

# Prospective\_Science\_Teachers\_ Based\_on\_Sociocultural\_Aspect s.pdf *by*

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**Submission date:** 15-Jun-2023 01:01PM (UTC+0700)

**Submission ID:** 2116446883

**File name:** Prospective\_Science\_Teachers\_Based\_on\_Sociocultural\_Aspects.pdf (345.16K)

**Word count:** 4165

**Character count:** 24159



## SCIENTIFIC COMMUNICATION SKILLS PROFILE OF PROSPECTIVE SCIENCE TEACHERS BASED ON SOCIOCULTURAL ASPECTS

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DOI: 10.15294/jpii.v9i2.24366

Accepted: May 7<sup>th</sup> 2020. Approved: June 25<sup>th</sup> 2020. Published: June 30<sup>th</sup> 2020

### ABSTRACT

One of the essential skills for future science teacher candidates is scientific communication while the background of sociocultural aspects influences communication which must have a scientific basis. This research aims to analyse the scientific communication skills of prospective science teacher based on sociocultural aspects. Quantitative survey research methods applied in this research, using a questionnaire as a data collection tool. The population in this research were students of natural science education programs at one of the state universities in Semarang, Central Java, Indonesia, while the samples are 87 students. The results of this research indicate that the sociocultural aspects of students vary with the characteristics of the area of origin, regional languages, different languages, regional cultures, and different social attitudes. The sociocultural aspects are specified in two levels, which are Zone of Proximal Development (ZPD) and More Knowledgeable Other (MKO). At the ZPD level, 67% of the students are in the intermediate criteria and 33% in the advanced criteria. While at the MKO level, the criteria are intermediate and advanced, with percentages almost equal to 49% and 51%, respectively. It was concluded that the profile of scientific communication skills of prospective science teacher based on sociocultural aspects was in the intermediate and advanced criteria. Students are indicated to experience "vernacular misconceptions" related to the sociocultural aspects of the use of various languages used in daily communication and writing. The frequency is dominated by the use of regional languages that are not relevant to scientific languages. Further research needs to be carried out on the identification of scientific misconceptions related to sociocultural aspects.

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Keywords: scientific communication skills; sociocultural aspects; prospective science teachers

### INTRODUCTION

The 21<sup>st</sup> century with the dynamics of the disruption era that presents sociocultural and technological transformation in terms of the industrial revolution 4.0 or society 5.0 encourages each individual to possess future special skills better known as 21st Century Skills. Fullan & Langworthy (2013) in Neghavati (2016) identified critical skills for the future in 6C, which included communication, collaboration, creativity, critical thinking, character and connectivity.

The current and future requirement in the field of education include the development of models and media to support the achievement of competencies expected in line with the development of science and technology (Taufiq et al., 2014). Communication skills become one of the skills that must be possessed in the world of work, including the science teacher and scientists. Someone who does not master the critical skills of the future will be in an unfavourable position in global competence and have difficulty facing challenges and obstacles that arise along with the development of science and technology (Edwards, 2013; Wijaya et al., 2016; Cantor, 2018).

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Prospective science teachers in the future must have the competence to communicate well. Communication skills consist of verbal, written and nonverbal communication skills (Dipalaya et al., 2016; San-Valero et al., 2019). This communication skill can be defined as a skill in conveying or sharing ideas about the knowledge that has been obtained (Kivunja, 2015; Sapriadil et al., 2018). The nature of science itself includes four elements, namely: 1) elements of attitude, 2) process, 3) products and 4) applications that are scientific, must be delivered with scientific communication skills.

Scientific communication skills consist of: (1) understanding of others' key ideas, (2) valuing others' perspectives, (3) developing active assertions, and (4) developing shared understanding (Chung et al., 2014). Moreover, the scientific communication skills in this research focused six high-level learning skills that are scientific information retrieval, scientific reading, listening and observing, scientific writing, information representation, and knowledge presentation (Binkley et al., 2012; Kent et al., 2014).

Improving everyone's communication skills in the fields of science, technology, engineering, and mathematics and the public is very important for the future (Chen & Simpson, 2015; Najmr et al., 2018; Ntemngwa & Oliver, 2018; Price et al., 2019). On the other hand, the background of the student environment is influenced by sociocultural conditions making diverse motives and needs, giving rise to a dynamic direction of social change, so that communication in society must also have a scientific basis. Sociocultural is a term related to social and cultural factors, which means traditions, habits, patterns, and beliefs that exist in a population (Routray et al., 2015; Burgoon et al., 2016). Ponterotto (2010) and Suriel & Atwater (2012), stated that research in sociocultural science education continues to be influenced by regional cultures, ethnicities, regional origins, regional languages, diverse languages, social attitudes, and different lifestyles. According to Clauss-Ehlers (2010), to promote youth development, it is crucial to identify and understand sociocultural factors. It is very relevant because of the increasing diversity of social, cultural and technology among youth. Scientific communication needs to regard the sociocultural aspects that are around the environment that want to communicate. The profile of scientific communication skills of prospective science teacher is not the same, and no mapping has been done before, based on sociocultural aspects specifically. Mapping profiles of students' fundamental skills

in general and specifically scientific communication skills should ideally be identified as early as possible (Dewi et al., 2017; Mercer-Mapstone, & Matthews, 2017; Rootman-le Grange & Retief, 2018). That is very important for later learning processes can be designed meaningful learning so that students can relate new information to relevant concepts contained in their cognitive structures (Goldin et al., 2011; Ifenthaler et al., 2011; Karpicke & Grimaldi, 2012).

The purpose of this research is to analyse the profile of scientific communication skills of prospective science teacher based on socio-cultural aspects. Indicator limits on scientific communication skills measured include scientific information retrieval, scientific reading, listening and observing, scientific writing, information representation, and knowledge presentation whereas the sociocultural aspect specified refers to Vygotsky's Sociocultural Theory. This research was conducted to analyse and answer the research question: How is the description of the profile of scientific communication skills of prospective science teacher students based on sociocultural aspects? This research was limited without making comparisons or connecting with other variables.

## METHODS

This research applies a quantitative survey research method, a study that uses a standardised questionnaire to collect data about people/respondents and their preferences, thoughts, and behaviour systematically (Bhattacharjee, 2012). The population in this study was students of the Natural Sciences Study Program odd semester 2019 at one of the state universities in Semarang, Central Java, Indonesia. Non-probability sampling techniques carried out based on the number or ration that has been determined or called purposive sampling (MacInnis et al., 2018; Rivera, 2019). Consideration of sampling in this research is a subject that is easily found so that it facilitates data collection. Besides, the characteristics of the sociocultural background of a prospective science teacher in this research are spread from various regions in Indonesia. The samples in this research are 87 students of prospective science teachers.

Quantitative survey research methods applied in this research using a questionnaire instrument with Goggle form online media as a data collection method. The questionnaire was divided into two parts: (1) to gather information from respondents about the level of sociocultural aspects; (2) to gather information from respondents about the profile of scientific communicati-

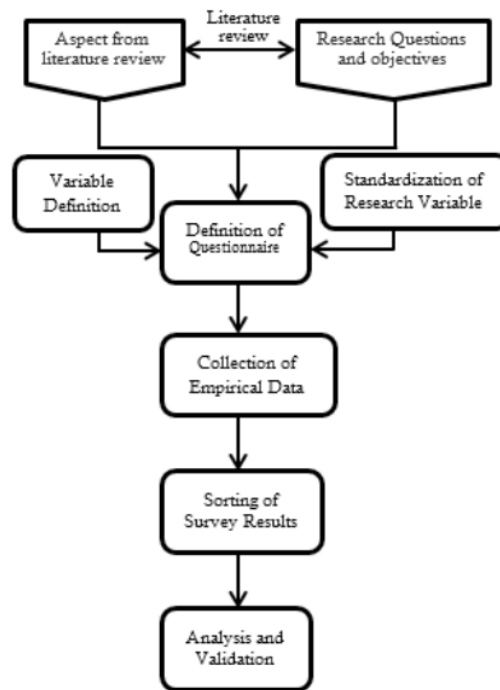
on skills. A seven-step process for questionnaires design in this research adapted from Artino et al. (2014) that are (1) conduct a literature review; (2) conduct focus groups; (3) synthesise the literature review and focus groups; (4) develop items; (5) conduct expert validation; (6) conduct the cognitive review; and (7) conduct pilot testing before delivering to students. The questionnaire about the level of sociocultural aspects consisted of 10 question items. The questionnaire about the profile of scientific communication skills consisted of 13 question items. Data obtained from the questionnaire were analysed descriptively quantitatively according to the descriptive statistical methods used in this research, which were interpreted based on specific criteria (Hamdi & Bahruddin, 2015; Loeb et al., 2017) and or limitations based on the theoretical review (Nardi, 2015; Norris et al., 2015).

The profile of scientific communication skills in this study is categorised into four categories with scoring criteria according to Table 1.

**Table 1.** Scoring Criteria for Scientific Communication Skills Profile Categories

No	Criteria	Score
1	Basic	13-25
2	Emerging	26-38
3	Intermediate	39-51
4	Advanced	52-65

The logical scheme of the steps carried out in the research methods adapted from Ghina et al. (2017) and relevant to Arsić et al. (2020) can be seen in Figure 1.



**Figure 1.** Logical Scheme of the Steps Taken in the Research Methodology

After sorting the data, sociocultural aspects are specified on two levels according to Vygotsky's Sociocultural Theory of Cognitive Development that is the Zone of Proximal Development (ZPD) and More Knowledgeable Other (MKO) (Shabani, 2016; Abtahi et al., 2017). The

results of scientific communication skills data are represented by six indicators of high-level learning skills, namely scientific information retrieval, scientific reading, listening and observing, scientific writing, information representation, and knowledge presentation.

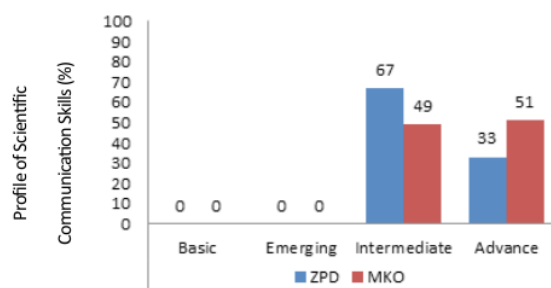
## 10 RESULTS AND DISCUSSION

Based on the recapitulation analysis of questionnaire data responses of this research indicate that the sociocultural aspects (Routray et al., 2015; Burgoon et al., 2016; Gay, 2018) of students vary with the characteristics of the area of origin, regional languages, different languages, regional cultures, and different social attitudes. The sociocultural aspects data are specified in two levels, namely Zone of Proximal Development (ZPD) and More Knowledgeable Other (MKO). The results of the data analysis showed that the sociocultural aspects of the prospective science teacher who were at the ZPD level were 17%, while those at the MKO level were 83%. These results indicate that the sociocultural aspects of prospective science teacher are far more at the MKO level compared to the ZPD level.

According to Vygotsky's theory, a person who is at the ZPD level for a particular task can almost do the task independently, but still needs the help of others to carry out the task successfully. At this level of social influence, especially instructions from someone, is very important for cognitive development. At the MKO level, a person learns through social interaction that includes collaborative and coopera-

tive dialogue with someone more skilled in the tasks they are trying to learn. According to Schilhab & Esbensen (2019), sociocultural aspects also determine cognitive processes. In this case, the results of the sociocultural aspects of a prospective teacher in general at the MKO level are supposed to support cognitive development including scientific communication actively. However, at the MKO level of 10 items examined in the sociocultural aspects, there were two items whose average score was not as expected, that are on social attitudes, especially gender equality and the use of various languages used in daily communication and writing the frequency is dominated by the use of local languages or vernacular. The use of words or language that means something to many people who are not experts with local characteristics has the opportunity to have meaning that is very different from a scientific point of view (Nurulwati et al. 2014) and potentially to cause science misconception called "vernacular misconceptions".

The sociocultural aspects at both the ZPD and MKO levels were analysed in terms of the scientific communication skills. The results of the analysis of scientific communication skills of prospective science teacher based on sociocultural aspects are shown in Figure 2.



**Figure 2.** Profile of Scientific Communication Skills Based on Sociocultural Aspects

Based on the data in Figure 2, the scientific communication profile of prospective science teacher based on sociocultural aspects are in the intermediate and advance criteria. The ZPD level is identified 67% in the intermediate criteria and 33% in the advanced criteria. While the MKO level, the criteria are intermediate and advance with almost the same percentage of 49% and 51%, respectively. Based on the results of this analysis the two levels of sociocultural aspects both ZPD and MKO although on the same criteria are intermediate and advance, but at the MKO level, the percentage of advance criteria is higher. These results are in line with Vygotsky's concept of scaffolding. Scaffolding refers to the tempora-

ry support given to students whereby others who are more expert so that it allows students to carry out tasks until the time they can do this task independently. Scaffolding requires a change in the quality and quantity of support given to students during teaching sessions. MKO adjusts the level of guidance to fit the level of student performance. For new tasks, MKO can use direct instruction. As students become more accustomed to the task and become more skilled at it, MKO can then provide less guidance. Consistent with Ahmad et al. (2019), the need for transformation in education will inevitably occur even if they are not ready. The sociocultural theory recognises that knowledge is a construction between indivi-

duals or between members of groups of people. Sociocultural theories can be adopted throughout the information literacy research process and also in the curriculum design process (Wang et al., 2011).

The findings show that the profile of scientific communication skills of prospective science teacher based on sociocultural aspects at the majority of the ZPD level on the intermediate criteria. In contrast, the MKO level is balanced on the intermediate and advanced criteria. However, based on analysis each indicator of scientific communication skills used in this research, that is: (1) taking scientific information; (2) scientific reading; (3) listening and observing (4) scientific writing; (5) information representation; and (6) knowledge presentation. Profiles on the indicator of scientific writing and knowledge presentation are still on emerging criteria, in addition to those on intermediate criteria.

Scientific communication skills indicator of scientific writing the average score is 48%, students gave responses indicated science misconceptions, especially in writing and reading symbolic languages. This finding is correlated with the results of the analysis of students' sociocultural aspects related to the use of various languages used in daily and written communication. The frequency is dominated by the use of local languages or vernacular. The use of words or language that means something to many people who are not experts with regional characteristics has the opportunity to have meaning that is very different from a scientific point of view (Nurulwati et al. 2014) and potentially to cause science misconception called "vernacular misconceptions". Scientific communication skills indicator of knowledge presentation, students give a response that they do not or do not understand the rules of preparing slides for research report presentations, the publication of scientific articles and portfolios. Scientific presentation skills are closely related to self-confidence and continuous experience (Earp & Trafimow, 2015). Students feel unconfident and need more practice to develop knowledge presentations and understanding the rules of preparing presentation slides for research reports, publishing scientific articles and portfolios.

The findings of this research provide new information about the importance of mapping scientific communication skills profiles of prospective science teacher based on sociocultural aspects. This knowledge is beneficial in the preparation of meaningful learning designs so that students can develop scientific communication

skills optimally and are also able to relate new information to relevant concepts contained in their cognitive structures and also minimise or reduce the occurrence of science misconceptions, especially "vernacular misconceptions".

## CONCLUSION

The profile of scientific communication skills of prospective science teacher based on sociocultural aspects is in the intermediate and advanced criteria. The ZPD level is identified 67% in the intermediate criteria and 33% in the advanced criteria. While the MKO level, the criteria are intermediate and advanced with almost the same percentage of 49% and 51%, respectively. Students are indicated to experience "vernacular misconceptions" related to the sociocultural aspects of the use of various languages used in daily communication and writing. The frequency is dominated by the use of local languages, or vernacular that is not relevant to scientific languages; this reveals that scientific communication skills of students in learning science necessary to be optimised and further explored in terms of sociocultural aspects with scientific communication skills.

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