

The Dual Role of a Reflective Future Teacher during School Practise

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Received: August 31, 2023; received in revised form: November 12, 2023;
accepted: November 13, 2023

Abstract:

Introduction: Teaching and learning are processes that significantly impact one's future. Active participation in school practises serves as a strong foundation for future educators. This paper aims to present the viewpoints and feedback of university students on chemistry lessons conducted in schools by fellow university students as part of their training. The study explores how these prospective teachers perceive lessons while simultaneously playing the roles of both the teacher and an observer. It also investigates their ability to identify areas in need of support and those that require further development during their subsequent pre-service teacher training courses.

Methods: Quantitative data was collected through formal documents, specifically observation sheets. The study's participants were university students enrolled in pre-service teacher training programs who conducted chemistry lessons in school settings. These participants assumed the dual roles of instructors and observers during the lessons they taught.

Results: Analysis of the observation sheets revealed that the experience of assuming both teaching and observing roles contributed to the enhancement of the pre-service teachers' reflective attitudes. This finding suggests the positive impact of this dual role on their professional development.

Discussion: Teaching demands a blend of pedagogical knowledge and the ability to reflect, as evidenced by a study at Jagiellonian University's Faculty of Chemistry. This research, aimed at understanding the effectiveness of trainee teachers, highlighted the importance of creativity, proper communication, and skills in interpersonal relations for educators. While the research provided valuable insights, there's a call for more extensive studies to gain deeper

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understandings and address challenges such as classroom management and student engagement.

Limitations: It is important to acknowledge certain limitations within this study. The scope of the investigation was restricted by the size and composition of the sample of participants. Consequently, the outcomes cannot be generalised to the broader population of pre-service teachers.

Conclusions: The findings of this research highlight the importance of adopting a dual-role methodology in teacher education. By assuming both teaching and observational roles, aspiring teachers acquire a more profound understanding of their pedagogical techniques and recognize potential enhancements. Engaging in such reflective practices promises to enhance their subsequent teaching experiences. This study emphasizes the advantages of weaving hands-on teaching experiences into teacher training, fostering a more introspective and effective teaching methodology.

Key words: chemistry education, reflective school practise, teacher development, observation sheets.

Introduction

Teaching is a beautiful, interesting, demanding, and very difficult task, especially for young teachers. It requires different types of methods, techniques and strategies depending on the subject of the school, the nature of the task, the learning objectives, the abilities of the school students and the behaviour of the students.

The teacher plays an extremely important role in contribution to shaping of the quality of the education process (Caires et al., 2012; Aglazor, 2017; Gabalán-Coello & Vásquez-Rizo, 2021; Trávníčková, 2021).

In the literature, science teaching can be defined in terms of the knowledge that teachers use in their teaching (Guskey, 1989). Each teacher must have subject matter knowledge (SMK), general pedagogical knowledge (PK), and pedagogical content knowledge (PCK) (Bucat, 2005; Abell, 2008). Another aspect considers formal preparation and teaching practise, including pre-service teachers who train students.

During subject matter preparation, all topics and questions discussed during the lesson should be determined in the context of objectives and order; taking into account the principles of teaching. Methodical preparation means finding a solution to the question of how specific lessons should be conducted and identifying how teaching methods and teaching aids should be applied. Teacher and student actions must be determined together with the forms and methods of control and homework. On the other hand, organisational preparation is related

to the preparation of the workplace and the necessary didactic (teaching) aids (Krzeczkowska, 2020).

According to researchers, teaching strategies are important for an effective educational process (Gabel, 1999; Sarica & Çetin, 2020). Teachers must be characterised by a flexible working style that changes the methods of work and the scope of the material in response to the needs and interests of the students. The teacher's role is to facilitate the acquisition of knowledge by students, and when selecting teaching methods and didactic resources, they must remember the diversity of learning styles, way of thinking, and student personalities (Beño et al., 2020; Junior, 2020).

During the lesson, school students should be involved in the learning process. Johnson (2011) underlined that student engagement brings better learning outcomes and satisfaction. Furthermore, some researchers promote an active approach to learning; school students are responsible for their educational results (e.g. Michael, 2006; Gül, 2023). Based on the literature, there are two categories of active learning: collaborative learning with interaction between teachers and students (Munir et al., 2018), problematic learning with two phases: understanding the problem and solving problems, and there is a correlation between collaborative learning and learning outcomes (Garrett, 1986).

Teacher education policy around the world takes into account the need for assessment and formative reflexion on skills development.

No educational system is able to prepare a future teacher to overcome all the didactic and educational problems they will face in the future. Reflexion is the tool that such an apprentice student needs and which he can acquire and improve in the process of education. According to Griffiths (2000) on teacher education and teacher professional development, a reflective concept of teacher education proposed by Schön (1997) should be considered.

Based on a situational understanding of events, as well as reflexion and analysis of their own actions, professional knowledge is created. It is the result of problem solving and taking into account the skills of interpretation in pedagogical activity, empathy, and reflectiveness; Castañeda-Trujillo, López & Molina Santana (2022) also distinguishes the most valuable element of the teaching profession: practises.

1 Pre-service teacher training - an example from Jagiellonian University

The Faculty of Chemistry of Jagiellonian University in Kraków offers the opportunity to obtain the qualification to teach chemistry at school by starting students' participation in pre-service training. In 2019 new standards for teacher education standards have emerged (<https://isap.sejm.gov.pl/isap.nsf/DocDetails>).

xsp?id=WDU20190001450). This was the reason for modifying the curriculum of courses for pre-service chemistry teacher training. The pre-service chemistry teacher training programme consists of various courses (see Figure 1).

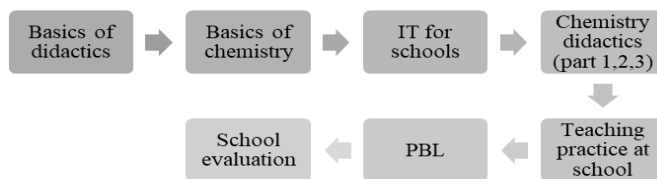


Figure 1. Scheme of courses for pre-service chemistry teacher training.

The practise of teaching in school is a crucial part of the pre-service teacher training (Kirbulut & Bektas, 2011). As Chong and Low (2009) reported, teaching practise is effective in the decision of students whether to become a teacher or not; after teaching practise, students (future teachers) decided whether or not to pursue the teaching profession. The practise of teaching in schools must precede good theoretical preparation. Students learn methods, strategies, rules, and didactic tools. The following topics in the student meeting are planning lessons, completing tasks, preparing didactic tools, and writing the outline of the lesson.

Before the four-week internship at school (teaching practise at school), university students have the option of conducting three lessons at school. This is done through a course called Chemistry didactics (part 2). One lesson is conducted at the primary school level (during winter semester), and the next two lessons at a secondary school (during summer semester), basic and extended level of the chemistry core curriculum (<https://podstawaprogramowa.pl/Liceum-technikum/Chemia>).

2 Purpose of the study

The purpose of the research was to explore how students (future teachers) deal with theories of effective teaching as well as if and which elements of theories were implemented during two chemistry lessons that they conducted at the secondary school level.

Furthermore, the research was designed to provoke trainees to reflect on their preparation for lessons and their ability to provide learning opportunities and positive classroom outcomes, also in the aspect of expected change.

Collected opinions allow for recognition of areas requiring support and further development.

The research problem was analyzed using sub-problems listed below:

Research question no.1: Did the students who proposed their own intriguing title for the lesson in the form of an affirmative sentence perform the experiments in the classroom?

Hypothesis: Suggesting one's own intriguing topic of the lesson affects the fact that experiments are made during the lesson.

Research question no.2: Did the students who proposed their own intriguing title of the lesson in the form of an affirmative sentence conduct lessons according to a schedule that assumed low teacher activity (40% or less on the activity scale during 45 minutes of lessons)?

Hypothesis: Suggesting one's own intriguing topic of the lesson affects the fact that during the lesson the activity of the teacher is lower (40% or less on the activity scale during 45 minutes of the lesson) than the activity of students.

Research question no.3: Did the students who proposed their own lesson title in the form of a problem question use the problem method in the lesson?

Hypothesis: Proposing your own intriguing topic for the lesson in the form of a problem question influences the fact that the lesson was conducted using the problem method as the leading teaching method in this lesson.

3 Methodology

3.1 Participants

Participants in this study were university students who enrolled in various pre-service teacher education courses: 72 students (80% female, 20% male; aged 22-23). During March 2021 to June 2021 and March 2022 to June 2022, students were escorted by the university supervisor, visited the secondary school, met the school supervisor for the first time, and conducted their own lessons (lesson no.2 and lesson no.3). During the winter semester of the academic year 2020/2021 and 2021/22, university students conducted the first lesson themselves at primary school (lesson no.1).

3.2 Context

University students go to the upper secondary school to practice chemistry teaching under the supervision of a school supervisor and a university supervisor. Each student conducts two lessons: the first at the basic level and the second at the level with an extended chemistry program. During the "preparation of the lesson" part, the student prepares a detailed lesson plan (scenario). This plan is sent to a school supervisor to prepare the final version based on the comments received. While the student conducts the lesson, the rest of the group fills in the observation sheet. Each lesson is followed by a discussion phase. It is obvious that conducting a lesson is not enough to develop and make some changes for future work as a teacher. There must be reflection. Reflective

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practise is a process that facilitates teaching, learning, and understanding, and plays a central role in the professional development of teachers (Mathew et al., 2017; Priya et al., 2017).

3.3 Research tool and data collection

The study was carried out using observation as a diagnostic method (Braun & Clarke, 2006; Black & Wiliam, 2010; Bell et al., 2019). Observation is a basic source of human knowledge. In the literature, there are five observation techniques for data collection (Adler, 1998; Patton, 1990; Rossi et al., 1999; Vierra & Pollock, 1992).

The authors created an observation sheet (teacher observation protocol) as a tool (see Table 1) that was designed to provide information on some details of the lessons (Chionidou - Moskoglou et al., 2019) and to stimulate students to reflect on their own lesson and the lesson conducted by other students.

This observation sheet has universal form and can be used for different science school subjects.

Table 1

Details of an observation sheet

The teacher gave the title of the lesson:		Yes	No
The teacher used teaching aids:		Yes	No
What was their use and was its use justified?			
During the lessons, the teacher used methods and forms of work / forms of teaching: lecture / individual work / discussion with students / group work / students solving a problem on their own / discussing the method of the obtained solution			
The teacher created the possibility of individual work of the students:			
Yes		No	
What was the activity of the students during the lesson (in %)?		What was the teacher's activity during the lesson (in %)?	
During the lessons, the teacher showed content in everyday life and gave some examples.			
Yes		No	Interesting examples:
Did the teacher correct the incorrect statements of the student?			
Yes		No	
The teacher summarised the lesson:		The teacher gave homework:	
Yes		No	Yes
			No
Was the idea for the lessons good?		Did the teacher remember the principles of teaching? Which? And what has he forgotten?	
Yes		No	Comments:
Have the main goals of the lesson been achieved based on the topic of the lesson and your own interpretation of the flow of the lesson?			
Yes, completely		Yes, partly	No (and why?):
Noticed chemical and didactic mistakes; suggestions, comments, opinions, proposals for changes, etc.			

Students who did not conduct the lesson, as observers, completed an observation sheet.

This pilot study took place during the months March 2021 to June 2021, and March 2022 to June 2022. In these periods, 72 students conducted two lessons at the upper secondary school level, for which 118 observation sheets were implemented. Each observed lesson lasted 45 minutes.

The essence of this method is to evaluate what is happening during the lesson. The study was exploratory-descriptive in nature (Eisenhardt, 1989).

3.4 Data analysis

For the purposes of this article, some parts of an observation sheet have been selected for simple qualitative and quantitative analysis.

Each observation sheet was coded prior to the analysis process. The analysis of the observation sheet was performed by a person who did not participate in the lessons of the students.

Furthermore, statistical calculations were performed using the Statistica 13 programme of the StatSoft company for the assumed significance level equal to $\alpha=0.05$. Pearson's chi-squared test (χ^2) was used in order to demonstrate the relationships for the nominal variables, we obtain statistical significance in the event that the calculated p-value is lower than the assumed significance level $\alpha=0.05$.

4 Results and discussion

Figure 2 shows the elements chosen from the lesson plan (scenario) which are in the observation sheet and included in the analysis.

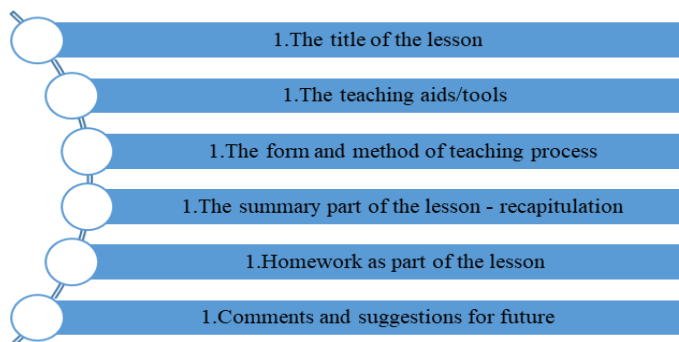


Figure 2. Selected elements of the lesson scenario analysed.

What is the purpose of a title of the lesson? A good title captures the interest of the student and is related to the main topic. As Iqbal et al. (2021) said, the theme in the form of an interrogative sentence is typical for problem lessons, as it contains an issue that needs to be solved. An interesting lesson title may play an important role in school students and engagement during the lesson (Derri et al., 2015; Bolliger & Martin, 2018).

Some researchers clearly emphasise the importance of teaching aids/tools in education (Augustinovič, 2019; Almasri, 2022; Daz Montes & Barrera Zapata, 2022; Gül, 2023). Teaching aids increase not only the attractiveness of lessons, but their proper use (the right form and the right moment in the lesson) increases motivation to learn, students' participation, and interest in the subject. Pekdag and Le Maréchal (2010) pay special attention to the proper use of videos in the lesson.

Well-designed didactic situations based on the work of individual school students are needed to increase awareness and responsibility for the learning process (Kholmuratovich et al., 2020).

4.1 The title of the lesson

In the case of two lessons conducted (1.7%), the title of the lesson was not given. The overwhelming majority of the lesson titles come directly from the curriculum (70%). But some interesting titles also emerged, such as these colours of chrome, magic halogens, all shades of manganese, and on the other side of the mirror. Some of the titles appeared in the form of a question, for example: Who rules in organic chemistry?, Gives back or downloads? Who is the head of the chemical reaction?

Formulating an interesting lesson title requires more time and a creative approach. Students may not have experience creating their own interesting lesson topics and do not want to make mistakes. It is necessary to explain to university students why it is important.

4.2 Teaching aids/tools

During the lessons different types of teaching aids/tools were used (see Figure 3).

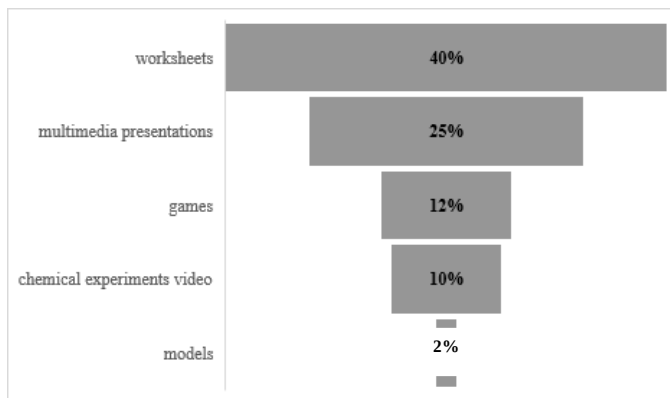


Figure 3. Frequency of occurrence of different forms of teaching aids.

All students used teaching aids during their lessons, but only 25% of respondents considered the use of teaching aids justified. The rest of the respondents did not complete this part of the observation sheet. The lack of justification for the choice may indicate an unwillingness to reflect, an unfamiliarity with the available aids or did not feel the need to use them.

The didactic / teaching aids most frequently used were worksheets (40%). According to the authors, it is valuable because, in addition to teaching chemistry, the physical act of writing activates the motor memory of the brain and strengthens the learning process (Sotáková et al., 2020; Pei et al., 2021). Multimedia presentations were popular during the lessons (25%) and chemical games were relatively rarely used (12%). All presentations were prepared by students.

Approximately, the chemical experiment video was used quantitatively the same number of times as games. The authors underlined that sometimes teachers may use chemistry movies during lessons; there are some benefits such movies provide students in the school environment. However, on the other hand, some recommendations for the training of teachers who are involved in using chemistry movies as a method to engage or motivate classes are needed.

Models were the least frequently used aid. Perhaps students did not find a ready-made model for their lesson or were unable to create their own model (no idea of a model).

4.3 The form and method of the teaching process

According to the respondents, during the lessons, discussions with school students occurred very often (about 48%). The dominant form of interaction was small talks. However, on the other hand, the lecture format was also often used (35%). Only in the case of 3% of the lessons conducted was the possibility of individual school student work.

What was the activity of the students during the lesson? Almost half of the lessons were characterised by the activity of the students above 70%; and every third allowed for 90% activity during lessons. It is worth highlighting that the students appreciated the interesting questions that were asked of them. Asking questions plays an important role in the teaching-learning process and stimulates students to be active during lessons (Chin, 2004).

In the authors' opinion, the above results indicate frequent use of active forms of work with the school student, but there is a need to show university students more opportunities to work with individual school students during lessons.

Group work was carried out in each lesson, although its duration varied considerably. Working in a group has many benefits for effective learning and prepares school students for future work (Burdett, 2003; Sarica & Çetin, 2020; Matúšová & Kollár, 2023). According to Vrieling-Teunter et al. (2022), the students had the potential to develop their inquiry skills, problem solving skills, team learning, relationship and increase motivation.

Each fifth lesson allows students to make chemical experiments on their own. According to the authors, the result is not satisfactory as the topics of the lessons conducted were suitable for making experiments. Perhaps it is fear and uncertainty that causes students not to carry out chemical experiments during their lessons. Chemical education should be based on making experiments, and this is the area that requires our greatest support. This is especially important in relation to science subjects. Shaping the student's research attitude will be possible through the use of an appropriate methodology, e.g., inquiry-based science education (Minnet et al., 2010; Delclaux & Saltiel, 2011; Crafword, 2000; Kožuchová et al., 2023) or STEM methodology (Craig et al., 2019).

4.4 The summary part of the lesson

The lesson must be recapitulated to consolidate the new knowledge taught to the school students in their minds - 89% of students (future teachers) summarised the lessons. University students used a variety of forms of task (e.g., rebus, logograph, domino, trimino, memo, puzzles), but Kahoo and Quizzes were the most widely used forms (70%). The authors attribute this to effective strategies adopted during the period of COVID-influenced education (Puspitarini & Hanif, 2019; Adnan, 2020; Brown, 2021).

4.5 Homework as part of the lesson

94% of the teachers gave homework to consolidate the new content learnt in the lesson.

Cooper et al. (2006) and Marković et al. (2010) wrote that a well-designed homework task can strengthen classroom learning by posing challenges to the student, who will thus gain a better understanding of the essence of the matter and further develop their ability to apply theoretically gained knowledge in practise.

Only in 30% of the observed lessons, homework appeared as original assignments created by the students. The rest of the tasks came directly from the workbook; they represented different forms, true or false, matching, chemograph, and simple open tasks, and they also required critical thinking and deep understanding of the topic. Explain this situation, analyse this situation, compare, design an experiment allowing, write an explanation of your choice, and here are some example commands for school students, tasks.

4.6 Comments and suggestions

As the respondents underlined, all the lessons had a good idea, but this part of the questionnaire was completed in 62%. The objectives of the lesson and their implementation during the lesson were the next step to be taken into account. In 93% of the lessons, the objectives were fully achieved; in the remaining lessons, the goals were only partially achieved. The authors emphasise that these are the opinions of university students based on their own interpretation of the observed lesson.

On the lesson observation sheet, students could also propose changes and make comments. Each observation sheet was competed in that area. 109 is the general number of all comments. The comments were divided into four groups (see Figure 4).

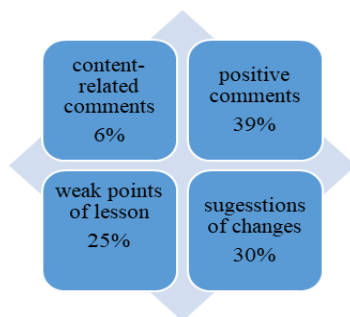


Figure 4. Different types of comments and percentage of their occurrence.

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6% of all comments are content-related comments. The students, as observers, noticed the following errors: an incorrect compound formula, an incorrect name of chemical substances, and incorrectly balanced chemical equations. Students also noticed incorrect definitions of terms or an ambiguous definition. The authors perceive it positively. Students demonstrate vigilance and up-to-date chemical knowledge.

30% of all comments consider the weak point of the lesson, for example, no summary of the lesson, imprecise formulation of questions for students, chaos, fast pace of the teacher's speech, conversation only with the student at the blackboard, standing with his back to the class, the teacher practically does not move around the room classroom, standing only at the desk or at the blackboard, standing in one place all the time and looking at the floor too often. It was also noted that the knowledge was presented and transferred during the lesson, but there was no time to use it to solve various problems, even typical ones.

39% of all comments are positive. Among them, attention was drawn to an interesting idea for lessons, a well-thought-out timetable with the right balance of time, a good pace of discussion, the conduct of lessons, the use of various teaching aids and frequent references to everyday life. It was emphasised that the teacher walks around the classroom, checking what the students have in their notebooks.

It seems interesting that the observers also comment on the student's behaviour in terms of his/her position in the classroom during the lesson. Each second lesson was characterised by the student not leaving the space between the desk and the blackboard.

25% of all comments are suggestions for change, for example, for worksheets, for the use of teaching aids at a given moment in the lesson, for example, chemical models of molecules, for making a simple experiment using materials available at home (an example of this experience is given) instead of the experience video that was shown in the lesson. Additionally, it was proposed that instead of dictating certain content, information can be prepared in appropriate worksheets, which additionally allows time gain. It is worth mentioning that the proposed changes are related to various areas. It is true that only every fifth student suggested changes; nevertheless, according to the authors, it is a good starting point for greater awareness of the need for a reflective attitude of teachers.

The respondents also described the lessons in terms of the following:

- a) 69% of the teachers showed content in the context of daily life,
- b) 98% of the teachers corrected the incorrect statements of the student.

The teacher should show the content in the context of everyday life, give examples of everyday life, and also show the usefulness of knowledge in everyday life. Contextual teaching and learning involve making learning

meaningful for students by connecting with the real world. It can be difficult for students, especially in the initial phase of pre-service teacher training. More specific examples of contextual teaching and learning are needed because applying this will make the educational process more interesting, engaging, and effective (Pekdag & Le Maréchal, 2010; Christensson & Jesper, 2014).

There were not enough data to confirm the significance of the hypothesis that those students who related the topic of the lesson to everyday life much more often than others showed content in the context of daily life (chi-square test = 30.611; $p > 0.05$).

It is important that university students correct the statements of school students. The authors appreciate the fact that university students respond appropriately to what is happening during the lesson.

Noise, chaos, and lack of skills and tools to cope with such situations were also troublesome for the trainees surveyed. Respondents indicated that the failure to cope with maintaining discipline is their main obstacle in the pedagogical area. Additionally, it was difficult for them to retain the attention and concentration of the school students.

In summary, reflective practices are an important factor in shaping the emotional bond with the profession and the professional environment (Cochran-Smith, 2003; Juuti et al., 2018). Therefore, it performs variety functions (see Figure 5).

cognitive	agility	integrative	personality formation	checking
•allows for a better understanding of the processes of teaching and learning	•affects the improvement of methodologic al skills and educational	•allows students to integrate the knowledge acquired during your studies, within various subjects	•develops personality (e.g. interpersonal skills) and motivation to perform professional tasks through direct contact with the school student and school teachers	•enables the practical verification of professional competences and chemical knowledge

Figure 5. Variety functions of reflective practices at school.

Conclusion of research question no.1: Students who proposed their own intriguing lesson title in the form of an affirmative sentence definitely more often

than others made experiments during the lesson (chi-square test = 42.13; $p < 0.05$).

Conclusion for research question no.2: Students who proposed their own intriguing lesson title in the form of an affirmative sentence definitely more often than others conducted a lesson during which the teacher's activity is lower (40% or less on the scale of activity during 45 minutes of the lesson) than the activity of the students (chi square = 57.6, $p < 0.05$).

Conclusion of research question no.3: Students who proposed their own intriguing title for the lesson in the form of a problem question much more often than others used the problem-based method as the main teaching method in their lesson (chi-square test = 32.44; $p < 0.05$).

Conclusions

Reflecting on your lesson is the result of peer review of the student (peer assessment). In recent years, peer evaluation has been used more and more often in the educational process (Double, McGrane, & Hopfenbeck, 2020). Despite the prevailing view that peer assessment has a positive impact on the learning process, it is important to remember that there are various factors that can affect the effect of peer assessment. Hongli Li and others (2020) explicitly point out that the assessment format, assessment criteria, and frequency of peer assessment, and most importantly the training of the assessors, can be used to determine how to effectively use peer assessment as a learning tool.

The pilot research was intended to provoke the trainees to reflect on school practices, also on the aspect of expected change. Based on the research conducted, certain conclusions could be drawn for a pre-service teacher training program.

Here, it is worth taking care of motivating students to active participation in university teaching activities, encouraging them to look for their own creative solutions, departing from traditional paths.

Research was limited and did not allow large-scale generalizations and deep analysis of correlation based on statistical methods.

Among others, the following skills and personality traits were considered necessary and even indispensable in the teacher's work: the skills of proper communication, reflective manner, regularity, conscientiousness, and empathy.

During the preparation for the teaching profession, the focus should also be on improving skills in the field of interpersonal relations. The area which, based on the reflections of the respondents, requires a change is as follows: acquiring methods, means, and tools to deal with educational situations, from standard ones (e.g. silencing, focus on a task) to particularly difficult (e.g. verbal and non-verbal aggression).

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The proposed observation sheet is a valuable tool, and collected information and comments provide a proper starting point for discussion.

According to Arrington (2023), pre-service teachers who engaged in the process of self-reflection experienced a significant increase in self-efficacy; their engagement, forms of classroom management, and teaching styles changed; teachers noticed increased concentration and better engagement of their students in class (Syam et al., 2023).

Acknowledgement

Thanks to all the students who participated in the class at the school, for their solid preparation for the lesson and their valuable and thoughtful comments in the observation sheets.

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