learning (RPP)
3.	3. Insights and grounding education	3.1 Background academic and understanding base education	3.1.1 Have background behind appropriate knowledge, as well knowledge and experience in do classroom learning.
			3.1.2 Have knowledge base educational foundation
		3.2 Thinking critical period long	Able to think critical for finish education problem
		3.3 Have ability communication	Able to deliver material learning with clear
4.	4. Implementation learning	4.1 Learning strategies	Able to apply learning strategies in delivery material
		4.2 Learning models	Able to apply learning models-based Student-Centered Learning (SCL)
		4.3 Systematic	Able to do learning in accordance with those who have planned
		4.4 Able to make participants educate think critically	Able to do that learning trigger participants educate / students for think critically
5.	5. Assessment and evaluation	5.1 Evaluation learning	5.1.1 Able to design remedial and enrichment for participant educate / students
			5.1.2 Able to provide bait back to the learning process
		5.2 Assessment	able to do evaluation cognitive, affective, and psychomotor for participant educate / students
6.	6. Develop potency participant educate / students	6.1 Potential participant educate / students	Can identify talents, interests, potential, and difficulties in study
		6.2 Able to push participant educate / students communicate	Can push participant educate study / student in accordance with each other's abilities
		6.3 Able to bring up creativity participant educate / students	Can come up with creative ideas participant educate / students for create something new
		6.4 Able to push participant educate / students innovate	Can push participant educate / students innovate in accordance with each other's abilities
7.	7. Development curriculum and syllabus	7.1 Curriculum	7.1.1 Have knowledge and understanding ever curriculum implemented in schools
			7.1.2 Able to apply moderate curriculum apply in learning
		7.2 Syllabus	can do development syllabus in accordance with principles and rules that have been set
8.	8. Utilization technology learning	8.1 Technology	Able to use technology and learning media kinesthetic for develop potency participant educate / students
		8.2 Application	Able to use various application deep audio-visual based learning
		8.3 IoT (Internet of Things)	8.3.1 Able to make learning media-based e-books that can accessed in a manner online
			8.3.2 Able to apply the learning process based mobile
			8.3.3 Able to make learning media based on VR (Virtual Reality)
			8.3.4 Able to make learning media AR (Augmented Reality) based

3. RESEARCH METHODS

The research design used is descriptive and aims to obtain information on the pedagogic competencies possessed by prospective technical education teachers in the Industrial Revolution 4.0 era. The population in this study were students of the Electrical Engineering Education Study Program and Informatics Engineering Education Study Program. The samples used were students in both study programs who had passed the teacher training course, which included: (1) Field Practice Studies (KPL), (2) Micro Learning Practices, (3) Vocational Education Curriculum, (4) Learning Planning, (5) Introduction to Education, (6) Evaluation of Learning, (7) Development of Learning Resources, (8) Management of Vocational Education, (9) Teaching and Learning, (10) Student Development, and (11) Classroom Management Workshop. The number of samples used was 116, consisting of: 50 undergraduate students in Electrical Engineering Education and 66 undergraduate students in Informatics Engineering Education.

The instrument in this study was a questionnaire using a Likert scale of 5, with the criteria: Strongly Agree - score 5, Agree - score 4, Sometimes - score 3, Disagree - score 2, and Strongly Disagree - score 1. Details of variables, indicators and descriptors in developing the questionnaire used in this study are described in Table 1.

4. RESULTS AND DISCUSSION

The pedagogic competency variables (KP) in this study include: (1) students' understanding (KP1); (2) Learning design (KP2); (3) Insights and educational foundation (KP3); (4) Implementation of learning (KP4); (5) Assessment and evaluation (KP5); (6) Develop students' potential (KP6); (7) Curriculum and syllabus development (KP7); and (8) Utilization of learning technology (KP8). From the data collected, an average score of 199.70 was obtained for the pedagogical competence of undergraduate Electrical Engineering Education (PTE) students, and 271.70 for S1 Informatics Engineering Education (PTI). Statistically (t-test), both have different average scores of pedagogic competences. However, both of them have the same level of pedagogic competence, namely in the medium category. Overall,

Table 2. Competency categories of S1 PTE and S1 PTI students.

No.	Category	S1 PTE	S1 PTI
1	Very High	12.96 %	30.37 %
2	High	7.41 %	0.00 %
3	Moderate	61.11 %	57.41 %
4	Low	18.52 %	22.22 %
5	Very Low	0.00 %	0.00 %

the pedagogic competencies possessed by PTE undergraduate and PTI undergraduate students are distributed as follows:

In Table 2, it can be seen that undergraduate PTE and PTI undergraduate students who have pedagogic competence are in the high or very high categories, the percentage is still relatively low/small. For this reason, it is necessary to improve the system and implementation of learning/lecture activities, both through theoretical lectures and educational practices, so that students have better pedagogical competence before becoming teachers in schools.

There are 54 indicators used in this study, which are translated through the pedagogic competency variable (KP). Referring to these indicators, a profile of the strengths and weaknesses of the pedagogic competencies of PTE and PTI undergraduate students was obtained. Graphically, the profiles of both pedagogic competencies are presented in Figure 1.
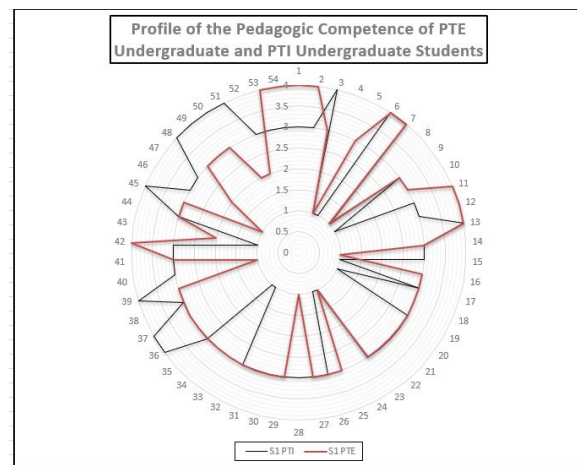
Figure 1. Profile of the pedagogic competence of PTE undergraduate and PTI undergraduate students.

Overall, both samples have strengths and weaknesses in their specific pedagogic competencies. Table 3 presents some of the strengths of the pedagogic competencies, and Table 4 the weaknesses of the pedagogic competencies that both of them have.

Referring to Table 3, S1 PTE and S1 PTI students have several strengths in pedagogical competence. The strength of the pedagogical competencies possessed by the two tends to be different. However, the strength of the pedagogic competencies in the High and Very High categories of the two is still relatively small/low in percentage, so it needs to be continuously improved (see Table 2). Likewise, if you refer to Table 4, the two samples have weaknesses in pedagogical competence that must be addressed immediately. In general, both have weaknesses in specific pedagogic competencies. From the differences in the weaknesses of the two, there are 3 (three) weaknesses in common in pedagogic

competence, namely: (1) Understanding the background of students/students; (2) Knowing the psychological problems of students/students in learning; and (3) Applying the basic concepts of education in learning activities

Understanding the background of learners/students is important and must be understood by the teacher. Before carrying out learning activities, teachers should recognize the background of their students individually. This will be very useful especially for building communication between teachers and students and students and students in learning activities. Besides that, the background that is not disclosed will have an impact on the adjustment of the social life of students/students at school. This, among other things, will lead to a feeling of loneliness at school, as well as a lack of a sense of belonging to the school. In the academic field, they also tend to be less prepared and have low self-confidence [18]. Other studies have also revealed that family background will affect the academic achievement of students [19].

Learning activities will always be related to teachers and students, where learning and teaching is a complicated process. The learning activities carried out by the teacher will have a big impact, related to what students learn [20]. In a psychological perspective, teachers must have a good understanding of individuals and culture, so as to create a conducive learning climate. Thus, psychological literacy plays an important role in learning activities [21]. However, as prospective vocational schoolteachers, they are not equipped with sufficient understanding of educational psychology, so they do not understand the psychological problems faced by students related to learning activities.

The foundation of education is conceptual. This is the basis for implementing educational activities. There are several important educational foundations in the implementation of educational practices that prospective teachers must understand, including: (a) Religious foundations; (b) Philosophical foundation; (c) Scientific basis (empirical/factual), including: educational psychology, educational sociology, and educational anthropology; and (d) juridical/legal basis. Implementation of the educational foundation does not focus on aspects of knowledge and skills in the field of study, but on educational insights that prospective teachers must choose and adopt [22], [23].

Regarding the weaknesses described in Table 4, it is necessary to thoroughly evaluate the system and implementation of learning/lecture activities, especially in the following subjects: (1) Introduction to Education; (2) Student Development; (3) Learning and Learning; (4) Learning Planning; (5) Micro Learning Practices; and (6)

Table 3. Strength competence pedagogic PTE undergraduate and PTI undergraduate students.

No	S1 Electrical Engineering Education (PTE)	S1 Informatics Engineering Education (PTI)
1.	Understand character / style Study participant educate / students	Able to embed attitude each other honor moment discuss
2.	able to provide strengthening to participant educate / students moment learning	Able to do evaluation cognitive through repeat
3.	Able to make plan activity learning (RPP)	Able to do evaluation affective through observation
4.	Able to make objective learning in accordance with indicator	Able to use technology in carry out activity learning
5.	Able to motivate participant educate / students For Study independent	Able to make tool display for activity learning
6.	Able to apply learning-based project (PjBL).	Able to apply draft mobile learning in learning

Table 4. Weaknesses competence pedagogic PTE undergraduate and PTI undergraduate students.

No.	S1 Electrical Engineering Education (PTE)	S1 Informatics Engineering Education (PTI)
1.	Understand background behind participant educate / students	Understand background behind participant educate / students
2.	Know problem psychological participant educate / students in learning	Stimulus participants educate / students to have logic think strong
3.	Carry out activity learning in accordance with plan (RPP)	Know problem psychological participant educate / students in learning
4.	Apply concepts base education in activity learning	Designing plan activity learning in accordance with applicable conditions
5.	Applying learning models-based Student-Centered Learning (SCL)	Apply concepts base education in activity learning
6.	Include participant educate / students in activity in accordance talents and interests	Guide participants educate / students in make work scientific

Field Experience Studies (KPL)/Schooling Field Experiences (PLP) [24], [25].

In particular, the abilities of PTE undergraduate and PTI undergraduate students in developing digital, mobile, and game-based learning media/resources tend to be different. The ability of PTE undergraduate students is in the low category, while PTI undergraduate students are in the high category. This is easy to understand, because their learning experiences tend to be different, especially related to the development of learning media. In the PTE Undergraduate Study Program there are only courses: (1) Development of Learning Resources; and (2) ICT-Based Learning [24]. Whereas in the PTI Undergraduate Study Program, there are several courses that are closely related to this, including: (1) Development of Learning Resources; (2) Multimedia Engineering; (3) Computer Assisted Learning; (4) Creative Learning Technology; (5) Multimedia Workshops; (6) Mobile Learning; and (7) Digital Media Technology and Games [25]. In order to increase the competency of PTE undergraduate students in developing digital, mobile, and game-based learning media/resources, it is necessary to add additional study program elective courses or transdisciplinary elective courses related to this matter. Prospective teachers are expected to have pedagogical competence in the use of processing facilities/tools to produce digital-based media, because this competency is one of the determining factors for success in the professional activities of a teacher [26], [27].

5. CONCLUSIONS AND RECOMMENDATIONS

Through the explanation described above, the following conclusions can be drawn:

(1) Even though undergraduate PTE and PTI undergraduate students have different average pedagogic competency scores, both of them have the same pedagogical competency level, which is moderate.

(2) PTE and PTI undergraduate students who have high or very high pedagogic competence, the percentage is still relatively low/small.

(3) PTE undergraduate and PTI undergraduate students both have strengths and weaknesses in specific pedagogic competencies, in other words, both have different pedagogic competency profiles.

(4) PTE undergraduate and PTI undergraduate students both have the same 3 (three) weaknesses in pedagogical competence, which are related to: (a) Understanding students' backgrounds; (b) Knowing students' psychological problems in learning; and (c) Applying basic educational concepts in learning activities.

(5) The ability of PTE undergraduate and PTI undergraduate students in developing digital, mobile, and game-based learning media/resources tends to differ significantly.

In order to improve the pedagogical competence of undergraduate PTE and PTI undergraduate students, it is best to:

(1) Evaluate and increase the effectiveness of learning, especially in the following subjects: (a) Introduction to Education; (b) Student Development; (c) Teaching and Learning; (d) Learning Planning; (e) Micro Learning Practices; and (f) Field Experience Studies (KPL)/Schooling Field Experiences (PLP).

(2) In order to increase the competency of PTE undergraduate students in developing digital, mobile, and game-based media/learning resources, it is necessary to add additional study program elective courses or transdisciplinary elective courses related to this matter.

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