Teacher Role and Domain of Expertise in the 21st Century: Evidence from Preservice Biology Teacher

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Abstract. This research focuses on biology education students' perspectives regarding teacher roles and domains of expertise in the 21st century identified from micro teaching courses. The aimed of this study was to describe the types of teacher roles that emerge in teaching practice in micro teaching courses and identify domains of expertise based on the perceptions of prospective biology teacher students while attending micro teaching courses. This research method is a qualitative based on the lesson study framework. The research instruments used questionnaires, interviews, and the observation of the learning process. The research results show that there are weaknesses in the domain of expertise needed in the 21st century, which consists of mastery of content/material, technology and pedagogy. Suggestions for further research are that good cooperation between universities and partners in schools is needed by forming the lesson study for learning communities (LSLC). This LSLC can develop the competencies of prospective biology teacher students, especially those related to pedagogical, technological, and concept mastery competencies on an ongoing basis.

Keywords: Teachers' role, domain of expertise, preservice biology teacher

Introduction
Providing opportunities for prospective teachers to develop their competence in teaching is very important as a process of establishing the role of being a teacher (Murphy, 2022; Zalavra & Makri, 2022). It has been believed that understanding the role of a teacher requires open attention from teacher-producing universities. One way to give open attention to teacher role construction is to conduct intensive teaching practices (Nasution et al., 2023: Cai et al., 2022). Continuous and programmed teaching practices can be applied to the lesson study approach (Fujii, 2019). The lesson study is considered the most capable of forming a person and developing a teacher role so that they have the courage, confidence, and competence needed in the 21st century. This opinion arises from philosophical theories about the role of the lesson study, which is not only a forum for discussion in a community but rather represents the person to develop actively and creatively (Ogegbo et al., 2019; YeşiLçinar & Aykan, 2022).
Student teacher candidates build knowledge and understand teacher roles through reflective and collaborative practice (Anderson, 2021; Asakereh, 2018). These two factors will affect teachers' ability to teach when they have a more comprehensive grasp of their expertise and function. This shows why it is important for prospective teachers to practice reflection early in the teaching practice process. Teachers cannot provide the best teaching performance if they cannot understand the teacher's role and domain of expertise (Bakar et al., 2020). A good understanding of the teacher's role and domain of expertise will produce professionalism. Critical awareness of the competencies possessed by student-teacher candidates will improve their personality (Plessis et al., 2023; Karlström & Hamza, 2019).

With our research, we explored the roles that emerge in teaching practice (microteaching) and the perceptions of prospective biology teacher students towards each of these roles. This will highlight them consciously about who they are as a teacher, as this research will reflect how they position themselves about their professionalism. We believe that by self-reflecting, we can identify domains of expertise based on the perceptions of prospective biology teacher students during micro-teaching lectures. Previous research has found that four teacher roles are formed, namely as facilitator, learning designer, reference source, and evaluator. This teacher role is used as a reference for biology education students in getting to know the role during teaching practice.

However, based on the independent curriculum which has been in effect since 2020, the role of teachers is increasingly enriched by the principles of collaboration and reflection. There are several studies which state that in this independent curriculum, as teachers, they can develop and build their ideas freely, especially in designing and implementing learning (teacher role) (Cai et al., 2022; Cañabate et al., 2019; Reyes et al., 2016).

Teachers can create and construct their thoughts about the teaching profession within the context of the domain of competence. For many years, the literature has placed a strong emphasis on how the teacher role is created and how it might be utilised to investigate teacher development (Marlin et al., 2023; Cai et al., 2022; Cañabate et al., 2019; Reyes et al. 2016). Through the investigation of a variety of sources, including reflective teaching, self-awareness, self-observation, and personal experience, the formation of the area of expertise has been studied. The realm of expertise develops throughout time as a consequence of ongoing instruction. Consequently, the process of creating the domain of expertise is ongoing and involves constant transformation. Research indicates that potential teachers should be first integrated into the teaching profession to assist the emerging teacher area of competence. This would help them feel more dedicated to teaching rather than like they have "lost out" (Çoban et al., 2016; Schmid et al., 2021; Tokmak et al., 2013).

The domain of expertise is divided into three aspects, namely subject matter, technology, and pedagogy. The subject matter domain is an important knowledge base to master according to the scientific background. According to Harden & Crosby (2000), pedagogy addresses topics including students, learning processes, student activities, and fundamental teaching techniques. Technology include items like media accessed through the internet. It is highly advised that universities look into the teaching practices of aspiring educators in order to help them develop pedagogical skills in addition to content knowledge as part of their subject competence. As expected, they are more proficient in content than
pedagogy since aspiring educators typically acquire material from subject matter experts and have fewer ties to the school as a training ground for pedagogy (Tondeur et al., 2017).

We explore the types of teacher roles that emerge in teaching exercises in microteaching courses and the perceptions of prospective biology teacher students towards each of these roles. We also identified a domain of expertise based on the perceptions of prospective biology teacher students while attending micro teaching courses. We recognise how important it is to investigate student teacher applicants' opinions and views on teaching roles and areas of competence. In order to discover domains of expertise based on prospective biology teacher students' perceptions while attending micro teaching courses, this research aims to investigate the types of teacher roles that occur in teaching practice in these courses.

**Methods**

This study uses a the lesson study approach. The the lesson study was carried out in 3 cycles (Figure 1). Each cycle consists of four stages, namely, plan, simulation, implementation, and reflection. Classes are divided into small heterogeneous groups (gender, ability, and experience). Before being formed into groups, all students were given a self-reflection questionnaire to measure the domain of expertise and teacher role in the 21st century. After being analyzed, 4 study groups were obtained, and each group carried out the process of planning and simulation in groups. At the same time, implementation and reflection are done classically.

![Figure 1. Stages of The lesson study in Research](image-url)

Participants were all biology education students who took micro teaching courses in the 2021/2022 academic year, totaling 30 students and consisting of 27 women and 3 men. Interviews were conducted with all participants (30 participants) with the help of a tape recorder. The interviewers consisted of 5 people, namely two micro teaching lecturers, two partner school principals, and 1 learning committee teacher. Each interviewer conducted interviews with 5-6 students. The researcher obtained prior consent from all participants to be recorded during the interview. The interview points are largely modified from Harden & Crosby (2000) shown in Table 1.
Table 1. Interview instruments

<table>
<thead>
<tr>
<th>Question</th>
<th>Targeted Focus</th>
</tr>
</thead>
<tbody>
<tr>
<td>(1) Did you involve yourself in the lesson plan discussion? Why?</td>
<td>To understand whether participants have the domain of expertise in collaborating on designing learning</td>
</tr>
<tr>
<td>(2) Did you propose to appear in the teaching exercise simulation? Why?</td>
<td>To understand whether participants have self-efficacy and the teacher's role in teaching performance</td>
</tr>
<tr>
<td>(3) How is your competence in determining the right learning strategy with the taught content?</td>
<td>To understand participants' perceptions of their mastery of the teacher role and learning strategies that are appropriate to the biology content</td>
</tr>
<tr>
<td>(4) How can microteaching affect the teacher's role as a biology teacher?</td>
<td>To examine whether the microteaching process is capable of influencing the formation of domain expertise and teacher roles in the 21st century</td>
</tr>
</tbody>
</table>

(Source: Harden & Crosby, 2000)

Context of the study

The research was conducted at the Biology Education Study Program, FKIP University, Tanjungpura Pontianak, in the even semester of the 2021/2022 academic year. 64 students took part in the microteaching course and only 30 students in the independent teaching program, a government program to improve partnerships between schools and universities (teaching program in partner schools in one period).

Participants

30 students participated in this study consisting of 3 boys and 27 girls. Their ages range from 18 to 20 years. All participants had experience designing independent learning and had experience performing in front of the class in the previous semester, namely in introductory teaching skills courses. Although not in real class conditions, they already have experience practicing learning directly in front of the class at least once for 20 to 45 minutes. Participants were carried out using saturated sample technique or total sampling. This technique is used because all members of the population are used as research samples.

Data collection

Data were collected using questionnaires and semi-structured interview sheets. The questionnaire distributed aims to collect participant responses about the practical teaching experiences they have experienced during the last cycle. Participants were asked to write down their role as a teacher in teaching exercises (microteaching). Because the questionnaires and interview sheets were asked directly to the participants, of course, this would cause bias because there would be a tendency for each participant to answer with good answers and think positively. To reduce bias, researchers use observation sheets in the learning process by involving other lecturers as observers who not only identify the continuity of learning syntax but observers are also tasked with identifying student competencies at each meeting.
Data analysis

We did the coding process twice for the data we obtained. The first coding was done on the questionnaire result data. This coding is used to analyze the teacher's role that appears in the teaching exercises in each cycle. Next, we did a second coding of the interview data, which refers to Saldana's research (2013), by using the terms struggle (STR) and comfortable (COM). This coding aims to explore the comments used by students in describing their experiences with these roles, whether they feel comfortable or struggle to carry out these roles.

Results and Discussion

Based on the results of the data analysis that has been carried out, we obtain information that students can perform seven roles of teachers according to the needs of the 21st century. The results of the analysis are shown in Figure 2.

Figure 2. The teacher's role in teaching exercises identified during the microteaching process

Based on the results of the interviews, information was found that prospective biology teacher students were not confident enough in designing lessons according to the topics being studied. So from the data analysis it shows that in the pre-cycle phase, students consider the learning designer has not been identified as one of the roles of a teacher. Recognized by prospective biology students, they have limitations in mastering teaching methods and strategies. Prospective teachers have limitations in recognizing strategies and approaches that are suitable for learning materials (Großschedl et al., 2019) forms the initial thought that a teacher does not need to master teaching methods but needs to be a good learning resource so that it can direct students to learn independently. Students described that a teacher required in the 21st century must have competence in guiding, designing lessons, implementing learning, and carrying out evaluations according to
learning objectives. Experience in playing the teacher in a teaching style that suits the needs of the 21st century was not all easy. Figure 3 shows the percentage of each teacher's role and the level of difficulty in playing it in teaching practice.

![Figure 3](image1.png)

**Figure 3.** The role of the teacher and the level of ease in playing it in teaching exercises

In Figure 3, information is shown that all students feel struggle in carrying out their role as learning designers. Instead, they think the role of the evaluator is elementary to as a teacher. They did not find it difficult to carry out their role as evaluators. Concerning the domain of expertise, the analysis results show that three domains are identified from the perceptions of all biology education students shown in Figure 4.

![Figure 4](image2.png)

**Figure 4.** The Expertise Domain of Preservice Teacher in Microteaching

Teacher’s role based on student perceptions in the micro teaching

Microteaching lectures provide teaching experiences for prospective teacher students. The pedagogical competence of aspiring teachers is greatly enhanced and developed by this experience (Zalavra & Makri, 2022). There are many strategies for increasing
pedagogical competence in microteaching courses. One of the most current trends is using the the lesson study approach (YeşiLçınar & Aykan, 2022). The lesson study applied in microteaching lectures can improve prospective teachers' mastery of eight basic teaching skills. Several findings have proved this. The first finding is that the lesson study is an effective approach that can facilitate supervising lecturers and student learning activities. Another result is that implementing the lesson study in microteaching is always based on careful planning (Karlström & Hamza, 2019; Zalavra & Makri, 2022).

The implementation of the lesson study in this study was divided into three learning cycles. The the lesson study cycle will allow students to improve their teaching performance based on input and reflection results from the previous meeting. The results of the last cycle's observations will be used as an evaluation so that they become a reference for analysis and reflection. The results of observations or observations will be concluded by comparing the expected targets with the actual achievement results so that the results of this reflection will be the basis for planning the following stages for improving learning. In order to establish a cooperative process between supervising lecturers and students in the use of microteaching, the lesson study provides valuable lessons. By include observers in the learning process, the lesson study seeks to enhance learning (Fujii, 2019; Schipper et al., 2020). The results of the observations become a reference for improving learning at the next stage so that the appearance of teaching becomes more qualified and more effective following the expected goals.

Implementing microteaching with the lesson study approach provides teaching experience to all prospective biology teacher students. Students act as teachers who have varied roles. In Figure 2, it is found that based on the perceptions of prospective biology teacher students who have implemented teaching exercises for three cycles, there are seven teacher roles, namely (1) lesson planner, (2) mediator, (3) evaluator, (4) motivator, (5) supervisors, (6) learning resources, and (7) facilitators. An interesting finding from the analysis of the teacher's role is that none of the students identified the teacher's role as a learning designer before implementing microteaching with the lesson study approach. However, after the implementation of the lesson study, all students thought that the teacher's role could not be separated in lesson planning. Learning will be good and will result in a fun teaching and learning process if the teacher himself designs the lesson (Ogegbo et al., 2019; YeşiLçınar & Aykan, 2022). Through the lesson study, learning design that is carried out by involving colleagues in groups and with the principles of collaboration and reflection will improve the quality of the designed lesson plan. It is not surprising that at the end of the cycle, all students (100%) agree that one of the important roles of the teacher in the 21st century is as a learning designer.

Another interesting finding is the result of an analysis of the teacher's role as an evaluator. It turns out that 50% of students agree that the lesson study is insufficient to direct a teacher to become an evaluator. The more students carry out the lesson study, some students realize that a teacher should not act as an evaluator but instead as a facilitator. This is what causes that at the end of the cycle, some students (50%) state that the role of the evaluator is not important in the 21st century. The role of the teacher as an evaluator cannot be eliminated because the evaluation process is needed to analyze whether learning is in accordance with the objectives to be achieved. Through the evaluation process, teachers can identify students still experiencing learning difficulties (Çoban et al., 2016).
Another finding is related to the teacher's role as a learning resource. All students consider that the role of the teacher as a source of learning cannot be replaced by anything else. Every student who has difficulty in learning can directly ask the teacher. In a sense, teachers can help students overcome challenges experienced by students in learning. This opinion is maintained until the second cycle. However, at the end of the cycle, some students thought that the teacher was not the only source of learning because students could solve problems or solve problems by holding discussions and collaborating to find the right and appropriate answers. The lesson study facilitates students to work together and collaborate in study groups and supports the formation of learning communities on an ongoing basis (Ogegbo et al., 2019; Schmid et al., 2021). At the end of the cycle, students find that the teacher's role is more of a mediator, and students realize that finding concepts is more fun and more understandable than just listening to explanations from other people. Not all information must come from the teacher. Students need to be given the freedom to find the information they need and cultivate the principles of collaboration and reflection in groups (Abbas et al., 2023). This principle can train communication competency and foster self-confidence (Bakar et al., 2020; Schipper et al., 2020).

Teacher candidates have varying pedagogical competencies. Previous teaching experience is one factor determining the courage to appear in teaching practice (Pham, 2022; Plessis et al., 2023). There are several roles that students think are very difficult to do, and several teacher roles are easy to play in microteaching. Based on the results of the analysis shown in Figure 3, 100% of students feel they struggle in playing the role of the teacher as a learning designer. The ability to design learning is mainly related to creative thinking (Sithole, 2023; Anderson, 2021). As a learning designer, a teacher is required to have a good mastery of pedagogy, approaches, methods, learning resources, and mastery of technology that follow the character of the students who will be taught (Fujii, 2019). This is the reason why teachers need to design good lesson plans. Learning designers will better understand and understand the learning process that will be implemented because it is made by themselves. A good teacher is not allowed to use an existing lesson plan or someone else's lesson plan because, of course, it is not in accordance with the character of the students who will be taught.

On the other hand, the role that biology education students find very comfortable to play is that of an evaluator. Students assume that questions and answers are widely available in electronic media and print media so that a teacher can follow an example and only need a few adjustments to achieve learning objectives. The role of evaluator so far has been carried out well by prospective biology teachers in all cycles. Students have no difficulty making questions, giving evaluations, and analyzing evaluation results. However, in this study, no measurement has been made of the competence of prospective teachers in making good questions in accordance with what is needed in the 21st century or what is known as high-order thinking skills (HOTs). A good arrangement of questions has not been identified.

The domain of expertise according to the perspective of prospective biology teacher students

A teacher is currently required to be an expert in the field of science according to his scientific background. The domain of expertise has long been recognized as a framework a teacher needs to streamline pedagogical practice and understand concepts by integrating
technology into the learning environment. It was discovered through training and actual teaching that instructors in Indonesia continue to face issues, such as inadequate material, media, and technological literacy (Suyamto et al., 2020). In Indonesia, a large number of educators continue to exclude students’ experiences from classroom instruction (Nevrita et al., 2020). Teacher knowledge is only centered on the use of media, videos, and animated shows, teachers are less able to explain contextually to students (Louis & King, 2022).

According to the perspective of biology education students, Figure 4 shows that there are three domains of expertise that teachers most need to support their role as educators in the 21st century, namely mastery of technology, technology, and pedagogy. Several experts have studied these three things before and have produced a framework for measuring and improving the competence of these domains, known as TPACK. So far, the professional competence of teachers in mastering content continues to be in the spotlight.

As a result, the development of the TPACK framework began to be directed at developing the professional competence of prospective teachers in specific content (Bakar et al., 2020; Ciampa, 2017; Çoban et al., 2016; Doukakis et al., 2010). To measure the TPACK of prospective biology teachers, several researchers have used instruments that were developed and widely used. The originator (Louis & King, 2022; Tafli & Atici, 2016) measured the TPACK of prospective biology teachers using a semi-structured interview instrument that focuses on the application of technology and pedagogy. Furthermore, the TPACK measurement instrument is equipped with multiple-choice tests (Suryawati et al., 2017) and observation sheets. The latest discovery of developing a domain of expertise measurement instrument for prospective biology teachers is currently equipped with a performance sheet (Kotzebue, 2022b, 2022a); (Muthmainnah & Nurkamilah, 2022).

More than two decades ago, in its development, the domain of expertise was described as a relationship with a strong correlation between technology, pedagogy, and knowledge (Tondeur et al., 2017). The domain of expertise is introduced as the pedagogical technology competence of prospective teachers (Tokmak et al., 2013). Prospective teachers must have mastery of pedagogy, technology, and knowledge in relevant fields of science. The contribution of the domain of expertise can be said to be very large for the formation and professional development of prospective teachers (Bakar et al., 2020; Cai et al., 2019; Doukakis et al., 2010; Jimoyiannis, 2010; Wilson et al., 2020).

The domain of expertise framework has received much support in Indonesia from academics and practitioners (Paristiowati et al., 2019; Zaeni et al., 2021). Real evidence of the global effect of using the domain of expertise as a tool in various teacher education contexts has been extensively researched before. Various studies have used this domain of expertise as an instrument for measuring teacher education programs and evaluating teacher pedagogical competence (Chai et al., 2020; Gill & Dalgarno, 2017; Kaplon-Schilis & Lyublinskaya, 2019; Luo et al., 2018; Paristiowati et al., 2019; Reyes et al., 2016; Rigelman & Ruben, 2012; Schmid et al., 2021). Three domains of expertise for prospective biology teachers consisting of mastery of material/content, technology, and pedagogy, need to be continuously developed to identify the skills of prospective Indonesian biology teachers in the 21st century. The three domains of expertise for prospective biology teachers are considered important and relevant to ensure that prospective Biology teachers in Indonesia are prepared for a better future. Among the research on measuring the three domains of expertise of prospective biology teachers both in Indonesia and abroad, no instrument can comprehensively measure the ability of biology content and context. The
overall findings on implementing the domain of expertise framework, including in Indonesia, are still measuring prospective teachers’ technological and pedagogical competence. This means there are no published studies on manufacturing instruments with structures that contain clear biological content and context (Otero & Torres, 2018). As a follow-up, there is a need for research that specifically develops comprehensive instruments on the domain of expertise of biology teachers so that they are more focused according to the needs of partners and future schools.

**Conclusion**

Implementing microteaching with the lesson study approach provides teaching experience to all prospective biology teacher students. Students act as model teachers who have varied roles. Based on the perceptions of prospective biology teacher students who have implemented teaching exercises for three cycles, there are seven teacher roles identified, namely (1) learning designer, (2) mediator, (3) evaluator, (4) motivator, (5) mentor, (6) learning resources, and (7) facilitators. There are several roles that students think are very difficult to do, and several teacher roles are easy to play in microteaching. Students struggle to play the role of the teacher as a learning designer. The ability to design learning is mostly related to creative thinking. As a learning designer, a teacher is required to have a good mastery of pedagogy, approaches, methods, learning resources, and mastery of technology in accordance with the character of the students who will be taught. A role that is very comfortable to play is as an evaluator. Students have no difficulty making questions, giving evaluations, and analyzing evaluation results. However, in this study, no measurement has been made of the competence of prospective teachers in making good questions in accordance with what is needed in the 21st century or what is known as HOTs. Good problem formulation has not yet been identified. The three domains of expertise for prospective biology teachers, which consist of mastery of material/content, technology, and pedagogy, need to be continuously developed to identify the skills of prospective Indonesian biology teachers in the 21st century. There is a need for good cooperation between universities and partners in schools by forming the lesson study for learning communities to develop the competence of prospective biology teacher students, especially those related to pedagogical competence, technology, and mastery of concepts in a sustainable manner.

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