Readines Science Teaching Orientation (STO) of Preservice Teacher in Online Professional Learning Communities

Kartika, Rokhmaniyah, Murwani

Teacher Training Education Program, Sebelas Maret University

kartika@fkip.uns.ac.id, rokhmaniyah@staff.uns.ac.id, murwani.dewi@staff.uns.ac.id

Abstract. Science Teaching Orientation (STO) and online professional learning are very important supporting factors in the teaching and learning process because they will affect learning achievement. This study aims to analyze the readiness of science teaching orientation (STO) in science learning using an online professional learning community. The involvement of sixth semester undergraduate students, in-service teacher professional education students, and pre-service teacher professional education students in the online professional learning community shows the diversity of quality. This research used a survey approach and data were taken from 148 students. Data collection techniques using a questionnaire with a Likert scale. The survey results were analyzed using the Rasch model showing a positive trend in involvement in the online professional learning community in learning. The readiness of science teaching orientation in pre-service teacher professional education students is better than undergraduate students. These differences can be seen in the quality of planning for preparing learning tools (such as lesson plans, teaching materials, evaluations, and learning media). The high readiness of science teaching orientation (STO) in students determines the quality of learning in Online Professional Learning Communities. Therefore, it is recommended for students to develop more teaching readiness and self-confidence to improve the quality of learning. Meeting student needs and paying attention to instilling self-efficacy beliefs to increase learning engagement in online professional learning communities.

Keywords: online professional learning, STO, science

1 Introduction

To fulfill the need for sustainable education towards 2030, students who have higher curiosity, communication skills, collaboration and character are needed. Quality learning needs an interactive environment with innovations in technology and the curriculum will fundamentally change the role of the teacher. STO is the main component of Pedagogical Content Knowledge as a guide for students and teachers in teaching science

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well. STO consists of knowledge and beliefs to determine learning activities in the classroom. The nature of "knowledge and belief" in this context requires that science teachers understand the nature of science as a product, process skills, scientific attitude and application. Knowledge of the nature of this science helps to learn about natural phenomena [1;2]. Science teaching orientation as the main component in PCK which contributes specifically to developing the quality of teacher learning. Science teaching orientation consists of five domains, which consist of: a) knowledge of the special science curriculum, b) knowledge of students' understanding of science, c) knowledge of learning strategies, d) knowledge of science learning assessment, and e) orientation on science teaching. STO covers a sub-domain of the science curriculum that students and teachers must understand before teaching. Every material in science learning in every meeting is built on a concept map [1;3]. Thus, the teacher understands the outline and objectives of science learning. The student teacher's understanding of STO as a teaching requirement affects the quality of science teaching which affects the understanding of the science concept. STO teaching skills and teacher self-efficacy must meet the needs of students in learning science. This knowledge needs to be understood as a way to prevent misconceptions during science learning [2; 3; 4]. Students' difficulties in understanding science concepts are caused by several things, including: 1) abstract concepts in fields such as protein synthesis, quantum mechanics, atoms and molecules, and cellular respiration, 2) inappropriate selection of learning methods and models, 3) students do not have sufficient knowledge of how to think effectively in problem solving, and 4) scientific misconceptions due to prior knowledge. These misconceptions are not easy to overcome because they are coherent and related to everyday life [4; 5; 6].

A science teacher is responsible for preparing the learning process and science knowledge for students. Good preparation and knowledge are very important to help students understand scientific concepts which have an impact on improving science learning outcomes [7]. Teachers' and pre-service students' belief in the understanding of science is very helpful in teaching science to students. Improve the science learning process if they apply innovative learning models such as inquiry, problem based learning, project based learning. Teachers with experience and deep understanding of science will be more confident to deliver science material [7; 8]. Readiness for a good STO will increase teacher confidence in the science learning process gained from experience and observation.

Online learning communities can provide a setting for constructive, exploratory, and collaborative learning. Online learning communities can help students in distance learning programs and provide each other with input in understanding STO. Online learning communities can increase interaction between students, student-teacher, student-learning interactions in distance learning [7; 8; 9]. Beyond that, online learning communities are also a valuable offering for authentic and personalized learning in the area of teacher professional development. Successful online learning communities for teachers enhance communication, collaboration and support skills among participants. Students as teacher candidates develop community awareness, increase knowledge of pedagogical content, critical thinking skills, and improve teaching practices [10;11;12]. Evidence from studies of online teacher communities shows that they offer great potential for professional learning, relationship building, and emotional support. Participants showed positive perceptions of using online learning communities in teacher professional development. Their satisfaction is higher with professional development.

Despite the high use of online learning communities in professional teachers. In its development, there is still a gap between literature and practice on how to design effective online communities and maintain them, especially given the cultural differences in multicultural community. Creating and sustaining online learning communities in teacher professional development is different from integrating technology into traditional professional development courses or programs. Rather, it is an opportunity to think differently about professional development approaches because technology provides teachers with many opportunities to think, reflect, share, collaborate, and solve problems [11].

One of the teacher's efforts to support collaborative learning is by establishing an online professional learning community as a basic requirement of a social constructivist approach. Several studies have focused on teacher activities and performance in learning through online learning communities. In a study on developing a scale to measure learning engagement and investigating the effect of a Facebook-based learning approach on student teacher student achievement and engagement [10; 11; 12]. Teacher activity recorded on online learning platforms also helps to explain learning engagement. For example, calculating the frequency of teacher discussions on group discussion boards, and using activity data to determine the role of teachers in online learning communities. Based on the data, several important factors related to teacher presence in online learning communities were analyzed [11; 12]. Teacher learning involvement in the online professional learning community is measured and analyzed by several behavioral indicators in this study, such as the number of logins, the number of posts, the number of resources submitted. The purpose of this study is to describe the readiness of students' science teaching orientation through online learning communities.

2 Method

The survey method was used in this study. The survey method was used to gather the research data. The survey method is a research approach which aims to describe a recent or past situation as how it exists originally. The individual or object mentioned in the research is tried to describe as in its own conditions [13; 14]. Data collection methods are questionnaire sheets of.

2.1 Participants and Data Collection

Participants consisted of 56 undergraduate students of primary school teacher education in semester VI (participant 1), not yet a teacher with 0 years of teaching experience and aged 20-22 years, 45 students of teaching profession education in positions, meaning that they have taught in schools between 3-5 years (participant 2) aged 35-45 years, and 37 students of pre-service/fresgraduate teacher professional education (participant 3) have not started teaching, age 23-27 years. The total participants are 148 students of Elementary School Teacher Education Sebelas Maret University in Indonesia, 2021/2022. This study was based on a questionnaire survey distributed to 148 participants of a science learning. The time of the research is January 2021-June 2022. A total of 148 participants were taken for data by a survey assisted by a google form. Following the questionnaire survey, interviews were conducted with selected teachers from the sample. After an initial screening of the questionnaires, participants were chosen based on the variety of their personal data and answers in the questionnaire. The interviews were conducted two weeks after the questionnaire survey in order to deepen the findings from the questionnaire. In the questionnaire, the respondents were asked to describe their personal backgrounds, including teaching qualifications, teaching institutions, and teaching experience. Details of the educational background, affiliation type, and teaching experience are given in Table 1.Demography of participants.

Table 1. Demography of participants

No	Aspect	Number of students
1.	Educational background a. undergraduate student (participant 1) b. teacher professional education student in office (participant 2) c. pre-service teacher professional education student (participant 3)	 56 45 37
2.	Age a. 20-22 years b. 23-27 years c. 35-45 years	 56 47 37
3.	Teaching experience a. 0 years b. 1-5 years	 56 75

2.2 Analyzing of Data

Data were analyzed qualitatively and quantitatively. Qualitative data All answers were transcribed and analyzed descriptively. The analysis of the open questions and the interview data was performed following the basic tenets of qualitative content analysis. The responses to the open-ended questions were coded and counted according to categories inductively derived from the data. The analysis of the questionnaire data was later illustrated and enriched by responses from the follow-up interviews. Qualitative data in the form of the results of differences in the preparation of science learning tools, the form of interview answers about science teaching orientation (STO) [14; 15].

Quantitative data was obtained by using a questionnaire using a Likert scale with a score of 1-4 (Strongly Disagree, Disagree, Agree, and Strongly Agree) observed for the percentage of readings towards Science Teaching Orientation in online professional learning. The analysis of the Rasch model with a variable map is used to see the distribution of respondents with each question item. The participants are undergraduate students in semester VI (code A), students in teaching profession education in office (code B) and students in pre-service teacher professional education (code C).

The next subsections provide instructions on how to insert figures, tables, and equations in your document.

3 Findings / Results

The results showed the level of readiness of Science Teaching Orientation through online professional learning communities for undergraduate students, students of in-service teacher professional education and pre-service teacher professional education students. The aspects observed were the Learning Implementation Plan, teaching materials, Student Worksheets, evaluation and digital-based learning media (Table 1). Based on table 1, it can be seen that the completeness of learning tools for pre-service teacher professional education students is more complete than sixth semester undergraduate students and in-service teacher professional education students. In the aspect of planning the implementation of learning more fully includes STEAM, high order thinking skills, and TPCK. The teaching materials and student sheets have met the construction, didactic and engineering requirements. The evaluation has implemented authentic assessments and digital-based learning media. The strengths of participant 1 are that it is easier to capture knowledge in learning technology than participant 2, but the weakness is that they still have not mastered STO (Table 1).

Table 2. Differences in the arrangement of learning tools in science learning for participants

Aspects	Undergraduate Student (participant 1)	Teacher professional education student in office (participant 2)	pre-service teacher professional education student (participant 3)
Lesson plan	The preparation of the Learning Implementation Plan contains objectives that contain elements of audience, behavior, condition, degree with operational verbs. Includes opening, core and closing activities.	Preparation of the Learning Implementation Plan contains objectives that contain elements of audience, behavior, condition, degree with operational verbs oriented to high order thinking skills, Contains opening, core and closing activities but there is no selected learning model syntax	The preparation of the Learning Implementation Plan contains objectives that contain elements of audience, behavior, condition, degree with operational verbs oriented to high order thinking skills, TPCK and STEAM and contains opening, core and closing activities but there is no selected learning model syntax
Teaching materials	-Menyusun bahan ajar berorientasi pada buku guru kurang inovasi	-Preparing teaching materials oriented towards less innovative teachers' books	-Composing teaching materials oriented to

	-Memenuhi syarat konstruksi, Teknik dan didaktis secara sederhana	-Meet the construction, engineering and didactic requirements in a simple way	teacher books with innovations on natural phenomena -Qualified construction, engineering and didactic with an attractive appearance
Student worksheets	-Taking from the teacher's book / manual -Involve students for science experiments but still rely on the teacher's book -Meet the construction, engineering and didactic requirements in a simple way	-Taking from the teacher's book / manual with a little innovation -Engage students for science experiments but still stick to the teacher's book with innovation -Some do not meet the construction, engineering and didactic requirements in a simple way	-student worksheet according to the characteristics of students with innovation -Involve students to carry out innovative science experiments based on inquiry and HOTS -The appearance of the student worksheet is attractive according to the construction, didactic and technical requirements
Evaluation	-More emphasis on cognitive assessment -Lack of carrying out the assessment of science process skills and scientific attitudes in science learning -Less to show portfolio assessment with rubric	-More emphasis on cognitive assessment, psychomotor, and scientific attitude -Has carried out an assessment of science process skills and scientific attitudes in science learning -Already carrying out portfolio assessment with rubrics but lacking in detail	-More emphasis on authentic assessment including cognitive, psychomotor, and scientific attitude -Has carried out an assessment of science process skills and scientific attitudes in science learning -Already carrying out portfolio assessment with rubrics but lacking in detail
Digital-based learning media	Mastering digital-based learning media applications but less in-depth science content	Lack of mastery of digital-based learning media applications with good mastery of science content	More mastery of digital-based learning media applications with good mastery of science content

Based on table 2 shows the results of interviews with participants about the differences in the forms of answers from participant 2, participant 3 and participant 1. Participant 2 gave more complex answers, and was more prepared to teach science, than participant 1. Student explanations for teaching science needed "hand on and mind on" requires concrete and digital media, and involves students to be active critically, creatively, communicatively and collaboratively. Meanwhile, student participant 2 is still oriented towards achieving the value of learning outcomes that are reviewed cognitively, participant 1 does not understand learning outcomes in each science material.

Based on the observation, the motivation to learn new things and read was lower in participant 2, this was because participant 2 was less able to divide time between work at school and the teacher's obligation to prepare for learning well. Table 2 shows the form of answers based on interviews with the three participants.

Table 3. The Pattern Pre-service Teacher responses for science teaching orientation based on Magnusson

Undergraduate Student (participant 1)	Teacher professional education student in office (participant 2)	pre-service teacher professional education student (participant 3)
Involvement of students for group work, discussions and presentations but participants do not understand the learning outcomes of each science material	Involving students to memorize science concepts and prioritizing cognitive learning outcomes.	Involve students in group work, investigations, discussions and presentations to understand science concepts, prioritizing process
Explain the process of photosynthesis in plants	Explain the process of photosynthesis in plants with video without analogy	Explain the process of photosynthesis using analogies and internet media.
Explanation of science material separated by physics, chemistry and biology	Explaining thematically integrated science material without differentiating the concepts of physics, chemistry and biology	Explaining thematically integrated science material without differentiating the concepts of physics, chemistry and biology
The explanation of science material conceptually is not accompanied by practice	Explaining science material "hand on and mind on" to avoid misconceptions.	Explanation of science concepts "hand on and mind on" to avoid misconceptions. The teacher explores answers according to the characteristics of students according to their abilities. The teacher understands the students' difficulties in understanding science
Science learning is more of a lecture model, less emphasis on 'What', 'Why', 'How' questions	Science learning as inquiry, project and discovery learning. Instruction engages students to investigate problems, critically & creatively. Using questions with 'What', 'Why', 'How'	Science learning as inquiry, project and discovery learning. Instruction engages students to investigate problems, critically & creatively. Using questions with 'What', 'Why', 'How'

Based on Table 3 shows the percentage of students towards science teaching orientation through online professional learning with aspects of a) Knowledge specific science curriculum, b) Knowledge of students' understanding of science, c) Knowledge of instructional strategies and d) Knowledge of assessment of science literacy. Undergraduate students with a score of less than 75%, while teaching professional education students in positions and pre-service students are more than 75% ready to teach science. This shows that teaching profession education students are more professional than undergraduate students to become classroom teachers.

Table 4. Percentage of readiness towards Science Teaching Orientation in online professional learning

Aspect STO	Undergraduate Student (participant 1)	Teacher professional education student in office (participant 2)	pre-service teacher professional education student (participant 3)
a.Knowledge specific science curriculum	68	78	81
b.Knowledge of students' understanding of science	73	80	85
c. Knowledge of instructional strategies	65	75	84
d.Knowledge of assessment of science literacy	60	73	83

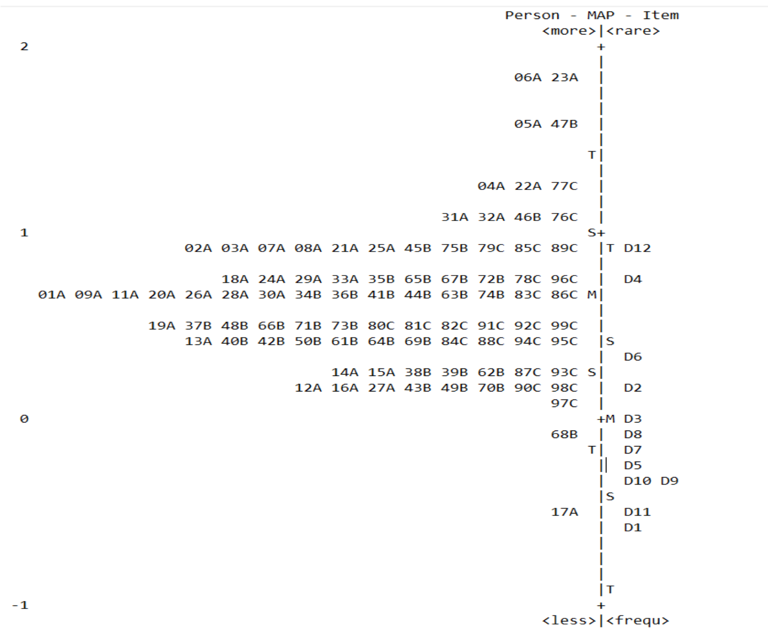

Fig. 1. Variable Map

Based on Figure 1. The results show that participant 1 (code A) is less ready to conduct online discussions to discuss the assessment of science learning in terms of cognitive tests, scientific attitudes and process skills. On the statement item (D 11) and online discussion to convey the objectives of science learning with the ABCD concept (item D1). For statement items D12 and D4 about indicators for assessing science process skills, which are equated with other subjects and compiled independently, are statements that are easily agreed by student respondents (participant 1: code A, participant 2: code B and participant 3: code C). Respondent participant 1 is more comfortable teaching science with lectures, lectures and questions and answers. Respondents of participant 2 and participant 3 more often share with colleagues for preparation for teaching science online (item D9), online discussion to prepare Student Worksheets independently (item D10), and online discussion discussing assessment of science learning in terms of cognitive tests, attitudes scientific and process skills (item D11). While respondent participant 1, participant 2 and participant 3 are more prepared for the concept of statements in preparing to teach science concepts by presenting problems and then doing critical questions (item C), teaching science with innovative learning through inquiry, PBL or PjBL methods (item D5), understanding concepts science is quite easy with practicum and concrete media, applying the concept of the scientific method to low and high grade students (item D7).

4 Discussion

Participant 1, participant 2 and participant 3 had almost the same response, but participant 3 gave more varied and complex answers. Participant 3 shows that they understand more about STO, participants are still fresh graduates with high learning motivation. Participant 1 is a sixth semester student who has not become a teacher where teaching experience is still minimal even though he has passed micro teaching learning, while for participant 2 he has become a teacher but lacks skills in applying technology. Participants' understanding of science differs as a collection of knowledge and science as an application. Advanced students understanding of science as a body of knowledge. One of the causes of this difference is that advanced level students have completed 1.5 months of Field Experience and Practice and have experienced microteaching, while introductory level students or participant 1 have just completed microteaching courses [16; 17].

The results of this study are relevant to the study, which proves that beliefs and orientations in science teaching are interrelated. In this study, respondents or undergraduate students and advanced professional students (participants 1 and 2) differ in their understanding of science as a body of knowledge. One of the reasons for this discrepancy is that advanced professional students are currently pursuing a teacher professional education program [17; 18].

With reference to learning for students in the Basic Teacher Education Program, basic scientific concepts must be delivered thematically and holistically along with practicum. After the training respondents have mastered the content of the science material, they must then be taught how to transfer it to their elementary school students. Therefore, the content of the lesson and the method of delivery are considered as an inseparable part. This will benefit the trainees as they will immediately pass on what they have learned to their primary school students. In this way, they will gain high self-confidence so as to enable them to have a better attitude and perception when teaching science [18; 19; 20]. Based on the observation that undergraduate students understand science as a separate component; however, they cannot integrate it harmoniously. The results reveal that when the necessary support is provided, undergraduate students can develop PCK and the interactions between its components to some extent. Furthermore, it should be stated that mentoring is very useful for pre-service teachers to learn how to integrate STO components. As pre-service teacher educators, we witnessed that planning with a mentor paid explicit attention to the interactions among the STO components [19; 20; 21].

5 Conclusion

Based on the results of the study, it can be concluded that in order to teach science well, it is necessary to have STO readiness for undergraduate students, students of professional teacher education in positions and students of pre-service teacher professional education. Student readiness about STO affects the quality of learning and the resulting portfolio such as teaching materials, lesson plans, evaluations, and learning media. Students by participating in online professional learning communities can increase STO readiness in learning, as a requirement for a professional teacher. The implications of the STO research are part of the readiness of teachers' professionalism related to technology, pedagogy and material knowledge. Teachers and prospective teachers need ongoing assistance to master STO.

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