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Data Literacy Intervention in Scientific Speaking Learning:Perspectives of Teachers and Students in High School

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Abstarct
Data literacy interventions in learning are an important part of improving student competency. Data literacy is a form of new literacy development that is considered adaptive and mandatory for students to support the competencies they want to achieve, especially in scientific speaking. This study aims to investigate data literacy interventions in scientific speaking learning from the perspectives of teachers and students at the high school level. Data literacy skills are considered to have a positive impact on how students speak argumentatively. This study used descriptive qualitative methods and data collection techniques through interviews and questionnaires. Data analysis techniques through data collection, data presentation, data condensation, and conclusion drawing. The research findings indicate that teachers' perspectives on data literacy interventions have a good and positive impact on students' tendency to argue through scientific speaking activities, and learning activities with data literacy interventions stimulate students to be able to access, collect, sort, and analyze various data into information that can be communicated through scientific speaking skills. Student perspectives on data literacy interventions indicate that data literacy has a positive impact on supporting scientific speaking skills.

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I. INTRODUCTION

Current developments in literacy have shown high expectations for data literacy skills among students at all levels of education (Mills, 2010; Sang, 2017). The innovative role of teachers in learning is expected to provide a positive intervention to support students' literacy understanding in responding to data developments in this era of rapid and massive information (Bakkenes et al., 2010; Drent & Meelissen, 2008). Students must have a good understanding of the appropriate ways to search for data sources, be able to analyze and interpret data so that they can make various conclusions based on the data they have to convey correctly and effectively. One form of new literacy development today is data literacy skills for students (Reeves & Honig, 2015). The concept of data literacy is based on the idea that literacy is the ability to understand and use various data effectively as a basis for determining appropriate co1clusions or decisions (Beck & Nunnaley, 2021). Therefore, data literacy skills for students in learning must be taken into account through appropriate strategies or methods.

The principles of data literacy that are important for students to understand consist of the ability to explore, evaluate, interpret or draw conclusions based on data, and present or display data statistically, graphically, or in tables (Gebre, 2022; Raffaghelli & Stewart, 2020). Another review emphasizes that data literacy is oriented towards analytical activities that students must specifically carry out before presenting them in writing or orally. Students must be able to

understand general patterns in using data, selecting data, and making comparisons based on data (Jacobs et al., 2009). Wolff et al. (2016) state that data literacy can include students' ability to identify and produce answers related to the information sought. Students are directed to be able to create an identification strategy and determine answers or hypotheses based on data. This is closely related to how students can effectively present their understanding of data that has been processed into relevant information orally. Therefore, understanding data literacy is one of the foundations for students in practicing speaking skills with attention to scientific principles.

In a review of several literatures, the concept of data literacy is built on a long history of media literacy and digital literacy research (Pangrazio & Sefton-Green, 2020; Van Audenhove et al., 2020). According to this view, although literacy has long been understood as the skill of using (digital) media productively, this understanding has been criticized as not very important (Bawden, 2001). Several approaches and studies on the concept of data literacy show developments in recent years. Most research on data literacy describes creative strategies for providing an understanding of how data is read, managed, used, and communicated. In their research, Bhargava and D'Ignazio (2015) reveal that there are a number of concepts that include critical reflection on the understanding of data, both during data exploration and as a result of data processing that is communicated to the public.

In relation to the concept of data literacy, students' speaking skills in the context of learning are communication activities that must be understood as a way of expressing ideas based on data. Data literacy aims to develop autonomy in students' thinking. Ting (2015) and Erwin (2015) both emphasize the importance of student autonomy in developing data literacy. Ting's study on data literacy and negotiated learning found that student autonomy in data literacy can be transferred to learning in school, while Erwin's research on project-based learning with data sets shows that students can develop data literacy through authentic data analysis tasks. The development of student thinking autonomy is defined as the ability to make independent decisions about what they believe through critical consideration based on the use of data. Therefore, the discourse and arguments presented when speaking scientifically must be based on accurate and tested data.

Students' scientific speaking skills in the classroom are an integral part of building their knowledge (Wijaya, 2018). Students' speaking skills in classroom learning are quite complex activities (Eriyanti, 2018; Wijaya, 2018). Referring to a review of the literature on speaking and communication skills, complex speaking objectives involve various instruments as a means of expressing ideas to others appropriately (Brooks & Wilson, 2014; Kusumawati, 2018). Data literacy, as one of the instruments that students must possess, plays an important role in supporting scientific speaking skills. In this regard, the communication situation in classroom learning has been arranged to be oriented towards speaking practices (Steviani, 2020). The learning arrangement is based on the consideration of stimulating student activities to realize the dominance of speaking practices during learning. In these activities, speaking skills in classroom learning must focus on critical understanding of the data to be communicated, taking into account both verbal and nonverbal dimensions (De Grez et al., 2009). The verbal dimension in scientific speaking emphasizes the principles of speaking related to language, while the nonverbal dimension emphasizes paralinguistics or performance when speaking.

In several relevant studies, literacy and numeracy interventions have been widely conducted in several scientific disciplines (Bu et al., 2020; Guess et al., 2020; Kim et al., 2021). From a learning perspective, intervention is interpreted as a form of strategic steps to make conditions more focused and better. Strategies that have been proven effective in literacy research show that literacy interventions help students who experience difficulties to increase their language awareness, such as phonemic awareness, vocabulary, speaking fluency, and understanding of data and information (Light & McNaughton, 2012). Several relevant studies emphasize the need for learning interventions with literacy integration (Alvermann & Rush, 2004; Khakima et al., 2021; Sukartaatmadja & Muktiadji, 2020).

The findings of these studies show good results in terms of how students view solving problems they encounter, both at the school level and at the university level. Unlike previous

studies, this study focuses on the perspectives of teachers and students on data literacy interventions in scientific speaking learning. According to the researcher's observations, the focus of research on this topic has never been done before. The rationale behind this study is to determine the perspectives of teachers who have applied the principles of data literacy in their teaching. Specifically, data literacy interventions provide opportunities for students to improve their skills in searching for data, analyzing data, interpreting data, and conveying data correctly through effective communication (Gebre, 2018; Kippers et al., 2018). In this regard, scientific speaking activities require individuals to convey and present accurate and precise data or final information. The activity of talking about processed data and following up with final information is an important part that cannot be separated from scientific speaking activities in learning. Teachers have their own strategies and perspectives on concrete efforts that can be made in teaching speaking skills. Therefore, this study attempts to describe data literacy interventions based on the perspectives of teachers and students regarding data literacy interventions in scientific speaking learning. Data literacy interventions are considered to be a form of concrete support for students so that they can understand the principles of communicating data through speaking skills (Kansa & Kansa, 2021).

Based on the background explanation above, this study aims to explore the perspectives of teachers and students regarding data literacy interventions in scientific speaking learning. Data literacy interventions in the context of learning in this study focus on several aspects that students must master in the process of scientific speaking delivered in class forums. Therefore, data literacy principles become indicators in assessing interventions carried out in scientific speaking learning. The results of this study are expected to make a positive contribution to teachers' and students' perspectives on data literacy in improving students' scientific speaking skills and provide new insights into efforts to improve data literacy among students. In addition, this study can be applied practically in the form of concrete efforts that can be made so that other students are able to speak scientifically based on accurate data through the process they have gone through.

2. RESEARCH METHODS

This study used a descriptive qualitative method with the aim of describing teachers' and students' perceptions of data literacy interventions in student speaking learning in the classroom. The research data sources were collected from the participation of 6 teachers and 92 students at the high school level. Data collection was carried out using interview techniques, questionnaires, and reviewing related documents. The interview guidelines consisted of three aspects, including data literacy integration, data literacy strategies, and data literacy support systems (Bhargava & D'Ignazio, 2015; Prado & Marzal, 2013). These three aspects were used to explore teachers' perceptions of data literacy interventions in speaking learning. The research data analysis technique was carried out through data collection, data presentation, data condensation, and conclusion drawing (Miles et al., 2014).

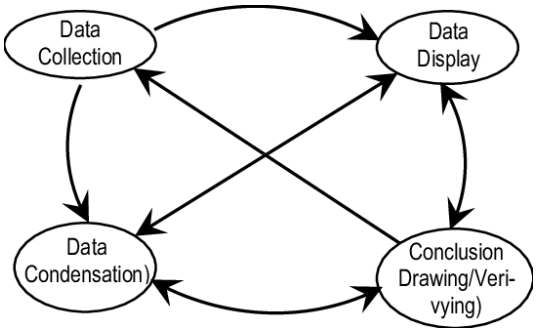

Figure 1. Data Analysis Flow with Interactive Model adapted from Miles et al. (2014)

Based on Figure 1, it can be explained that the research flow begins with data collection through observation, interviews, and documentation. Next, data condensation is carried out in the form of sorting data to be followed up through the data display stage. At the data display stage,

data organization and integration techniques are carried out to draw a conclusion about the focus of the problem being studied. To obtain an assessment of the validity of the research data obtained, the confirmability examination technique is then carried out.

2. RESULTS AND DISCUSSION

Teachers' perspectives on data literacy interventions in scientific speaking learning

Teachers' perspectives on data literacy interventions are ways of viewing or assessing by interpreting and concluding about objects in their environment. Teachers' perspectives on data literacy interventions were obtained through interviews covering three main aspects, namely data literacy integration, data literacy strategies, and data literacy support systems. The following is a systematic description of the results and discussion of these three main aspects.

Table 1. Interview Transcripts on the Aspect of Data Literacy Integration

Code	Aspect of Data Literacy Integration
G-1	The aspect of data literacy integration in learning constitutes a unified activity within the implementation of instruction. The integration of data literacy in scientific speaking practices not only imparts an understanding of literacy but, more significantly, becomes one of the learning objectives itself.
G-2	The integration of data literacy is essential in learning. Specifically in scientific speaking instruction, it can facilitate a fundamental understanding of how one prepares a specific, high-quality theme before engaging in scientific discourse. This underscores the importance of data literacy as a support for speaking skills in scientific contexts.
G-3	Data literacy integration needs to be implemented to guide and direct students toward achieving the objectives of scientific speaking based on appropriate data. Furthermore, data literacy integration is designed with the specific aim of fostering student competence in sourcing data and analyzing it correctly before it is delivered orally through speaking activities.
G-4	It is important to serve as a vehicle for instilling the competency to assess the quality of data or information, thereby enabling students to select high-quality materials based on data processed according to data literacy principles.
G-5	A form of quality learning development must involve the integration of data literacy. Students must understand how to process and draw accurate conclusions from data. In this era of rapid information advancement, it is crucial to cultivate an understanding of data or information literacy. While they can easily access data or information, they must comprehend how to read and filter it to be used effectively.
G-6	Data literacy in learning should be integrated into specific material criteria. However, literacy integration in general should be applied across all learning materials. If literacy is understood as a fundamental skill, then it should be reflected throughout the learning process. A similar approach can be implemented with data literacy to support students' scientific speaking skills. This is because speaking is a relatively complex activity, which includes the critical task of preparing speaking content for scientific situations.

Based on the interview results in Table 1, it shows that the six teachers as respondents have the same perspective on the aspect of data literacy integration in scientific speaking learning. The six respondents explained that data literacy integration has an orientation that, in principle, learning fosters competence in reading and understanding various data effectively. A similar perspective is described in research conducted by Bhargava & D'Ignazio (2015), which states that to support students' understanding of data, it is very important to design tools and activities with strong pedagogical principles. According to Prado & Marzal (2013), a set of core competencies and content needs to be integrated into learning with data literacy so that it functions as a framework for developing the competence of reading and understanding data. The competence of reading and understanding data is one of the basic

competencies a person needs to be able to determine the core information that can be used. Another aspect that is highlighted in the integration of data literacy in learning is that it can increase concentration or focus on the various data or information to be used. Similar relevant research mentions that the integration of literacy has a dual role, namely as an approach and as a map to the goals to be achieved (Koltay, 2015). The practice of integrating literacy in various types of learning can be a key activity that must be carried out (Hafifah & Sulistyo, 2020).

In scientific speaking lessons at the high school level and equivalent, the integration of data literacy in speaking lessons contributes to the way students prepare material to be presented in scientific forums. Students must understand good and correct speaking skills in scientific situations. In addition, the integration of data literacy in scientific speaking lessons instills scientific attitudes about data or information presented and explained with speaking principles that meet the rules of scientific communication. In this regard, Yildiz (2021) revealed that the integration of literacy in learning at the high school level is an alternative to increase students' self-efficacy. Self-efficacy arising from the integration of data literacy will lead students to have confidence in achieving learning objectives. Relevant research results explain that literacy integration can increase self-efficacy so that it can overcome anxiety or confusion when speaking (Nafila & Al Fatah, 2022). Thus, the teacher's perspective on data literacy integration is an element of literacy that focuses on literacy practices in the scientific speaking

Table 2. Interview Transcripts on Data Literacy Strategy Aspects

Code	Aspect of Data Literacy Integration
G-1	In the learning process, appropriate strategies must be able to create a learning environment that is conducive to literacy practices. It is essential for teachers to maximize students' potential in inquiring and exploring, albeit from credible data sources.
G-2	Establishing a learning environment that supports data literacy activities. Utilizing various instruments that can support speaking learning based on data literacy principles. The classroom layout can be arranged by considering the speaking learning process to reflect a dominance of literate speaking practices.
G-3	Data literacy strategies in learning should originate from the designed learning tools. Data literacy strategies should reflect the necessary literate nuances through diverse references and learning materials. Students are given the freedom to explore topics of their interest through self-determined methods.
G-4	Building directed communication by incorporating diverse student perspectives on data literacy practices for use in speaking activities. Students first understand that speaking in a specific context requires in-depth mastery of the data or material to be delivered. Furthermore, students are provided with ample opportunities to collaborate and express their ideas in a guided manner, thereby eliciting a variety of student perspectives.
G-5	Preparing the learning process through a social system that encourages active student collaboration. Scientific speaking practices should provide students with broad opportunities to seek information and utilize their digital skills. As a facilitator, the teacher plays a role in continuously guiding and steering the learning process to remain aligned with the objectives mutually understood with the students.
G-6	Strategies implemented by considering several factors. First, the effort to plan learning as effectively as possible and in accordance with student needs. Second, the implementation of learning must align with the plan. Third, literacy strategies must be based on literacy principles and speaking learning principles that should accommodate collaborative and participatory learning. Fourth, the teacher's active role as a facilitator in the learning process must comprehend both the process and the objectives of learning based on the intended goals.

Based on Table 2, aspects of data literacy strategies in scientific speaking learning show that all respondents' perspectives focus on technical matters. An important thing to do is to condition the learning space. The conditioning of the learning space must be relevant and support literacy practices. Respondents G-1, G-2, and G-3 assessed that the learning environment is a supporting force for scientific speaking learning practices. In the context of scientific speaking learning, the learning environment is one of the keys that influence classroom management strategies. Well-designed data literacy strategies in learning are expected to create a more productive learning ecosystem so that learning takes place actively, collaboratively, and effectively. According to G-4, G-5, and G-6, who share a similar view, data literacy strategies should encourage active participation in collaboration and the creation of diverse perspectives, thereby generating creative ideas from students. In scientific speaking learning, active participation and collaboration are good strategies for providing a learning environment that encourages students to speak scientifically. This is in line with the results of research by Shi et al. (2022). A learning environment that has been systematically designed for learning will encourage students' literacy skills to continue to uphold the principles of scientific thinking. In this study, teachers' perspectives on data literacy strategies in scientific speaking learning show that students will understand the context of scientific discourse. Students will continue to strive to use rationality as a basis when interacting in their learning environment. The arrangement of the classroom environment or management of the learning environment will have an impact on students' scientific thinking abilities during learning (Birgili, 2015). Thus, the respondents' perspective on the aspect of data literacy strategies in scientific speaking learning prioritizes the arrangement of learning spaces and learning environments that encourage data literacy practices in scientific speaking.

Table 3. Interview Transcripts on Aspects of the Data Literacy Support System

Code	Aspect of Data Literacy Integration
G-1	The data literacy support system is principled on creating open learning with every piece of data and information. It comprises all learning tools, materials, and technical facilities that can assist in learning scientific speaking skills.
G-2	Data literacy intervention in scientific speaking skill learning is supported by a system that provides students with adequate space and technical facilities. A variety of technologies and learning materials should be utilized appropriately to enhance the quality of interaction in open learning, particularly in scientific speaking instruction.
G-3	The learning of scientific speaking skills must be supported by a well-planned support system that considers the adaptation of credible learning resources. Students should be provided with technical facilities that foster active engagement in scientific speaking practices. The data literacy support system in learning has been prepared according to the needs of scientific speaking skill instruction. Every form of learning activity must be supported by a high-quality support system.
G-4	The data literacy support system in scientific speaking learning encompasses sources, materials, and learning tools that accommodate the entire learning sequence and emphasize scientific speaking practice. Data literacy interventions in learning are designed to provide students with the broadest possible opportunity to practice scientific speaking based on robust and valid data.
G-5	The data literacy support system in scientific speaking skill learning is oriented towards facilities and efforts to provide students with ease in learning. The principles of data literacy as a basis for learning scientific speaking skills should be reflected in the learning materials and resources. Furthermore, students must be provided with guidance and direction so they can maximally excavate information through the dominance of structured practice.

G-6	The data literacy support system designed for scientific speaking learning must provide assistance to students through representative teaching and learning resources. The data literacy support system in scientific speaking skill learning should provide materials and resources that can enhance students' critical thinking abilities and leverage technology to support their scientific speaking activities.

Based on Table 3, aspects of data literacy support systems in scientific speaking learning must pay attention to technical facilities to support open learning (G-1, G-2). All respondents considered that data literacy support systems in scientific speaking learning need to pay attention to adequate learning support tools. According to respondents G-3, G-4, and G-5, the data literacy support system must emphasize speaking practices supported by appropriate learning tools. In addition, teaching materials, learning resources, and learning support tools must be tailored to the needs of students in scientific speaking learning. According to respondent G-6, the data literacy support system in scientific speaking learning can improve students' critical thinking skills and active involvement in scientific speaking learning. The support system in speaking learning must integrate all support systems in learning (Arciosa et al., 2022). Previous relevant research explains that the concept of literacy integration in teaching is a form of metaconstruction that includes literacy constructs (Beck & Nunnaley, 2021; Cowie & Cooper, 2017; Mandinach & Gummer, 2013). Therefore, the data literacy support system in scientific speaking learning has an important role as a supporting element that must be integrated in learning.

Students' Perspectives on Data Literacy Interventions in Scientific Speaking Learning

In this section, students' perspectives on data literacy interventions in scientific speaking learning are examined based on indicators of ability to explore data and information, ability to evaluate the quality of data and information, ability to draw conclusions based on data, and ability to communicate data using various techniques (Ridsdale et al., 2016). The following are the results of research related to students' perspectives on data literacy interventions in scientific speaking learning.

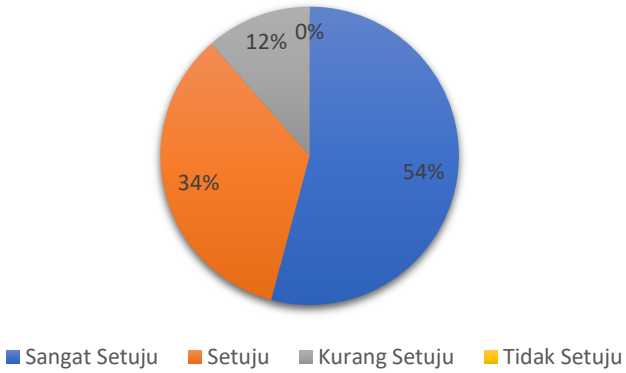

Figure 2. Students' perspectives on data and information exploration skills
(Source: researcher's primary data, 2023)

Figure 2 shows that students' perspectives on data literacy interventions improve data and information exploration skills with fairly positive responses. A total of 54% of students strongly agreed and 34% agreed that data literacy skills in scientific speaking learning improved their ability to explore data and information for scientific speaking materials. A total of 12% of respondents strongly disagreed that data literacy interventions play a role in data exploration activities. However, the majority of respondents strongly agreed that data literacy skills contribute to data or information exploration activities. According to Deahl (2014), data exploration skills can develop critical thinking skills in determining a scientific discussion topic. The data and information to be presented in scientific speaking activities are based on the results of accurate and correct data exploration so that relevant data and

information are obtained. Previous relevant studies have stated that students' data exploration abilities are related to their skills in selecting and sorting data quality appropriately (Kjelvik & Schultheis, 2019; Susilawati et al., 2017). Thus, data literacy interventions can provide a basic understanding of how data is obtained using scientific principles.

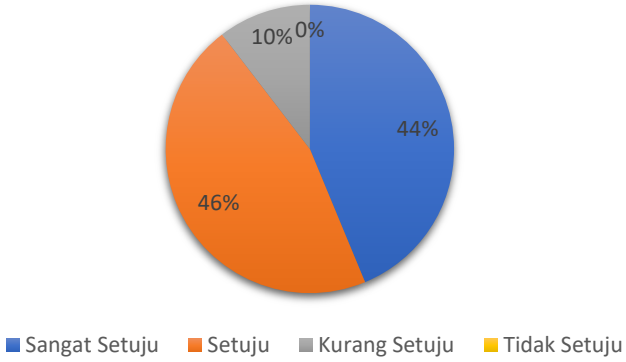

Figure 3. Students' perspectives on the ability to evaluate data and information quality (Source: researcher's primary data, 2023)

Figure 3 shows that students' perspectives on data literacy interventions improve their ability to evaluate data and information quality. A total of 44% of students agreed; 46% of students agreed; and 10% of students disagreed. Based on these percentages, it can be concluded that almost all respondents stated that data literacy interventions in scientific speaking learning help students improve their ability to evaluate the quality of data and information to be presented in scientific speaking activities. In addition to data exploration skills, students must have the ability to assess the data and information obtained from exploration activities. The data and information obtained must go through a selection and sorting procedure based on data quality according to the required criteria. The quality of data and information that has gone through the evaluation process can improve the quality of the final information to be presented in scientific speaking activities. To ensure the quality of scientific and technical information, it is important to consider assessment factors such as accuracy, reliability, and relevance of data in speaking (Robin et al., 2020). The principles of accuracy and validity of data and information are very important in scientific speaking activities so that the final information presented can be accounted for.

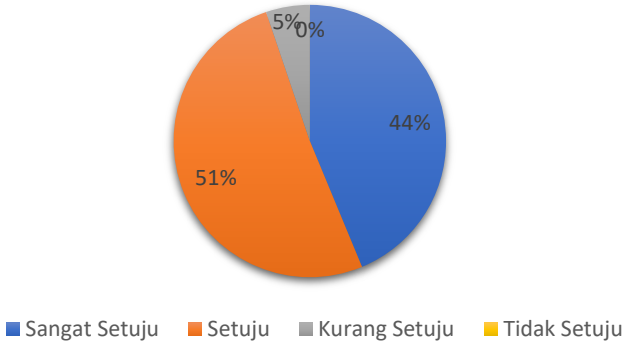

Figure 4. Students' perspectives on the ability to draw conclusions based on data (Source: researcher's primary data, 2023)

Figure 4 shows that 44% of students strongly agree; 51% agree; and 5% disagree. Based on these percentages, it can be concluded that data literacy interventions in scientific speaking learning help students to make accurate conclusions based on data. Conclusions in

scientific speaking play a very important role. Conclusions based on the data presented must be able to leave an impression of the important points or a representative overview so as to convey the substance to the audience. Data literacy interventions in scientific speaking learning are oriented so that students can correctly and accurately draw conclusions based on correct data. The results of data and information evaluation are taken into consideration when someone speaks scientifically to draw conclusions. According to Miller (1951), effective conclusions contain three basic parts: a restatement of the topic; a review of the main points presented; and a closing statement that helps create a lasting impression on the audience. Thus, data literacy intervention for students provides a good learning experience by paying attention to the conclusions that will be presented to the audience.

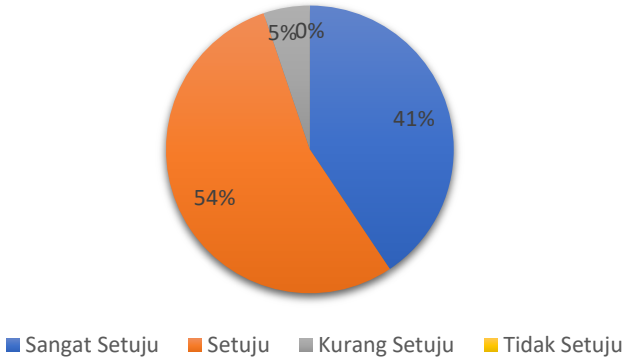

Figure 5. Students' perspectives on their ability to communicate data using various techniques (Source: researcher's primary data, 2023)

Figure 5 shows that 41% of students agreed; 54% strongly agreed; and 5% disagreed. These percentages indicate that data literacy interventions in scientific speaking learning help students communicate data using appropriate visualizations or techniques. The presentation of data through scientific speaking activities must be supported by techniques and the use of technology as a form of graphic support in the presentation of data and information. Therefore, the use of technology in presenting data is necessary so that data and information can be understood properly (Oktavia & Hulu, 2017).

In the context of scientific speaking, data communication is important and must be given careful attention by every speaker. Through data literacy intervention in scientific speaking learning, students are expected to be able to convey ideas by paying attention to patterns in data, be able to provide a new or unique perspective, and be able to explain data that is considered complex into data and information that is easily understood by the audience clearly and efficiently (Watson & Lom, 2008).

To reinforce the results of the above discussion, this study provides insights into the urgency and intervention of data literacy in scientific speaking learning. Based on the teacher's perspective, it can be understood that the aspects of integration, strategy, and data literacy support systems have a positive impact on scientific speaking learning. Meanwhile, from the students' perspective, it shows a positive impact on their ability to explore, evaluate, draw conclusions, and communicate them appropriately. Based on this, the results of this study recommend an effort to improve the quality of innovative scientific speaking learning through the adaptation of an appropriate pedagogical framework.

4. CONCLUSION

Based on the results and discussion of the study, this article concludes that data literacy currently needs to be developed and not only as a skill in reading and understanding data. Data literacy interventions based on the perspectives of teachers and students show that data literacy has a positive impact on supporting scientific speaking skills. The research findings presented in this study provide insights based on the teachers' perspective that data literacy interventions in

learning are very positive if they are well prepared and adaptive to support scientific speaking skills. Three important aspects that must be considered in scientific speaking learning are the integration of data literacy, literacy strategies, and data literacy support systems. These three aspects, from the teachers' perspective, must be given special attention as a basis for applying data literacy in scientific speaking learning. Findings from the students' perspective related to data literacy are oriented towards the ability to explore data, evaluate the quality of data and information, draw appropriate and correct conclusions based on data, and communicate data using various techniques. The findings of this study recommend that data literacy intervention in scientific speaking learning can be used as a new asset in learning so that it is expected to contribute conceptually and procedurally to improving students' speaking skills.

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