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

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ABSTRACT

One of the most important skills mastered by future science teacher candidates is scientific communication. Meanwhile, the background of sociocultural aspects influences communication which must also 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 the city of Semarang, Central Java, Indonesia, while the sample amounted to 87 students. The results of this study 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, namely Zone of Proximal Development (ZPD) and More Knowledgeable Other (MKO). At the ZPD level some 67% in the intermediate criteria and 33% in the advanced criteria. Meanwhile, at the MKO level the criteria are intermediate and advance 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 advance 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 factors.

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

INTRODUCTION

The 21st 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) also in Neghavati (2016), identified key skills for the future in 6C which included communication, collaboration, creativity, critical thinking, character and connectivity.

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

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of work including the science teacher profession and scientists. Someone who does not master the key skills of the future will be in an unfavorable position in global competence, and can have difficulty facing challenges and obstacles that arise along with the development of science and technology (Edwards, 2013; Wijaya et al., 2016; Cantor , 2019).

Prospective science teachers in the future must have the competence to communicate well. Communication skills consist of oral, written and nonverbal communication skills (Griffith et al., 2003; 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.

According to Levy et al. (2008) indicators of scientific communication skills consist of: (1) identifying the ability to obtain information; (2) can state everyday events in language or symbols; (3) contribute ideas in group work; and (4) explains ideas and tasks in the making of products/ reports; and (5) communicating product results can be in the form of work or reports. The scientific communication skills in this research focused on 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 (Van Steensel, 2006; Routray et al., 2015; Burgoon et al., 2016). Ponterotto (2010) and Suriel & Atwater (2012), state that research in socio-multicultural science education continues to be influenced by regional cultures, ethnicities, regional origins, regional languages, diverse languages, social attitudes, and different lifestyles. According to LaPoint et al. (2010), to promote youth development, it is important to identify and understand sociocultural factors. This 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, specifically based on sociocultural aspects. Mapping profiles of students' initial 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) so that is very important for later learning processes can be designed meaningful learning so that students are able to relate new information to relevant concepts contained in their cognitive structures (Goldin et al., 2011; Ifenthaler et al., 2011; Karpicke & Grimaldi, 2012).

The purpose and focus of this research is to analyze the profile of scientific communication skills of prospective science teacher based on sociocultural 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 analyze and answer 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, which is a study that uses a standardized questionnaire to collect data about people/ respondents and their preferences, thoughts, and behavior systematically (Bhattacherjee, 2012). The population in this study was students of the Natural Sciences Study Program odd semester 2019 at one of the state universities in the city of Semarang, Central Java, Indonesia. Non-probability sampling techniques carried out on the basis of 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. In addition, the characteristics of the socio-cultural background of prospective science teacher in this research are spread from various regions in Indonesia.The sample in this research amounted to 87 student 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 communication skills. Seven-step process for questionnaires design in this research adapted from Artino et al. (2014), thats are (1) conduct literature review; (2) conduct focus groups; (3) synthesize the literature review and focus groups; (4) develop items; (5) conduct expert validation; (6) conduct cognitive review; and (7) conduct pilot testing before before delivering to students. The questionnaire about the level of sociocultural aspects consisted of 10 question items (Examples of questionnaire content/ statement content on indicators of socio-cultural aspects include: Where is your origin region/ city?; The people from whom I come from education have become priorities in both formal and non-formal education and the level of literacy is evenly distributed; My local community language is more often used than the national/ international language, both in spoken and writing), while the questionnaire about the profile of scientific communication skills consisted of 13 question items (Examples of question/ statement content on indicators of scientific communication skills include: I am familiar searching for online learning resources like e-books, online journals, virtual labs etc.; I voluntarily state my ideas in various ways including explanations in Indonesian and local languages; and Some diagnostic questions to identify students science misconception). Data obtained from the questionnaire were analyzed descriptively quantitatively according to the descriptive statistical methods used in this research, which were interpreted based on certain criteria (Hamdi & Bahruddin, 2015; Loeb et al., 2017) and or limitations based on the theoretical review (Nardi, 2015; Norris et al., 2015).

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.

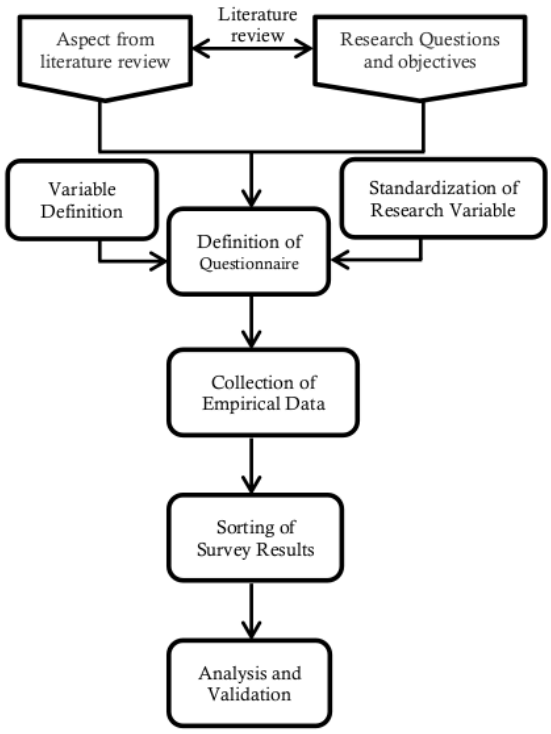

Figure 1. Logical scheme of the steps taken in the research methodology

The profile of scientific communication skills in this research are categorized 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	Advance	52-65

After sorting the data, sociocultural aspects are specified on two levels according to Vygotsky's Sociocultural Theory of Cognitive Development that are 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.

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 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 cooperative dialogue with someone who is 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 prospective teacher in general at the MKO level are supposed to strongly support cognitive development including scientific communication. However, at the MKO level of 10 items examined in the sociocultural aspects, there were 2 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 analyzed 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.

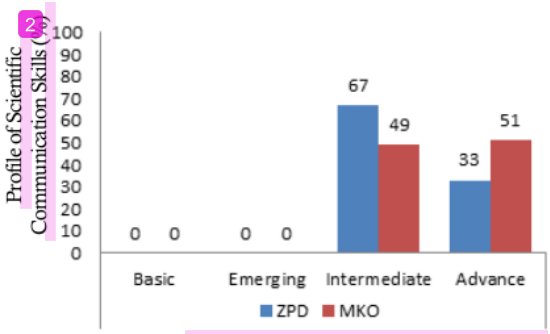

Figure 2. Profile of Scientific Communication Skills Based on Sociocultural Aspects

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 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 temporary support given to students where by 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 themselves are not ready. Sociocultural theory recognizes that knowledge is a construction between individuals 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, while the MKO level is balanced on the intermediate and advance criteria. However, based on analysis each indicator of scientific communication skills used in is research, that are: (1) taking scientific information; (2) scientific reading; (3) listening and observing, (4) scientific writing; (5) information representation; and (6) owledge presentation. Profiles on the indicator of scientific writing and knowledge presentation are still on emerging criteria, in add on 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 mbolic 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, 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 th research provide new information about the importance of mapping scientific communication skills profiles of prospective science teacher based on sociocultural aspects. This knowledge is very useful in the preparation of meaningful learning designs so that students are able to develop scientific communication skills optimally and are also able to relate new information to relevant concepts contained in their cognitive structures and also minimize 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 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. 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 optimized and further explored in terms of sociocultural aspects with scientific communication skills.

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