

STEM TEACHER STRATEGIES FOR THE LITERACY OF ENGLISH LANGUAGE LEARNER

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Abstract

Teachers have a responsibility to help students who are not yet fluent in English in learning the language while they are enrolled in lessons. Researchers examined at how English language learners' academic progress could be benefited by STEM knowledge. Students can learn more about technology and how to use it in their daily lives with the help of STEM instructors. In addition, students who are learning to read and write in another language should take an English language course as part of their literacy curriculum. There are many different techniques and strategies that may be used to help students enhance their understanding of the concepts of STEM subjects as well as their academic English, which will help them become more proficient in the language and more confident in their ability to utilize it. Since this activity is cantered on Isaac Newton's first, second, and third laws of motion, STEM teachers can gain from these ideas.

Keywords: English Language Learners; Cultural and Linguistic Diversity; Content-Specific Teaching Methodologies; Science, Technology, Engineering, and Math (STEM) Literacy

INTRODUCTION

The increasing globalization of business and trade has led to a greater demand for individuals who are proficient in English, as it is often considered the international language of commerce (Pennycook, 2009). This has led to a rise in the number of English language teaching institutions worldwide, as individuals and organizations seek to improve their English language skills in order to be more competitive in the global marketplace (Chapple, 2015). The demand for English language instruction is particularly high in non-English speaking countries where English is not the primary language. In these countries, learning English is often seen as a way to gain access to better job opportunities, higher education, and other opportunities that are only available to English speakers (Pennycook, 2009). Additionally, the rise of English-language media, such as the internet and social media, has also contributed to the increase in demand for English language instruction. As more and more people are exposed to English-language content, they may feel compelled to learn the language in order to be able to fully understand and participate in the conversation (Shyamlee & Phil, 2012). Overall, the market-driven process of globalization has led to a growing need for English language teaching institutions worldwide, as more and more people seek to improve their English language skills in order to take advantage of the opportunities that are available in the global marketplace (Gilakjani, 2017). Due to the increasing popularity of content-based ELT approaches and the STEM-based world of the future, STEM education in English has gained importance during the past two decades. Several studies have indeed shown that many non-English speaking countries in English as a Foreign Language (EFL) settings have adopted STEM education to varying degrees by using English as a Medium of Instruction (EMI) (Han, 2015).

This is because STEM education is often seen as crucial for economic development and competitiveness, and many countries believe that by teaching STEM subjects in English, their students will be better prepared for the global workforce (Han, 2015). However, using English as a medium of instruction can present a number of challenges for students, particularly those who are not proficient in the language. These challenges include difficulties with comprehension, lack of confidence in using the language, and a lack of familiarity with the cultural and educational norms associated with STEM education. Despite these challenges, many countries have implemented policies and programs to support the use of English as a medium of instruction in STEM education. These include providing additional language support for students, training teachers in EMI methodologies, and developing educational materials that are specifically designed for EFL learners. Additionally, some studies have also shown that students in EMI STEM classrooms have better academic results and more positive attitudes towards learning STEM subjects compared to those in non-EMI classrooms. It is important to note that EMI implementation should be done considering the context and needs of the students and teachers, and not only by considering the economic benefits (Guimaraes & Kremer, 2020).

STEM education (Science, Technology, Engineering, and Mathematics) typically includes the teaching of all subjects that fall within these four areas. This often includes traditional subjects such as physics, chemistry, biology, and mathematics, as well as newer fields such as computer science and engineering. STEM education also encourages the integration of these subjects and the application of knowledge from one subject to another. STEM education also promotes problem-solving, critical thinking and creativity. It also emphasizes on the use of hands-on and inquiry-based approaches to learning. It also helps students to develop the necessary skills for future careers in STEM-related fields, and to become informed citizens who can make informed decisions about the use of technology and the application of scientific knowledge in society (Kelley & Knowles, 2016). In addition to traditional STEM subjects, some programs also include subjects such as environmental science, robotics, and digital design, and even subjects like economics and business management that have a direct correlation with STEM. It is important to note that STEM education is not just limited to high school or college students, but it is also being incorporated in primary and secondary education. This is in an effort to expose students to STEM subjects and skills at an early age and to help develop a strong foundation in these areas. By starting STEM education early, students can develop an interest and passion in these subjects at a young age, which can lead to a greater likelihood of pursuing STEM-related careers in the future. Additionally, early exposure to STEM education can also help to close the achievement gap between different student groups and to promote greater equity in access to STEM education and careers (Breiner, 2012).

METHOD

This research aims to examine the significance of STEM education and English Language Learners (ELLs) in the context of Indonesia, through the lens of content analysis. The study will review previous research on ELLs and STEM education, with a specific focus on the STEM education approach in Indonesia. The research will examine the challenges and opportunities that ELLs face in STEM education in Indonesia, as well as the policies and programs that have been implemented to support their success in these subjects. It will also investigate the use of English as a medium of instruction in STEM education in Indonesia and its impact on ELLs. The research will explore the effectiveness of different teaching methodologies, such as those that incorporate hands-on activities and inquiry-based learning, in engaging ELLs in STEM subjects. Additionally, the research will also review the available research on the socio-economic and cultural factors that may affect the success of ELLs in STEM education in

Indonesia, and suggest strategies to address these challenges. Finally, the research will include recommendations for future research on ELLs and STEM education in Indonesia and other EFL settings.

RESULTS AND DISCUSSION

Results

There is a connection between knowledge in Science, Technology, Engineering, and Math (STEM) and literacy in the English language (Rose, 2007). STEM subjects often require a high level of literacy in order to understand and use technical vocabulary and concepts, read and analyze research papers, and communicate ideas effectively. Additionally, many STEM-related careers require proficiency in English as it is the language used in international scientific and technological communication (Flores, 2011). English language literacy also plays a crucial role in supporting students in understanding and engaging with STEM subjects. ELLs (English Language Learners) may face challenges in understanding technical vocabulary and concepts, which can hinder their participation and engagement in STEM subjects. Therefore, a strong foundation in English language literacy is essential for ELLs to be able to fully participate in STEM education and to be prepared for STEM-related careers (Flores, 2011). Furthermore, STEM education often utilizes a problem-solving approach, which requires students to read, analyze, and interpret information from a variety of sources. This skillset is closely related to reading comprehension, critical thinking, and written communication, which are all essential components of English language literacy. In conclusion, while STEM education and English language literacy may seem distinct, they are interconnected and support each other. A strong foundation in both STEM knowledge and English language literacy is essential for students to fully participate and succeed in STEM education and in STEM-related careers (Flores, 2011). Many instructors, including those in STEM fields, may lack the training and experience needed to effectively support students who are learning English. These educators may not be familiar with the unique challenges that English Language Learners (ELLs) face in understanding and engaging with STEM subjects, and may not be aware of the teaching strategies and resources that can be used to support their success (Flores, 2011).. This lack of experience and expertise can lead to a number of challenges for ELLs in STEM education, including difficulties with understanding technical vocabulary and concepts, lack of engagement in class activities, and poor performance on assessments. To address this issue, professional development opportunities can be provided for educators to help them gain the knowledge and skills they need to effectively support ELLs in STEM education. This can include training on second language acquisition theories and strategies, as well as workshops on creating inclusive and culturally responsive classroom environments. Additionally, providing access to resources such as translated materials and language support services can also help to support ELLs in STEM classrooms. It is important for educators, particularly in STEM fields, to be aware of their students' language proficiency and to adapt their teaching methods to support their English language learners. Additionally, providing opportunities for bilingual and multilingual students to use their native languages in the classroom can also support their understanding and engagement in STEM subjects (Oliveira, 2019).

STEM disciplines, like any other field, require certain foundational knowledge and skills in order to be successful. These can include: Strong mathematical skills: A solid understanding of mathematical concepts and problem-solving is essential for success in STEM subjects, as it forms the foundation for many technical and scientific disciplines. Scientific literacy: Understanding the basic principles of science, including the scientific method and experimental design, is crucial for success in STEM fields (Sanches, et al 2018). Technical skills: STEM

disciplines often require specific technical skills, such as programming languages, data analysis, and laboratory techniques. Problem-solving skills: STEM disciplines often involve finding solutions to complex problems, so strong problem-solving skills are essential for success. Creativity and innovation: STEM fields often require thinking outside the box, and being able to come up with new and creative solutions to problems. Communication: STEM professionals need to be able to effectively communicate their ideas and findings to both technical and non-technical audiences. Digital literacy: STEM fields are becoming more and more dependent on technology and digital literacy, such as data analysis, coding, and use of software, is essential. Collaboration and teamwork: STEM disciplines often require collaboration and teamwork, both within and across disciplines (Siekman & Korbel, 2016). Having strong foundational knowledge and skills in these areas will help students to be more successful in STEM disciplines, and be prepared for STEM-related careers. Additionally, having a strong background in STEM education will also help students to be informed citizens who can make informed decisions about the use of technology and the application of scientific knowledge in society.

Gaining competence in both standard and colloquial English can help improve the academic performance of English Language Learners (ELLs) in STEM education. Standard English is the formal, written and spoken language used in academic and professional settings, while colloquial English is the informal, spoken language used in everyday conversation. Standard English is often required in STEM classes, as it is the language used in technical texts, scientific papers, and classroom discussions. ELLs who are proficient in standard English will be better equipped to understand and participate in class, and to engage with the technical vocabulary and concepts required in STEM subjects. Colloquial English, on the other hand, is often used in informal settings such as in conversations with classmates, teachers and other students. ELLs who are proficient in colloquial English will have an easier time building relationships and communicating with others, which can help to improve their overall engagement and participation in class. It is important to note that both types of English are important for English Language Learners, and by gaining competence in both, they will be able to improve their academic performance, and to better understand and participate in STEM education (Santau, et al, 2011). Additionally, providing opportunities for bilingual and multilingual students to use their native languages in the classroom can also support their understanding and engagement in STEM subjects.

It can be helpful to consider the many different types of language that people use in different social contexts when thinking about the process of language learning. In our daily lives, we use different types of language depending on the situation and the people we are communicating with. For example, we may use formal, standard language in a professional setting, while using more casual, colloquial language in a social setting with friends and family. Similarly, as English language learners, students may need to learn different types of English depending on the context (Santau, et al, 2011). They may need to learn standard English for academic and professional settings, while also learning colloquial English for everyday conversations and interactions. This can help to illustrate that language learning is not just about memorizing vocabulary and grammar rules, but also about understanding the social and cultural context in which the language is used. By understanding the different types of language and the situations in which they are used, students will be better equipped to navigate different social contexts, and to communicate effectively in a variety of settings. Additionally, understanding the different types of language and their usage also helps students to appreciate the diversity and richness of a language, and to use it appropriately. This helps them to be more confident in their language skills and to have a better overall learning experience (Santau, et al, 2011).

Both teachers of English as a Second Language (ESL) and teachers of native English speakers may detect similarities in their students' social and academic language development. This is because language development is a complex process that is influenced by a variety of factors, such as age, cognitive development, and social and cultural background. For example, both ESL and native English-speaking students may go through similar stages of language development, such as the early stages of vocabulary acquisition and the later stages of syntax and grammar development. Additionally, both groups of students may experience similar challenges in understanding and using academic language, such as understanding technical vocabulary and concepts and writing clear and coherent sentences. Furthermore, both groups of students may also have similar needs when it comes to language support and instruction, such as opportunities to practice and use language in authentic contexts, and explicit instruction in language skills such as reading comprehension, writing, and listening. It's important to note that while there may be similarities in the language development process, ESL students may have additional challenges due to their language proficiency and cultural background. ESL teachers may need to provide additional support and accommodations to help their students overcome these challenges. In conclusion, while there may be similarities in the language development process for ESL and native English-speaking students, ESL students may have additional challenges and needs that should be taken into consideration when providing instruction and support (Foster & Skehan, 1996).

There are already a variety of resources available to teachers that outline what to anticipate from students learning English. These resources can include:

1. Second language acquisition theories: These theories provide an understanding of the stages and processes of language development, and can help teachers anticipate what students are likely to know and be able to do at different points in their language learning journey.
2. Proficiency level descriptions: Many organizations, such as the American Council on the Teaching of Foreign Languages (ACTFL) and the Common European Framework of Reference for Languages (CEFR), provide detailed descriptions of what students at different proficiency levels can be expected to know and be able to do.
3. Curricular materials: Many curriculum materials, such as textbooks and lesson plans, include detailed information about what students should know and be able to do at different stages of their language learning.
4. Professional development opportunities: Teachers can also attend professional development workshops, webinars and conferences that provide information on what to anticipate from students learning English.
5. Online resources: There are a variety of online resources available such as blogs, articles, and websites that provide information and strategies for teaching English language learners (Jefferies & Hussain, 1998).

By using these resources, teachers can gain a better understanding of what to anticipate from students learning English, and can plan instructions and assessments accordingly. Additionally, by being aware of the language proficiency level of their students, teachers can make adjustments in their teaching methods and materials that would best support the language development of their students.

STEM educators are aware that the material they teach must have some kind of tangible application in the world around them. This is because STEM education focuses on the teaching of Science, Technology, Engineering, and Mathematics, which are subjects that are closely linked to the real world and have direct applications in society. For example, science education must include the understanding of natural phenomena, and how it relates to the world around us. Technology education must include an understanding of how technology is used in different

fields and its impact on society. Engineering education must include how to design and create solutions to real-world problems. Mathematics education must include how math is used in different fields and how it can be used to model real-world situations.

By connecting the materials they teach to real-world applications, STEM educators can help students to see the relevance and importance of what they are learning, and to develop the skills and knowledge needed to be active and informed citizens. Additionally, by making connections to the real world, STEM education can also become more engaging and motivating for students, and can increase their interest in STEM fields. Overall, STEM educators are aware that connecting the material they teach to real-world applications is essential for student engagement, understanding and motivation in STEM subjects, as well as preparing them for STEM-related careers.

One approach to teaching English to speakers of other languages (ESOL) is to "teach backwards" by beginning each class with an experiment. This approach involves starting a class with a hands-on activity or experiment that relates to the lesson's content, and then using the experiment as a springboard for language instruction. By starting with an experiment, teachers can create an engaging and interactive learning experience for students, as well as provide a meaningful context for the language instruction that follows. This approach can help students to actively engage with the content and to see the relevance and importance of what they are learning. Additionally, by starting with an experiment, teachers can also provide students with the opportunity to use English in a meaningful and authentic context. For example, students may use English to discuss experiments, ask questions, and make predictions. This can help build students' confidence in using English and develop their language skills.

It is important to note that while this approach can be effective, it should be used in conjunction with other methods and strategies that support language development. Additionally, teachers should also consider their students' language proficiency levels and adapt the experiment accordingly, as well as ensure that students are provided with the necessary linguistic support for the task. In conclusion, "teaching backwards" by beginning each class with an experiment can be an effective approach to teaching English to speakers of other languages, as it provides an engaging and interactive learning experience and provides students with the opportunity to use English in a meaningful and authentic context.

Enhancing students' capabilities in developing their vocabularies is essential for their academic success and language development. Here are some strategies that teachers can use to support students in developing their vocabulary:

Provide explicit vocabulary instructions:

1. This can include teaching word meanings, word relationships, and word-learning strategies.
2. Use a variety of techniques to teach vocabulary, such as word maps, flashcards, and interactive games.
3. Incorporate vocabulary instruction into content-area instruction: This can include teaching academic and technical vocabulary that is specific to a content area.
4. Provide opportunities for students to use new vocabulary in context: This can include using new vocabulary in writing and speaking activities, and in small group and whole-class discussions.
5. Encourage students to read widely: This can include providing access to a variety of texts that are at an appropriate reading level for students, and encouraging them to read for pleasure.

6. Use technology to support vocabulary development: This can include using online resources such as vocabulary games, quizzes, and interactive activities to support vocabulary development.
7. Create a language-rich environment in the classroom: This can include using a wide range of vocabulary and concepts in classroom instruction and activities, and encouraging students to use new vocabulary in their speech and writing.
8. Provide feedback on students' vocabulary use: This can include providing students with feedback on the accuracy and appropriateness of the vocabulary they use in their speech and writing.

By implementing these strategies, teachers can help students to develop their vocabularies, which will support their academic success and language development. It is important to note that teachers should also consider students' language proficiency level and adapt the strategies accordingly.

The concept of taking into account all three levels of vocabulary (receptive, productive, and interactive) may seem unnecessary to instructors who are not trained in language acquisition, but it is important to consider the potential impact on students' language development and academic success (Chien, 2015). Receptive vocabulary refers to the words that students understand when they hear or read them. Productive vocabulary refers to the words that students can use when speaking or writing. Interactive vocabulary refers to words that students can understand and use in conversation.

Consider a scenario where an instructor is teaching a science lesson to English Language Learners (ELLs) and only focuses on receptive vocabulary. In this case, the students may be able to understand the scientific terms and concepts presented in the lesson, but they may struggle to participate in class discussions or to explain their understanding in writing. By not considering the other levels of vocabulary, the students may miss important opportunities to develop their language skills and to fully engage with the content (Chien, 2015)..

An example of how vocabulary relating to STEM subjects ought to be used is through the integration of STEM-related vocabulary into the curriculum and instruction. This can be done in a variety of ways, such as:

1. Incorporating STEM-related vocabulary into content-area instruction: This can include teaching technical and academic vocabulary that is specific to a STEM subject, such as scientific terms, mathematical symbols and engineering concepts.
2. Using STEM-related vocabulary in real-world context: This can include using STEM-related vocabulary in hands-on activities, experiments, and projects that relate to real-world problems and applications.
3. Providing opportunities for students to use STEM-related vocabulary in different interactions: This can include using STEM-related vocabulary in writing, speaking, and listening activities, and in small group and whole-class discussions.
4. Creating a language-rich environment in the classroom: This can include using a wide range of STEM-related vocabulary and concepts in classroom instruction and activities, and encouraging students to use new vocabulary in their speech and writing.

By using STEM-related vocabulary in this way, students can see the relevance and importance of the vocabulary they are learning, and understand how it is used in the real world. Additionally, by using STEM-related vocabulary in different interactions, students can practice using the vocabulary in a variety of contexts, which can help solidify their understanding and retention of the vocabulary. It's important to note that while incorporating STEM-related vocabulary into instruction, teachers should also consider the students' language proficiency

level and adapt the instruction accordingly, as well as ensure that students are provided with the necessary linguistic support for the task.

Increasing students' opportunities to communicate with one another is an effective way to foster language production and support language development.

1. Collaborative Learning: Collaborative learning activities such as group discussions, debates, and project-based learning can provide opportunities for students to communicate with one another and to practice using language in a social context.
2. Pair Work: Pair work activities such as partner conversations, interviews, and role-plays can provide opportunities for students to communicate with a peer and to practice using language in a supportive and less intimidating environment.
3. Cooperative Learning: Cooperative learning activities such as jigsaw, think-pair-share and group problem solving can provide opportunities for students to communicate with one another and to collaborate on a task or project.
4. Use of Technology: Technology tools such as discussion boards, video conferencing, and virtual reality can provide opportunities for students to communicate with one another and to practice using language in a digital context.
5. Authentic Communication: Providing opportunities for students to use language in authentic situations, such as community service projects, field trips, and guest speaker events, can help to increase students' motivation to communicate and to use language in real-world contexts.

By providing these opportunities to communicate, teachers can create a supportive and inclusive learning environment for students to practice using language in a variety of contexts and to develop their language skills. Additionally, by providing opportunities for students to communicate with one another, teachers can also help students to develop their social and communication skills, which are essential for success in academic and professional settings. Making use of a variety of different grouping strategies according to the task at hand is an effective way to support student learning and development. It allows teachers to adapt their instruction to the specific needs of their students and the task at hand. Here are some examples of different grouping strategies that teachers can use:

1. Whole-class instruction: This strategy is used when the teacher is introducing new content or skills to the entire class.
2. Small-group instruction: This strategy is used when the teacher is providing targeted instruction to a small group of students with similar needs.
3. Peer-tutoring: This strategy is used when students work in pairs or small groups to support one another's learning.
4. Cooperative learning groups: This strategy is used when students work in small groups to achieve a common goal or complete a task.
5. Flexible grouping: This strategy is used when the teacher changes the groupings of students based on their needs or the task at hand.
6. Station Teaching: This strategy is used when students rotate through different centers, each with a different task or activity.
7. Project-based learning: This strategy is used when students work in small groups to complete a project or presentation on a topic of their choice.
8. Flipped Classroom: This strategy is used when students watch videos or read materials at home and do homework in class.

9. By using a variety of different grouping strategies, teachers can provide opportunities for students to learn in different ways and to work with different students, which can foster a more inclusive and effective learning environment.

It's important to note that while using different grouping strategies, teachers should consider the students' language proficiency level and adapt the instruction accordingly, as well as ensure that students are provided with the necessary linguistic support for the task. There are several lenses through which we might examine the learning of students. Some of the common lenses include:

1. Cognitive lens: This lens focuses on the mental processes and strategies that students use to acquire, process and retain information. It examines how students think, reason, and solve problems.
2. Affective lens: This lens focuses on the emotional and motivational aspects of learning. It examines how students' attitudes, values, and beliefs affect their learning.
3. Behavioral lens: This lens focuses on the observable actions and reactions of students. It examines how students' behavior is affected by the learning environment and the teaching strategies used.
4. Social lens: This lens focuses on the social interactions and relationships that influence students' learning. It examines how students learn through collaboration, communication and cooperation with their peers and teachers.
5. Cultural lens: This lens focuses on the cultural background and experiences of students. It examines how students' cultural backgrounds and experiences shape their learning and how teachers can incorporate students' culture into the instruction.
6. Technological lens: This lens focuses on the use of technology to support student learning and how technology is integrated into the instruction.

Each lens provides a different perspective on the learning process, and by using multiple lenses, we can gain a more comprehensive understanding of student learning. The fact that children in the classroom are bilingual is becoming more common as the world becomes increasingly globalized and diverse. Bilingualism can have a number of benefits for children, including:

1. Improved cognitive development: Studies have shown that bilingual children have superior cognitive abilities, such as problem solving, multitasking, and abstract reasoning.
2. Enhanced academic performance: Bilingual children often have better academic performance, particularly in reading and math, than monolingual children.
3. Increased cultural awareness and empathy: Bilingual children often have greater cultural awareness and empathy, which can help them better understand and appreciate the diversity of the world around them.
4. Improved language skills: Bilingual children often have stronger language skills in both their languages, which can be beneficial for communication and learning.
5. Better job opportunities and career advancement: Bilingualism is an asset in today's globalized job market and can open up more job opportunities and career advancement for bilinguals.

It's important to note that, while bilingualism can have many benefits, it is important that bilingual children have access to appropriate education and support in order to fully develop their language skills and reach their full potential.

CONCLUSION

In conclusion, guidance for teachers in teaching English Language Learners (ELLs) in STEM education can be improved by considering the following points:

1. Emphasizing the importance of students gaining competence in both standard and colloquial English to improve their academic performance.
2. Making use of the resources that are available to teachers that outline what to anticipate from students learning English.
3. Realizing that the linguistic assistance that teachers provide to students who are learning English is also helpful to students who are not learning English.
4. Constructing a new understanding of the background, culture, and experiences of ELLs to better support their learning and development.
5. Enhancing students' capabilities in developing their vocabulary through different strategies and techniques.
6. Providing an example of how the vocabulary relating to STEM subjects ought to be used, including incorporation into the curriculum, real-world context, and different interactions.
7. Increasing students' opportunities to communicate with one another in order to foster language production, through collaborative learning, pair work, cooperative learning, use of technology, and authentic communication.
8. Making use of a variety of different grouping strategies according to the task at hand, to better support student learning and development.
9. Bridging the gap between what is known about ELLs and effective teaching practices, and what is actually being done in the classroom.
10. Encouraging teachers to reflect on their teaching practices, and make adjustments as needed to better support ELLs' learning and development in STEM education.

By considering these points, teachers can improve their guidance and support for ELLs in STEM education, which can lead to improved academic performance, language development, and overall success for ELLs.

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