

The Effect of Scientific Terms Error on Scientific Communication of Prospective Teachers and Progressive Education

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DOI: 10.23917/ijolae.v3i3.14214

Received: April 21st, 2021. Revised: July 6th, 2021. Accepted: July 14th, 2021

Available Online: August 17th, 2021. Published Regularly: September 1st, 2021

Abstract

The error of term usage in communication can be caused due to the misunderstanding of the words' meaning, or even the users might even realize their error but somehow keep using it deliberately. Thus, this study was conducted to find errors in using scientific terms in communication that influence the scientific communication of prospective science teachers. The research design used was mixed methods with sequential explanatory strategies. The data were gathered through a closed questionnaire referring to the optional Likert Scale of 5 options and analyzed quantitatively. There were 256 participants or prospective science teachers as research subjects. The mean of the r count was 0.64, and the r table was 0.12. Therefore, it was judged as valid. The reliability test was obtained by Cronbach's Alpha of $0.951 > 0.80$. The results show that there were 13 errors of scientific terms performed by participants. Wilcoxon test obtained the Asymp value. Sig. of $0,000 < 0.005$ meaning that there were differences in the use of the term science in society and university. Representing and presenting were two aspects of scientific communication, with $>40\%$ obtaining moderate criteria. The research concludes that the scientific terms' error affects prospective teachers' scientific communication and progressive education since the errors have become a long habit. It must be overcome because the habit scientifically will also influence the trust of scientific truth.

Keywords: prospective teacher, science education, science teacher, scientific communication, scientific term error, progressive education

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1. Introduction

Future science learning challenges lie in applying the concept due to obstacles that stem from long-standing daily traditions (Tuan & Lu, 2019; Budiarti et al., 2020). Early studies found that obstacles causing the problem of science development are the error of using scientific terms. Then, it becomes a regular habit in daily communication. Meanwhile, students expected to understand the term conceptually often misuse the terms in daily communication to convey the message. The purpose of communication is

as long as the recipients understand the message; the conceptual truth is often ignored. Arsih et al. (2019) and Kervinen et al. (2020) stated that when there is a gap between the truth of knowledge and its use in daily life, it can be a severe obstacle to the learning accomplishment. The initial study found that people use this "*bulu menempel pada kulit manusia*" or "humans have fur growing in their skin", the term "fur" has existed in Indonesian society for a long time, this example is evidence of a gap with scientific truth

because people tend to say fur instead of hair as the conceptual fact.

People should concern the misuse of scientific terms because it will affect the application of the science concept in daily life. The concept will only exist at the knowledge level without the actual application. The more significant concern will occur when there is mistrust of the community, especially students when dealing with the truth of science from learning activities at school. One of the fundamental problems that lead the Indonesian students' achievement in science learning is frequently low. Referring to the Program for International Student Assessment (PISA) findings, science is mainly learned conceptually, not practically as part of life. Taber (2017) proposed that trust in scientific truth is the key to success in learning science. Another finding in the initial study from the communication context in Javanese society mentioned that people use the term of stone that gets bigger as "*watu urip*" or living stone. Thus, this is not only a misconception phenomenon but also the way of thinking misleading, and it shows that they are mistaken the concept of one of living things' characteristics can also be applied to the non-living things. Teo & Goh (2019) mentioned that one of the causes of false understanding in scientific knowledge is errors in the scientific communication content. Scientific communication reflects the skills of elaborating ideas and opinions obtained due to the learning process (Stehle & Peters, 2019).

The term misuse in communication leads to distrust of the validity of science. If this happens continuously, the opinion of science is only conceptually studied, not directly applied might be eventually confirmed. She et al. (2018) said that students need to be introduced to the environment as the learning resource of science to improve

their desire for learning and applying the knowledge. Using the incorrect term in daily communication has become a long-standing habit in the community, where it is also found in prospective science teachers since they are also part of society. If they also have practised that communication model of delivering terms contrary to the conceptual truth, then this becomes the base of the problem that should be overcome. Prospective teachers need to be trained to correct scientific errors in society, as they must have the skills to overcome applying knowledge (Demirhan & Sahin, 2019).

The use of words in communication in ethnolinguistic studies emphasizes the truth of meaning (Härtull & Saarela, 2019). However, society sometimes practices a different way of delivering a message in the communication context. The term correctness in a language is the key to communication because it determines the message conveyed correctly. Language errors can be caused due to a misunderstanding of the meaning of the words used. This type of error can raise significant problems in the learning process because it will result in misconceptions at the knowledge level. The ignorance will cause the misuse of the language term. People usually use the terms that exist in daily communication without verifying the truth of their meaning. Without the rules of scientific communication, it can potentially raise the problem of building knowledge. Language errors in communication have a systemic impact on the correctness of the information (John, 2018; Pendlebury, 2019). When the words obtained from daily communication are incorrectly used, and it becomes a habit, then this message will continue to spread widely and increasingly complicated. Language errors in scientific communication can occur in learning, so it is necessary to ensure

that the terms used are scientifically correct (Chung et al., 2016).

Prospective science teachers must have scientific communication skills with qualified content based on data and facts because the accuracy of the content must be scientifically justified. As a prospective teacher, one of the learning achievements is having decent communication skills because it is related to their main future job of transferring knowledge to students. The purpose of communication as a tool to convey information in science learning should be ensured to be scientifically correct (Yemen, 2018; Faisal, 2019). Scientific communication skills for prospective teachers should comprise the indicators of delivering ideas and opinions, explaining the process of an activity, and guiding to the results, conclusions and recommendations based on data and facts or study learning content to students.

Being skilful in communication is the primary competence in transferring knowledge which prospective teachers should have (Faikhamta et al. 2018; Mahmud, 2018; Hsieh et al., 2019). Learning as a process to connect previous knowledge with the new one where the initial knowledge is brought from the experience and environment while the new knowledge will be obtained easily when there is connec-

tivity with the previous one (Morris et al. 2019). The preparation of prospective science teachers in Indonesia is based on curriculum needs in schools. The dynamic change of the science curriculum is due to the development of new findings from the research along with information technology advancement (Faisal, 2019; Karakaya et al., 2019; Khan & Krell, 2019).

The gap between scientific truth and scientific term errors must be overcome because it will significantly impact truth, applicability, and trust in the application of science. This research focuses on revealing the error of scientific terms used in daily communication in society. Do prospective science teachers also use incorrect scientific terms in daily communication, society, and learning activities? How is the profile of the scientific communication skills of prospective science teachers? This study aims to find errors in scientific terms used in daily communication in society, analyze errors of scientific terms, and find profiles of scientific communication skills of prospective science teachers.

2. Method

This research reveals the connection between the misuse of scientific terms and the scientific communication skills of prospective science teachers, as shown in Figure 1.

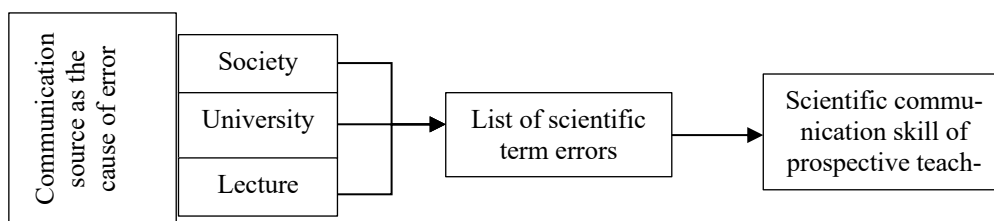


Figure 1. Research Model

Prospective science teachers are part of society who communicate daily with other members of it. As students, they interact between students and the university community. Communication also happens between

students and lecturers occur through the learning process. Those three communication events carried out by the research target have the potential parts where they misuse the scientific terms.

The research design was mixed methods with sequential explanatory strategies (Creswell, 2008). The data were gathered using a questionnaire given to prospective teachers. Then they were analyzed quantitatively. Based on the results of the questionnaire analysis, the next activity was to collect data through interviews and analyzed them qualitatively. The research instrument was a closed questionnaire referring to Marguerite et al. (2010) using the Likert Scale of 5 options (Dawes, 2008). The criteria are 5 (very often), 4 (often), 3 (sometimes), 2 (rarely), and 1 (never). The questionnaire was measured its validity, reliability and normality to make sure it is valid to obtain reliable data.

The participants were 256 students of prospective science teachers who are sixth or seventh students of science education programs in Universitas Negeri Semarang, Universitas Negeri Malang, Universitas Negeri Surabaya, Universitas Sebelas Maret, and Universitas Negeri Yogyakarta. They consisted of 79 (31%) male students and 177 (69%) female students aged 20-21. Those participants have spent their education for three years (60%) and three and a half years (40%). They come from various regions but mostly are Javanese. Their scientific communication skill was measured to identify the misuse of scientific terms. The observation was done during their presentations in the Seminar Course.

The closed-type questionnaire instrument was developed, referring to Boyes and Stanisstreet (1993). Each questionnaire for three forms of communication consisted of 13 statements with five choices arranged into three parts with six statements each. The first part revealed the use of scientific terms in society daily communication. The second part measured the use of scientific terms in the university environment, and the third section was to observe the use of the terms

during lectures. The instrument was validated by two science experts and two language experts. SPSS program was used to analyze the validity, and the testing technique used Pearson Product Moment correlation and Cronbach's Alpha analysis. Questionnaires as the key to discovering the misuse of scientific terms must be valid in construction and content aspects. The normality test was performed to confirm whether the data were normally distributed or not. Scientific communication skill data were obtained during observation in Seminar Course presentation. The recorded interviews were also conducted in a semi-structured Q-sorting procedure. Each interview lasted about 30 to 50 minutes individually, with 30 students as interviewees. It involved two linguists to ensure the questions in the interview can explore participants' opinions. The interviewer started by revealing scientific terms in daily conversation in society, university, and learning activities.

The questionnaire was delivered through docs.google.com, and then after three weeks, there were 256 questionnaires returned. The scientific communication aspects measured were reading, writing, representing, and presenting. Exploring quantitative data from the questionnaire results were carried through an open-ended interview to obtain additional information about the logical reasons of the participants so that they accurately described it correctly and comprehensively.

SPSS program was used to analyze the validity, and the testing technique used Pearson Product Moment correlation (Lee, 2001). It was analyzed by correlating each item score with the total score, and the total score is the sum of all items. Questionnaire items that correlate significantly with the total score showed that those items provided support in revealing what they want to express (Cooper and Schindler in Zulganef, 2006). If

r count $\geq r$ table (2-side test with sig. 0.05) then the questionnaire correlated significantly to the total score (valid).

The reliability testing of the questionnaire instrument used the Cronbach's Alpha formula since the research instrument was multilevel. Cronbach's Alpha was used to measure the reliability of the indicators used in the research questionnaire, referring to

McDaniel and Gates (2013). Cronbach's Alpha test was applied to detect inconsistent indicators (Malhotra, 2012). The category of scientific communication by assessing each individual was performed by comparing the scores obtained with the maximum scores. The reliability determination was quoted from Hair et al. (2010) in Table 1.

Table 1. Reliability Level of Cronbach's Alpha

Cronbach's Alpha Score	Reliability Level
0.0 - 0.20	Less Reliable
>0.20 – 0.40	Slightly Reliable
>0.40 – 0.60	Moderately Reliable
>0.60 – 0.80	Reliable
>0.80 – 1.00	Very Reliable

One sample, Kolmogorov-Smirnov, is used to test whether the data are normal or not. If the data are not normal, then a further test should be conducted with the Fredman Test to test the differences of the three data sources of the misuse scientific terms found in the society, university, and learning activity. If there are differences between the three aspects of the test, then the Wilcoxon test is performed to find differences in those three aspects.

3. Result and Discussion

The questionnaire from the results of the validity test was declared as valid. The mean of the r count was 0.64, and the r table was 0.12. The reliability test obtained by Cronbach's Alpha was $0.951 > 0.80$, and it was reliable with very reliable criteria. The questionnaire showed items that can reveal the scientific terms error in scientific communication. The normality test data are presented in Table 2.

Table 2. Normality Test

N		777
Normal Pamateres	Mean	40.7645
	Std. Deviation	11.74218
Most Extreme Differences	Absolute	.039
	Positive	.023
	Negative	-.039
Test Statistic		.039
Asymp. Sig. (2-tailed)		.007

If it shows Asymp Sig 2-tailed > 0.05 , it means that it is normally distributed. Based on the table one-sample Kolmogorov-Smirnov test, the obtained Asymp Sig. (2-

tailed) was $0.007 < 0.05$, meaning that the data were not normally distributed, so that the data was tested with a non-parametric approach, as shown in Table 3.

Table 3. Data Analysis

N	259
Chi-Square	45.677
df	2
Asymp. Sig.	.000

The score of Asymp. Sig. was $0,000 < 0,005$, and then it indicated a difference in the use of scientific terms in society, univer-

sity and learning activity. The error scientific terms are presented in Table 4.

Table 4. Errors of Scientific Terms

Incorrect Terms	Correct Terms
Fur grows in men's chest	Hair grows in men's chest
Her body weight is 42 kilogram	Her body mass is 42 kilogram
We can see muscle from the surface of our skin	We can see vein from the surface of our skin
We cannot eat food containing chemicals	We cannot eat food containing dangerous chemicals
Low blood pressure is caused by low blood level	Low blood pressure is when your blood pressure lower than normal
We inhale oxygen	We inhale air
Mosquitos bite	Mosquitos suck blood
Whale is fish	Whale is mammals
A dolphin fish	A dolphin mammal
Star fell from the sky	Meteorite fell from the sky
Banana tree	Banana plant
Eggplant is one of vegetables	Eggplant is one of fruits
Soybean milk	Soybean concentrate

There are 13 errors found which occurred widely in society and schools. It means that the scientific term error has become a habit that happens continuously, and

become no one is considered as a mistake. The number of incorrect scientific terms from the questionnaire from participants can be seen in Figure 2.

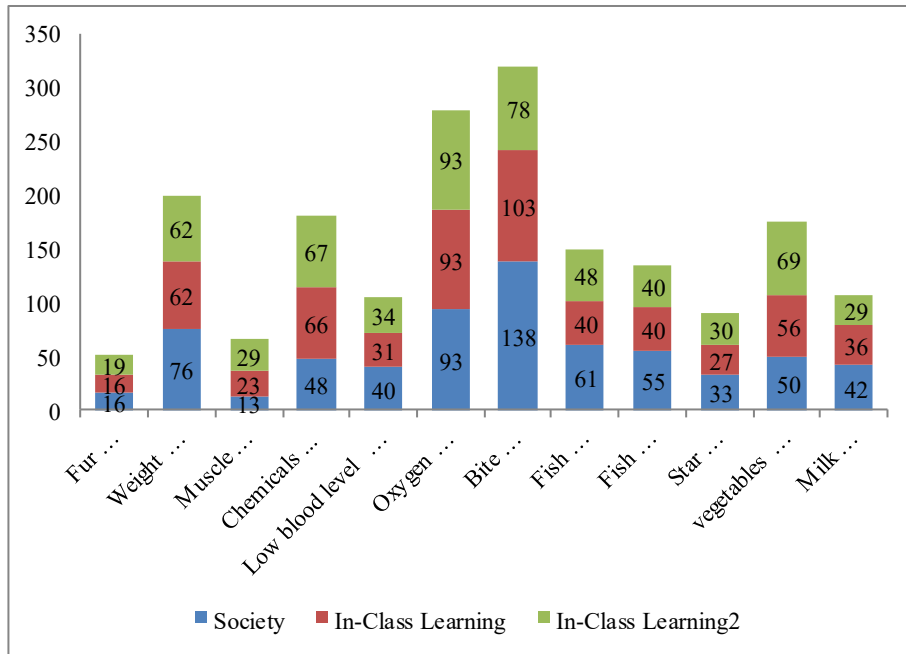


Figure 2. The Number of Participants Conveying Scientific Term Errors

The most common mistakes are "mosquitos bite" and "we inhale oxygen", while the least common is "fur grows in men's chest". All participants have used all the incorrect scientific terms. It needs further analysis to ex-

plore the impact on the prospective teachers' communication skills in reading, writing, representing, and presenting. The analysis is presented in Table 5.

Table 5. Scientific Communication of Prospective Teachers

Scientific Communication	Percentage (%) Prospective Teachers				
	Very Good	Good	Moderate	Poor	Very Poor
Reading	64	36	-	-	-
Writing	30	40	30	-	-
Representing	20	34	46	-	-
Presenting	34	26	40	-	-

The skill of representing and presenting obtained $\geq 40\%$ in moderate criteria. Those aspects contain indicators of using correct scientific terms. These findings show that the errors of scientific terms were found in oral and written communication performed by prospective teachers.

Participants understand the correct terminology, but they choose to use the common habits that exist in society. Conceptual truths are ignored in daily communication habits because they feel more pleasant fol-

lowing the existing communication habits. The incorrect terms have finally become commonly used in daily communication. As prospective science teachers who learn from the conceptual level, participants said they could not change this incorrect tradition during the interviews. These findings are not following the expectations, and the findings of Diyaddin (2017) were stated that every prospective science teacher must have qualified scientific communication skills. The application of science is not only producing a

product but starting from disseminating the truth of science. Spektor et al. (2009) and Omer (2017) stated that scientific communication is the key to knowledge transfer success in science learning. However, participants were not able to rectify errors in the daily communication context performed by society.

As part of society, the existence of teachers while learning new terms or language is vital for students. One of the reasons is the experimental attitude of educators (Andrade & Santos, 2012). Progressive education proposes experiential learning that further develops instructional, curricular, and evaluative methods (Kridel, 2020). If the teacher or educator does not have good communication skills, students will not learn new terms well and the education will not be progressive.

The questionnaire helped to reveal the errors of scientific terms by confirming participants to choose the correct or incorrect terms. The questionnaire is exceptional because the participants' habit is being explored unconsciously and naturally. Then, their direct expressions were discovered from the interview process to explore their questionnaire answer. Bolarinwa (2015) said the questionnaire needs to be developed by researchers in order to be able to uncover something hidden in the research target naturally. Participants made choices naturally without worrying. The findings of this study revealed unknown errors by the participants so that they behaved naturally when the interviewer explored hidden information from them.

The misuse of scientific terms has a severe impact on participants' scientific communication. The types of scientific communication that are affected are representing and presenting. In the representing skill part, incorrect terms were found when explaining

their paper. When they presented their paper, the error was also found during the oral presentation. Therefore, the misuse is found in oral and written communication. The cause of the error is due to the habit of mentioning commonly incorrect terms used. The conceptual truth is ignored, and they tend to use the society communication pattern. They even use those incorrect terms in the academic context, for example, when doing a presentation. Sher (2017) revealed that the truth of science is obtained through scientific work, and then it merges with life so that science becomes useful knowledge. However, students find it challenging to change habits and worry if communication messages cannot be understood when using the correct scientific terms.

The common mistake found during the interview was "we inhale oxygen", which lead to misconception. Participants think that humans only inhale oxygen as one of the gas components and lungs only absorb oxygen. Misconceptions that last for a long time can lead to false understanding in science (Moodley & Gaigher, 2019; Yang & Sianturi, 2020). Meanwhile, the misuse of the terms also affected students' scientific communication. The problem will get more significant if the habit is continuously practised, then in the future, they will deliver false information to their students. The worst part is when their students make the same mistakes of delivering incorrect terms in their daily communication. Therefore, prospective science should be prepared to have a qualified conceptual understanding and communication skills. Verawati (2019) and Munford (2020) stated that improvements to the learning system have a tangible impact if the target of improvement is improving the quality of prospective teachers. Consistency and courage to use the correct terms need to be done. Lecturers have to train them to al-

ways use the correct terms, especially during the academic activity in the lecturing, to form a positive habit.

Both teachers and students are social beings and parts of society. If we relate to the Lifelong learning concept, the presence of people as a social principle in a learning process helps their educational development, both for now and throughout their life (Murthado et al., 2021). As the future education pillar, prospective teachers must have sufficient skills, including communication skills, to keep the education process progressive and lifelong. Lifelong Learning, which is the concept of the 21st century, has covered and mediates both learners and educators as individuals in involving them to gain their intellectual and social intelligence as what progressive education proposed at the end of the 19th century (Murthado et al., 2021).

4. Conclusion

The conceptual truth of science unites in daily life and communication. Errors in scientific terms affect prospective teachers' scientific communication and progressive education. It should be overcome because it will also affect the trust in scientific truth. The misuse of the terms will ultimately cause the problem of the scientific communication skill of prospective science teachers. Prospective teachers' scientific communication skills must be improved to keep the quality and progressive education on track.

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