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Analysing The Different Students' Science Mental State between Regular Students, Grey Students, and Special Needs Students in Inclusive Schools: A Case Study

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Abstract

For educators and schools, implementing inclusive education has brought both opportunities and obstacles. Students' mental health has a significant impact on their capacity to participate in and excel in science classes. This study aimed to analyse the differences in the mental state of science between regular and special needs students within an inclusive school. The research subject is 42 students in grades 7, 8, and 9 from one of the inclusive schools in Bandung. The sample was divided into regular, grey, and special needs students based on the school classification obtained. This study used a quantitative method survey research design. A mental state learning environment questionnaire (MSLEQ) and open-ended questions were used as instruments to assess students' science mental state. The data was analysed by using the SPSS Program one-way analysis of variance (ANOVA). The result shows that there are at least two significant differences in students' science mental state scores between regular students, grey students, and special needs students. Based on the post-hoc Tukey HSD test, a significant difference is shown between regular students and grey as well as special needs students. The mean index analysis of each factor shows that the significant difference is in external mental representation. Most regular and special needs students argued that experiments made them more interested in learning science. Meanwhile, most of the grey students failed to describe their opinions. Regular students explained that many scientific terms to be memorised made them less interested in learning science. Grey students are more likely to avoid experimenting. Meanwhile, students with special needs were given unrelated answers about what made them less interested in learning science.

Keywords: Inclusive School, Science Mental State, Special Need Students

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INTRODUCTION

Education is a fundamental human right and a critical driver of societal progress. Access to quality education can empower individuals, reduce inequalities, and promote long-term economic and social development. Over the past few decades, there has been a growing recognition of the importance of inclusive education as a strategy to ensure equity and equal opportunities for all students(Villanueva et al., 2012). Inclusive education refers to the practice of educating students with diverse learning needs—ranging from those in the general education population to those requiring special support—in the same classroom environment (Efendi, 2018). This approach aligns with global frameworks, such as the United Nations' Sustainable Development Goal 4, which emphasises inclusive and equitable quality education for all students(UNESCO, 2017).

The growing recognition of inclusive education as a critical element of educational policy and practice reflects a broader understanding of social justice and equity. It is no longer sufficient to simply provide education to a select group of students or segregate those with special needs into separate schools or classrooms. Inclusive education involves integrating students with varying levels of ability, including those with disabilities or other learning difficulties, into general education classrooms alongside their peers. The implementation of inclusive education has brought both opportunities and challenges to educators and schools. On the one hand, inclusive classrooms encourage social integration, mutual respect, and a sense of belonging among students with different abilities (Slavin, 2011). On the other hand, they require tailored instructional strategies, adaptive technologies, and a deep understanding of individual student needs (Leijen et al., 2021). Within the field of science education, these challenges become even more pronounced, as the subject often involves complex concepts, hands-on experimentation, and collaborative problem-solving.

The mental state of students plays a pivotal role in students' ability to engage with and succeed in science education. Mental states pertain to the conditions created by the interaction of students' psychological status and mental representations during science education, and these states impact students' conceptual learning (Liu et al., 2014). Perner (1991) defined mental states as types of internal human energy that stimulate and generate noticeable mental behaviours, thoughts, and strategies. Mental states serve to elucidate, anticipate, and comprehend behaviour, the inner condition, and the contextual factors, along with any connections between these elements (Leslie, 1994). In other terms, during science education, students' mental state can affect not just the motivation and attitudes towards learning but also the outcomes of conceptual understanding.

Liu et al. (2014) explained that a student's mental state is indicative of the learning environment's quality when he/she engages and interacts with other aspects within that setting. In summary, every element in the environment interacts with each other based on the student's mental state and indirectly affects the student's behaviour and language. Four factors associated with mental states that should be considered are intention, emotion, and both internal and external representations ((Liu & Treagust, 2005). Emotions are defined as students' emotions toward science classes (Liu et al., 2014). In this study, the intention factor refers to how intentions to gain from others affect the learning of science (Liu et al., 2014). Internal mental representation is the effect of image formation and the transforming of internal knowledge during the process of learning. External mental representation, on the other hand, is the utilisation of the representation of science during problem-solving (Liu et al., 2014).

In general, for regular students, factors such as curiosity, self-confidence, and interest in scientific topics can drive engagement (Davis et al., 2006). For students with special needs, additional considerations, such as sensory sensitivity, cognitive processing challenges, or emotional regulation, may influence their learning experience (Hardman et al., 2011). Students with special needs typically denote those who need extra assistance for their learning and educational requirements (Villanueva et al., 2012). While nations or school districts might utilise various methods to classify SEN, shared terms within this category encompass intellectual disabilities, learning disabilities (LD), giftedness, emotional or behavioural challenges, physical dependence, deaf-blindness, deaf or hard of hearing, visual impairments, and chronic health issues, also known as exceptionalities (Hallahan & Kauffman, 2008; Hardman et al., 2011). Despite these differences, relatively little research has focused on the comparative mental states of regular and special needs students in inclusive science classrooms.

Understanding these disparities is essential for designing effective educational practices. For example, while collaborative group activities may enhance social and cognitive engagement for regular students, they might present difficulties for students with autism spectrum disorder (ASD) or attention-deficit/hyperactivity disorder (ADHD) without adequate support (Hatch et al., 2023). Similarly, while hands-on experiments may foster excitement and curiosity among most learners, they may require significant modifications to be accessible for students with physical or sensory disabilities (Brigham et al., 2011). However, there is a lack of studies that analyse the differences in students' science mental states between special needs students and regular students in inclusive schools.

This study seeks to analyse the differences in the mental state of science between regular and special needs students within an inclusive school setting. Specifically, it investigates four main key factors of mental states: emotion, intention, internal mental representation (IMR), and external mental representation (EMR). This study proposed two research questions: (1) How is the mental state of regular students different from students with special needs? Moreover, (2) How is the interest of regular students in learning science different from that of students with special needs? The novelty of this study lies in the comparative focus on science mental state on context-specific insight by conducting a case study within inclusive schools. The results aim to provide evidence-based recommendations for educators and policymakers to create more effective and supportive inclusive learning environments.

METHODS

This study uses a quantitative method in survey research design by exploring quantitative data in one variable and comparing it based on several groups. Survey research offers a numeric or quantitative portrayal of trends, attitudes, or opinions within a population by examining a sample from that population (Creswell, 2018). It comprises cross-sectional and longitudinal research utilising questionnaires or structured interviews for gathering data—with the aim of extrapolating from a sample to a population (Fowler, 2014). The goal of the comparing process in this study is to describe, explore, and explain similarities and differences, which in this case is students' science mental state (Iranifard & Roudsari, 2022).

The participants of this study were 42 secondary inclusive school students in grades 7, 8, and 9 located in Bandung, Indonesia. There were 20 students of grade 7, 5 students of grade 8, and 16 students of grade 9. Students aged 12 to 16 years consist of 21 females and 21 males. Based on the school system occupied, the students from all classes were divided into three groups: regular students, grey students, and special needs students. Regular students consisted of 30 students who did not need any special treatment.

Table 1. Participant Grouping

Group	Total
Regular Students	30
Grey Students	5
Special Needs Students	7

Grey students are the students who got a different treatment, which consists of four slow-learner students and one fast-learner student. Special needs students are the students who get special treatment due to their particular conditions, and they are assisted by a special needs assistant (SNA) teacher. In this study, there are seven special needs students with five different diagnoses, including anxiety disorder, selective mutism, attention-deficit/hyperactivity disorder (ADHD), sensory modulation disorder (SMD), and dyslexia.

This study used a convenience sampling technique to collect the data because the data was taken only one time without any treatment, and the participants were only from an inclusive school (Fraenkel et al., 2019).

Mental State in Learning Environment Questionnaire (MSLEQ) developed by Liu & Treagust (2005) was used to assess students' mental states. This questionnaire has been proven to have a high internal consistency reliability value between 0.70 and 0.92, as well as good construct validity and predictive validity (Liu & Treagust, 2005). This study directly adopted MSLEQ with 12 statements and four main factors of mental state, which are intention, emotion, internal mental representation, and external mental representation. Each factor consists of 3 statements, and the questionnaire used a five-point Likert scale, in which 1 = strongly disagree, 2 = disagree, 3 = not sure, 4 = agree, and 5 = strongly disagree. Accordingly, negative items were reverse-scored. This study also used open-ended questions to explore students' perspectives on the things that made them interested and disinterested in learning science. The open-ended question consists of two questions: (1) What makes you interested in learning science? Moreover, (2) What makes you less interested in learning science? The questions have been validated by one lecture in science education and two science teachers.

The data was initially collected by using Google Forms and converted into Microsoft Excel to analyse the mean mental state score and convert the open-ended questions into percentages. The categorisation of mental state score results is done based on the guidelines for categorising respondents' response scores used in Haetami.

Further analysis was done by using the SPSS Program. The initial analysis was to accomplish the minimal assumptions, which are normality and homogeneity tests. Then, if the data is normally distributed and homogeneous, the data will be analysed using the parametric test. In relation to the purpose of the study, which is to analyse whether there is a difference between regular and special needs students on science mental state, the test taken is the One-way Analysis of Variance (ANOVA) Test. The results of the analysis of variance (ANOVA) are significant, meaning that there is a greater likelihood that at least one group is different from the others (Salkind, 2010). Nevertheless, the test provides no information regarding the pattern of mean differences. A post-hoc test is done when a statistical difference is found between the groups, and this study used the Tukey honestly significant difference (HSD) test. The fundamental idea behind the Tukey HSD is that it uses a statistical procedure to calculate the honestly significant difference between two means (Nanda et al., 2021).

RESULTS & DISCUSSION

Students' Science Mental State Questionnaire

The results of the students' mental state scores were analysed based on grouping. The overall students' science mental state result was 3.35, which is categorised as medium. The grouping consists of 3 groups, which were regular, grey, and special needs students. The result showed that each group has a different mean index result. Then, the general mean index analysis of each group was analysed to compare the results. As shown in Figure 1, the average result of regular students was 4.00, grey students were 3.15, and special needs students were 2.90. Based on the categorisation of categorisation respondents' response scores (Haetami, 2023), regular students were categorised as high. On the other hand, grey and special needs students were categorised in the same way as the medium.

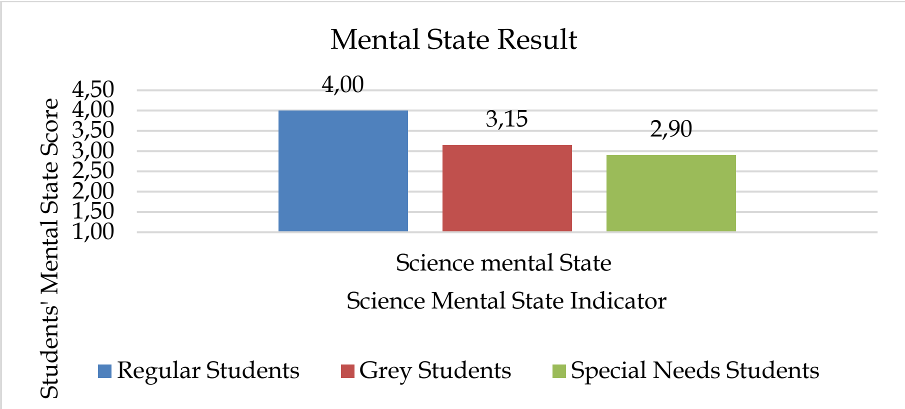

Figure 1. General Mental State Result

The data was further analysed by using one-way ANOVA in the SPSS program. However, minimal assumptions needed to be completed, which are that the data should be normally distributed and homogeny. Based on the Shapiro-Wilk test, the data of each group was normally distributed with a significance value of 0.396 for regular students, 0.068 for grey students, and 0.100 for special needs students. Furthermore, based on the mean on the test of homogeneity of variance, the data was homogeny with a significance value of 0.376. Consequently, further tests were done using a parametric test, which was one-way ANOVA.

This study formulated hypothesis zero (H0) as there is no significant difference in the average between regular students, grey students, and ABK students. The alternative hypothesis (HA) is that there are at least two significantly different means. Table 3 shows the result of one-way ANOVA on students' science mental state. Based on the significance value of <.001 in between groups, hypothesis zero is rejected. Thus, there are at least two significant differences in students' science mental state scores between regular students, grey students, and special needs students.

Table 3. One-way Anova Result

ANOVA					
Mental State					
	Sum of Squares	f	Mean Square	F	Sig.
Between Groups	8.639	2	4.320	49.562	<.001
Within Groups	3.399	39	0.087		
Total	12.038	41			

Further analysis was done by using the Tukey HSD test as a post-hoc test. Groups. Based on the results, as shown in Table 4, a significant difference was found between regular students and both grey and special needs students. This indicates that the mental state scores of regular students were significantly different from those of grey and special needs students. However, no significant difference was observed between grey students and special needs students, suggesting that their science mental states share similar characteristics. This result aligns with a study done by Liu & Treagust (2005), which demonstrated that low-achieving and special needs students often struggle with internal visualisation, display negative emotions, and have lower intentions and motivation when learning science. Additionally, they tend to experience difficulties in understanding graphics and interpreting visual representations, which are crucial components of science learning. In contrast, students who do not require special accommodations showed markedly different results, displaying greater foresight and stronger engagement in science-related tasks (Liu & Treagust, 2005). The lack of significant differences between grey and special needs students suggests that both groups may face similar cognitive and emotional barriers in science learning. This raises important considerations for educators, as it highlights the need for targeted interventions that address these students' challenges in visualisation and conceptual understanding. Providing more structured scaffolding, visual aids, and hands-on learning opportunities may help bridge the gap between these students and their regular peers.

Table 4. The Post-hoc Tukey HSD Result

Mental State				
			Subset for alpha = 0.05	
	Students	N	1	2
Tukey HSD[a,b]	Special Need	7	2.9043	
	Grey	5	3.1500	
	Regular	30		4.0003
	Sig.		.233	1.000

The differences observed between student groups can be attributed to several factors that influence students' mental states, particularly in science learning. Villanueva et al. (2012) explained that there are many challenges to effective science learning in inclusive education, which include teacher readiness, science textbooks for special needs students, and classroom-based science kits. Soodak et al. (1998) explained that teachers lack the necessary training to instruct special needs children in inclusive environments. This concern was echoed in interviews with science teachers, who expressed significant challenges in preparing materials, media, and worksheets for students of different learning abilities. The science teacher explained that "we need to prepare at least three different sets of worksheets and materials for our students, which requires extra time and effort." This preparation burden increases when conducting experiments in class, as teachers must design different versions of experiments to accommodate special needs students. The teacher also stated, "When we experiment in class, I have to prepare different experiments for special needs students, and it took more preparation." These challenges highlight the complexity of inclusive science education and the additional demands placed on teachers. Without adequate training, time, and resources, educators may struggle to create an equitable learning experience for all students. Addressing these issues requires more professional development programs for teachers, the creation of specialised instructional materials, and greater institutional support to ensure that all students, regardless of their learning abilities, can actively participate and engage in science education.

Specific analysis is also done based on each indicator of science's mental state, which are emotion, intention, internal-mental representation, and external-mental representation. Based on Figure 2, the significant difference between regular students and grey and special needs students is shown in external-mental representation. External-mental representation here is related to the seating arrangement to support the discussion process and the activeness of students to ask and express their ideas in learning science. Regular students basically show the highest score in every factor, but they show the highest score in EMR. In contrast, grey and special needs students show the lowest scores in EMR. This result is in line with a study done by Artdej et al. (2010), who found that students with special conditions were unable to express, ask, and describe their ideas when learning science, while regular students showed confidence during the learning process. According to a study, external representations serve far more significant purposes than only helping with remembering and are not just inputs and stimuli to the interior mind (Zhang, 1997).

The form of a representation dictates what information can be received, what processes can be triggered, and what structures may be found from the particular representation, according to the proposed representational determinism.

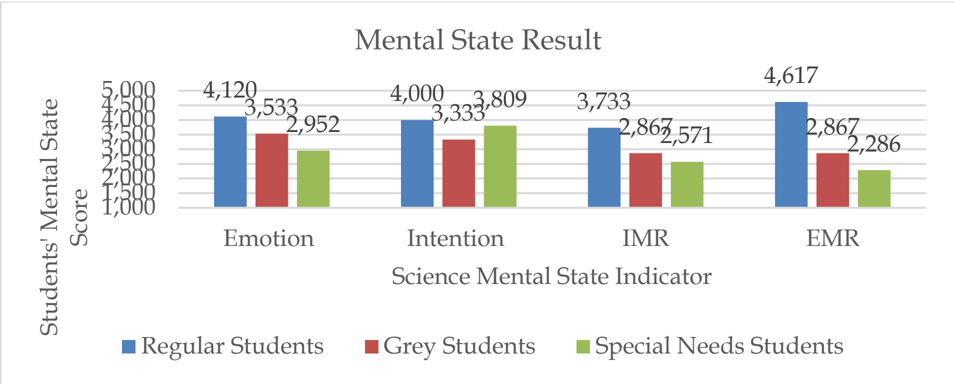

Figure 2. Average Result Based on Indicator

Open Ended Question Result

The open-ended questions given to the students consist of two questions: "What makes you interested in learning science? Please explain!" and "What makes you less interested in learning science? Please explain!". The students' answers were grouped based on their similarities. Table 5 shows the students' answers to the first question, "What makes you interested in learning science? Please explain!". The first open-ended question result shows that 60% of regular students explained that the experiment made them interested in learning science. Some students also explained that the experiment made them excited and challenged, and they could watch the real phenomena related to the topic discussed. Based on the interview with the science teacher, he stated, "Even though our school does not have separate science labs, we do experiment most of the time for most topics. We also have a special program to visit several science labs from several universities each semester so the students have a real experience in the science lab." A study done by Sherly et al. (2020) supported this result since they proved that experiments during science learning can foster students' interest, self-learning, and creativity. Another study also explained that the class who learned science through practical work showed significantly higher interest in science learning than the students who learned science through lecturing (Lee & Sulaiman, 2018).

Grey students, on the other hand, struggled to articulate what made them interested in learning science. A significant 40% of them failed to explain, often responding with "I do not know" when asked. This is also in line with the result of MSLEQ of grey students, who show relatively low scores in external-mental representation. Their difficulty in expressing themselves was further supported by interviews with their homeroom teachers, who noted that "Most grey students have very limited vocabulary, and they tend to have difficulty when they have to describe something". This suggests that their challenges in science learning may not stem from a lack of interest but rather from difficulties in verbal expression and cognitive processing. However, one student from grey students who was a fast learner student, stated that "Science is my passion, so it made me interested." This highlights the variability within the grey student category and suggests that while many struggle with verbal expression, some may still possess strong intrinsic motivation for science. A study done by Liu & Treagust (2005) explained that slow learner students were unable to express their feelings and understanding in learning science. These insights underscore the need for differentiated teaching approaches, including strategies to enhance vocabulary development and alternative ways for students to express their interest and comprehension in science.

Special needs students showed 57.14% of their answers to the first question, and the experiment made them interested in science. This suggests that hands-on, practical activities have a significant impact on engaging these students in the subject. Experiments allow students to interact with scientific concepts tangibly, making abstract ideas more accessible and understandable. However, the rest of the students give unrelated answers to the question. During the answering question process, most of them were helped by their SNA teacher to express their opinion. SNA teacher explained that "When learning science, students with special needs most of the times always learn from very simple experiments and barely learn only from explanation." For many special needs students, the concrete experience of experimenting can be more stimulating and effective than traditional verbal explanations. However, it is important to note that the remaining students did not provide answers directly related to the question, indicating that their engagement with science may have been limited or that they struggled to connect the experiments to the learning objectives. Efendi (2018) explained that to achieve good results in supporting special needs students, the material, skills, and assessment must be relevant and based on each student. This means that educators must be flexible and creative in their approach, offering a variety of learning strategies that accommodate different abilities and learning preferences. For instance, while some students may thrive in verbal discussions or written assignments, others may benefit more from visual aids, hands-on experiments, or interactive technology.

The second open-ended question result shows that 30% of regular students answered that many scientific terms and materials to be memorised made them less interested in science. This indicates that for a significant portion of students, the memorisation demands of science education can be a source of disengagement. In the interview, the science teacher explained, "It is challenging to make students always participate, especially when they find new scientific terms and have to memorise equations or materials in science." Many barriers and obstacles caused this to happen, including students' difficulties in remembering, lack of concentration, laziness to memorise, and students lack of enthusiasm for memorising (Suryani & Rachmijati, 2022). Students may face difficulties in remembering scientific terms and concepts, particularly when these terms are abstract or lack direct connections to their everyday experiences. For example, scientific terminology often involves Latin or Greek roots, which can seem unfamiliar and intimidating to students. This cognitive load may overwhelm their working memory, making it harder to retain and recall information.

Lack of concentration is another significant barrier. Many students struggle to focus on tasks that require sustained mental effort, such as memorisation. This lack of focus can stem from various factors, including distractions in the classroom, insufficient sleep, or a disinterest in the subject matter. When students cannot concentrate effectively, their ability to absorb and retain information diminishes, further exacerbating their disengagement. Students' laziness or unwillingness to memorise plays a role. This attitude may arise from a perception that memorisation is a monotonous or unnecessary activity, especially if students do not see the relevance of what they are learning to their own lives. If students view science as a subject that primarily involves rote memorisation rather than exploration and critical thinking, they are less likely to invest effort in mastering the material. A lack of enthusiasm for memorisation further hinders students' engagement. Enthusiasm and motivation are critical components of effective learning, as they drive students to persist in the face of challenges. However, when students perceive memorisation as a tedious task rather than an exciting opportunity to learn, their motivation wanes. This can create a negative feedback loop where students' lack of interest leads to poor performance, which in turn reinforces their disinterest.

Table 5. The Students Answer, "What makes you interested in learning science? Please explain!"

Student	Students' Answer	Percentage
Regular Students	The experiment made me interested in science.	60%
	I learned new things about nature, and various topics interested me in science, so it made me interested in science.	23.3%
	Some specific topics made me interested in science.	6.8%
	The way the science teacher teaches me made me interested in science.	3.3%
	The tools and instruments of science have made me interested in science.	3.3%
	I have learned many science topics before, so when learning in class, I can actively participate, and I feel excited when I learn it.	3.3%
Grey Students	I do not know what made me interested in science.	40%
	Science is my passion, so it interested me.	20%
	Science made me interested because I can imagine it.	20%
	I am not interested in science because I do not like science topics.	20%
Special Need Students	There is an experiment, so I am interested.	57.14%
	Unrelated Answer.	42.86%

Table 6. The Student's Answer, "What makes you less interested in learning science? Please Explain!"

Student	Students' Answer	Percentage
Regular Students	When there are many scientific terms and materials to be memorised.	30%
	Sometimes, the teacher's explanation of the materials is confusing and complicated.	26.67%
	When there are too many quizzes and worksheets.	16.67%
	Sometimes, my classmates were too noisy, so I could not focus and contribute to the discussion.	13.33%
	When there are many equations to be memorised.	6.67%
	When the material was not interesting.	3.33%
	When the material is repeated over and over again.	3.33%
Grey Students	I do not really like experiments, and there are so many terms to be memorised.	40%
	The material is too easy.	20%
	The topics are too hard.	20%
	The class was too noisy, so I could not focus.	20%
Special Need Students	Unrelated Answer.	71.44%
	Challenge critical and analytical thinking, take too many steps when experimenting, and do not always succeed on the first try.	14.28%
	There are many terms.	14.28%

Addressing these barriers requires a shift in teaching strategies. Educators can reduce the reliance on rote memorisation by adopting more interactive and student-centred approaches to teaching science. For instance, integrating project-based learning, concept mapping, or visual aids can help students understand and retain scientific concepts without feeling overwhelmed by memorisation. Additionally, incorporating real-life applications of scientific principles can make the subject matter more relatable and engaging for students. Furthermore, providing students with strategies to enhance their memory and concentration can be beneficial. Techniques such as mnemonics, chunking information, or using interactive learning tools can help students overcome difficulties in remembering scientific terms. Teachers can also create a more supportive and stimulating classroom environment to boost students' enthusiasm for science, such as incorporating experiments, group discussions, and gamified learning activities.

In contrast to grey students, 40% of them answered that they do not really like experiments and that there are many terms to be memorised. The science teacher explained that, “Most slow learner students easily give up when doing experiments since the experiment also requires critical thinking and deep analysis.” This is in line with Kranz et al. (2023) study, which concluded that the most challenging part for the students in experimenting is when they plan and conduct an experiment as well as data analysis and concluding. A study done by Palincsar et al. (2001) while conducting a science experiment in the form of Guided Inquiry supporting Multiple Literacies for inclusive classrooms, there are many challenges, including maintaining focus in the face of familiarity, social-relational issues that may prevent participation in the activity and role-playing, the cognitive and linguistic demands of defending one's ideas, the cognitive and linguistic demands of conducting alternative representations, and the linguistic and social challenges of publicly expressing one's thoughts. Thus, carrying out science experiments in inclusive classes requires great effort and is very challenging.

Special needs students gave 71.44% unrelated answers in answering the second question. The confirmation of their answer was done by doing follow-up interviews with related students. However, most of them actually do not really know how to answer and describe it. SNA teacher explained that “The students still struggle to imagine and understand scientific phenomena, so the science topic that they learn is different from regular students. All of the special needs students still learn the topic that is equal to elementary students.” Another SNA teacher also explained that most students with special needs have limited words and recognise and use the same words during a conversation. Therefore, they do have difficulty when asked to explain their understanding, especially in science subjects that have many specific terms. A study done by Brigham et al. (2011) explained that as a part of science education, students with learning disabilities struggle in working with numerical data, and they also struggle with written or spoken language, which may limit their capacity to demonstrate their proficiency. Thus, students with special needs need adjustments in the material and communication methods in science learning to support the development of their understanding.

The observed school has a special psychologist who provides professional consultation facilities. Based on the interview, the psychologist explained that all students with special needs are always monitored for sensory, motoric, and cognitive development during each term. Parents of each student have the right to consult with a psychologist at any time. The head of the Individualized Education Program (IEP), on the other hand, also explained that every student with special needs has a special session every week to support their development outside of the therapy carried out by each individual. These activities include brain jogging, outings, field trips, etc. Without special therapies and support, special needs students with diverse sets of conditions may have more immediate implications on language and learning, which could later have a variety of repercussions on behaviour and independent living, which may typically affect students in their early years (Lindly et al., 2022).

CONCLUSION

This study successfully analysed differences in students' science mental states among regular, grey, and special needs students. Statistical analysis showed significant differences, particularly in external mental representation. Regular and special needs students found experiments engaging, while grey students struggled to express what interested them. Regular students cited memorisation as a challenge; grey students tended to avoid experiments and special needs students provided unrelated responses regarding their disinterest. These findings highlight the need for tailored instructional strategies to support diverse learning needs. Educators can use these insights to create more inclusive science learning environments, while policymakers can develop frameworks that address subject-specific challenges in inclusive education. Future research should consider a larger and more diverse sample, including deeper insights into special needs students, to ensure more accurate and comprehensive results. Expanding the study to different cultural and geographic contexts could further reveal universal and context-specific trends in inclusive science education.

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