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Traffic Light Tiered Assessment: Examples from STEM

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Abstract

With rapid changes in the world, educational systems for the 21st century need to adapt by not just teaching any subjects by utilizing any approaches to students. The significant changes affect school curricula, which require more inclusive and diverse approaches for students. Based on these changes, and additionally, in reviewing the results of PISA (OECD, 2018) and TIMSS; OECD Future of Education and Skills 2030: OECD Learning Compass 2030 (OECD, 2019); Bahrain SDGs 2030; and 2022 CAEP standards, teachers should know how students differ in their approaches to learning and create instructional opportunities to provide equitable and inclusive learning experiences for all students. The authors are inspired to develop a traffic light colored tiered assessment in STEM using traffic light colors: green (tier 1), yellow (tier 2), and red (tier 3). In this study, we reviewed several types of tiered assessment integration in different fields such as math and science, to develop a model for tiered assessment using traffic light colors in STEM, in accordance with the available models and practices in different fields. In this paper, the traffic light colored tiered assessment provides some examples in the STEM curriculum as a guide to help further developments of these kinds of questions. Additionally, this paper attempts to provide guidance on how to write traffic-colored tiered questions in STEM to demonstrate how students can be inclusive in assessment. Furthermore, this paper recommends increasing the number of traffic light-colored tiered assessments in STEM to support classes in being more inclusive and differentiated.

INTRODUCTION

The 21st century educational systems need to adapt to the rapid changes happening in the world. It is no longer sufficient to teach subjects to students using any methodology. The significant changes in society also mean that educational curricula should be more inclusive and diverse, requiring teachers to have a broader understanding (OECD, 2019). To ensure equitable and inclusive learning experiences for all students, teachers should be aware of the differences in students' learning styles and employ differentiated instruction strategies. This means recognizing that some students may be exceptional learners, such as those who are gifted, have learning difficulties, or have physical or mental disabilities. Differentiated Instruction (DI) provides a framework for addressing diverse student needs by adapting teaching methods. Within this context, tiered assessment emerges as a practical approach to differentiate

evaluation based on students' varying levels of readiness, interests, and learning profiles. This study develops a model for tiered assessment using traffic light colors in STEM education, integrating DI principles to enhance student engagement and learning outcomes. According to Tomlinson (2001, p. 3),

"Differentiated instruction is a teaching philosophy based on the premise that teachers should adapt instruction to student differences. Rather than marching students through the curriculum lockstep, teachers should modify their instruction to meet students' varying readiness levels, learning preferences, and interests. Therefore, the teacher proactively plans a variety of ways to 'get at' and express learning."

Differentiated instruction does not mean that students will learn different content. Although students can learn in different ways, such as through visual learning, the main skills and content they learn will be the same. In other words, students can take different pathways to reach the same destination (Tomlinson, 2001). Students are motivated to learn through a variety of teaching strategies that are tailored to their interests, needs, and skills. This allows them to acquire knowledge and communicate their learning in different ways (Al-Shaboul, Al-Azaizah, & Al-Dosari, 2021). Numerous studies have shown that this approach boosts students' motivation and achievement, enhances their performance, fosters their creativity, and improves the quality of education (Al-Shaboul, Al-Azaizah, & Al-Dosari, 2021; Herner-Patnode & Lee, 2021; Koeze, 2007; Mavidou & Kakana, 2019). Furthermore, differentiated instruction has a significant impact on students' critical thinking, communication skills, attitudes, and problem-solving abilities (Al-Shaboul, Al-Azaizah, & Al-Dosari, 2021; Mizell, 2010; Morgan, 2014; Idrus, Asri, & Baharom, 2021). Based on the literature and our teaching experiences, differentiated instruction has a positive impact on teaching and learning. So, the question arises: how can instruction be differentiated? Tomlinson (1999) answers this question by stating that teachers can differentiate the learning environment, content, process, and product based on students' readiness, interests, and learning profiles. Even though students may be the same age, they have different levels of readiness, interests, and learning styles, as they come from diverse backgrounds and have different experiences and socioeconomic statuses (Ginja & Chen, 2020).

The following is a description of the essential components of differentiated education.

Key Elements of Differentiated Instruction

Differentiated instruction consists of four components: content, method, product, and learning environment, all of which can be tailored to meet individual student needs. Teachers have the ability to differentiate instruction through content, process, product, and learning environment based on a student's readiness, interests, and learning profile, as depicted in Figure 1. The following sections will provide a detailed description of each component.

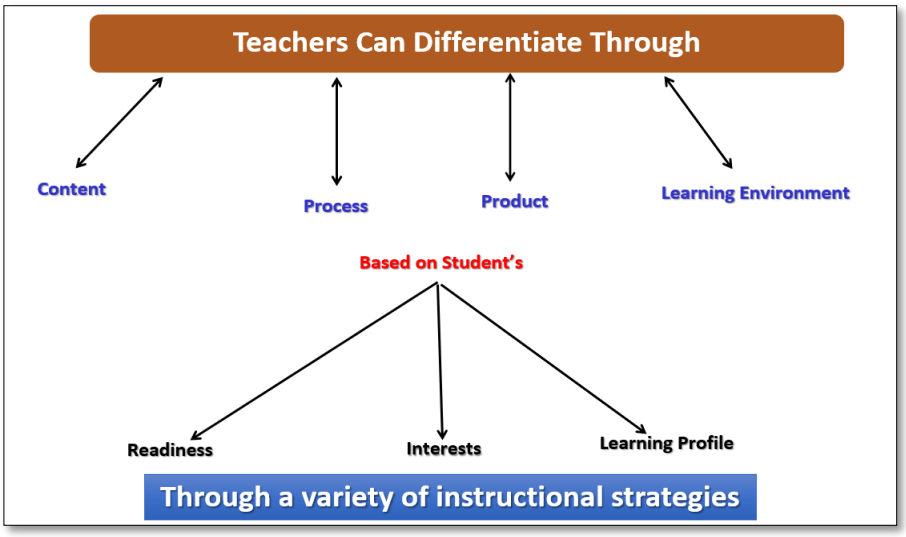


Figure 1. Differentiation process

Content

Content refers to the knowledge, understanding, and skills (KUD) that students must acquire (Tomlinson & Imbeau, 2010). In other words, it is related to what students will learn and the materials that represent the learning. It is important to note that learning objectives for the content will be the same. What will be differentiated are the methods that students use to comprehend the topic. For example, students may use multiple textbooks, articles, supplementary resources, varied online resources such as computer simulations, and varied visual resources such as videos, animations, and pictures. Teachers offer suitable scaffolding when working with content to address the needs of each student, as some students may require more support. For instance, teachers can provide certain students with the opportunity to learn the required material, allow more advanced students to skip ahead in class, or modify the course material for specific students according to their individual levels (Tomlinson & Imbeau, 2010).

For example, students can acquire knowledge about atoms in physics or chemistry courses by observing teachers' demonstrations, engaging in small group discussions, using videos and visuals, and utilizing computer simulations. As seen, the content is the same, but tools are differentiated to ensure all levels of students can comprehend the topic of atoms. Some students may learn best through watching videos, while others may prefer listening to the teacher.

Process

According to Tomlinson (2014), "process describes activities designed to ensure that students use key skills to make sense of, apply, and transfer essential knowledge and understandings" (p.18). Differentiating the process involves practicing the content. When teachers differentiate the process, they teach the same concept or skill in a way that allows each student to understand it. Therefore, teachers should provide a variety of activities for students to comprehend the concepts or acquire the skills. They can determine the best approach based on their students' readiness levels, interests, or learning profiles. For example, some students may prefer working with technology, such as computer simulations that are compatible with mobile devices. These students can use their smartphones or tablets to complete activities. Others may prefer hands-on or minds-on activities. Teachers can group students or assign individual tasks based on these preferences. To illustrate, during a lesson on length, area, and weight, teachers can create different tiered groups based on students' interests. In this activity,

students choose their groups and then begin the task. They are instructed to find 10 items in the classroom. The first group finds the length of the items, the second group finds the area, and the third group finds the weight. All groups create a table to present their findings.

Product

According to Tomlinson (2014), "products are vehicles through which students demonstrate and extend what they have learned" (p.18). Products allow students to demonstrate whether they have learned the key concepts and skills in a course and to apply what they have learned to solve problems. Different students can create different products based on their readiness levels, interests, and learning preferences (Tomlinson, 2001). Students should have a variety of products to demonstrate mastery of their learning. Additionally, students can work alone, in small groups, or in pairs on their prouducts. Of course, the products should be related to real-life problems. The products should not be used just for summarizing concepts or ideas, but they should encourage students to analyze and synthesize.

Tiered assignments, tiered assessments, lab experiments/activities with reports, and computer simulation activities with activity worksheets can be examples of products (Hogan, 2009; Lewis & Batts, 2005; Pozas et al., 2020). Moreover, 3D models and project work provide opportunities for students to work on different ideas that relate to the curriculum objectives. When working in groups, each group will produce a different model or project that addresses the same content but has different products that demonstrate their comprehension. When differentiating by product, teachers give students options to demonstrate what they've learned (Wormeli, R., 2023). For example, after finishing Newton’s laws of motion, some students may be able to show their learning by completing a worksheet while working on computer simulations about Newton's laws of motion. However, other students may prefer to demonstrate their learning through creating a PowerPoint presentation with videos, animations, or pictures, or by applying Newton’s laws of motion to real-life scenarios. Product is one of the key elements that we will focus on in this paper to create several traffic light-colored, tiered assessments in STEM.

Learning Environment

Students come to class with different emotions and feelings, which are created by their past experiences and their reactions to their current experiences (Mänty et al., 2020). These emotions and feelings influence how students view themselves and their motivation to learn and collaborate with their peers. As a result, all of these factors play a crucial role in students' learning process (Boekaerts, 2010). For example, we differentiate based on students' emotions and feelings when we provide alternative options for shy students who do not like to work in groups (Tomlinson & Imbeau, 2023). Another example is when we need to modify the learning environment for students who have difficulty sitting still for a certain amount of time. We should make it possible for them to move around the room to help them concentrate on their tasks. Additionally, some students cannot handle noise during classes or while working in groups, even in their own homes. In these cases, we should provide alternative options such as earplugs or an iPod with music, as some students find it helpful to complete tasks while listening to music.

Differentiation Based on Students’ Readiness, Interests, and Learning Profile

Teachers can differentiate content, process, product, and learning environment. However, how can teachers differentiate? Based on what? These four key elements can be differentiated by students' readiness, interests, and learning profiles. The following sections provide answers to these questions.

Readiness

According to Tomlinson (2014), "Readiness is a student's entry point relative to particular knowledge, understanding, or skills" (p.18). Teachers are required to differentiate based on students' readiness levels to evaluate prior knowledge, ascertain what students know, and determine their level of proficiency (Tomlinson, 2001). Once a teacher has this information about students' readiness - through questionnaires or diagnostic tests - they can use it to differentiate content, process, or product (Tomlinson, 2001). If students have lower readiness, they need more assistance, practice opportunities, and structured guidance for activities (Tomlinson, 1999). On the other hand, students with advanced readiness often need less practice and can handle more challenging and abstract tasks. They do not require scaffolding and support (Tomlinson, 1999). For example, in mathematics, students who have mastered the basic operations on whole numbers will find it easier to learn basic operations on integers, while students who struggle with multiplication and division of whole numbers might require more support and guidance during class activities to learn basic operations on integers.

Interests

Interest is related to one's preferences and curiosity; it can pertain to a specific subject or a broader topic (Tomlinson, 1999). Teachers can capture students' attention and involve them in class by incorporating their interests (Tomlinson, 2001), as students enjoy working on subjects that interest them. Teachers can offer examples that align with students' interests. For instance, if some students are particularly intrigued by driving and cars, teachers can provide examples related to driving cars in rainy conditions while teaching about force and friction.

Learning Profile

Learning style preferences, intelligence preferences, and preferences for group size, culture, and gender can all have an impact on students' learning profiles (Tomlinson, 2001). Learning styles refer to the various ways in which students learn. A student's preferred method of comprehending, processing, comprehending, and retaining information is known as their learning style, such as visual learners or auditory learners. Intelligence preferences are outlined by Howard Gardner (1983). According to him, each student may have different intelligence, so lessons should incorporate various intelligence activities. For instance, for linguistic intelligence, teachers can utilize storytelling or word games. Grouping preferences (working alone or with others) and gender preferences are related to the social aspect of learning and the disparities in learning between males and females (Koehler, 2010). Additionally, culture impacts students' learning. In order to identify students' learning profiles, all aspects of the learning profile should be taken into account by using questionnaires such as MI and VARK surveys.

Why Tiered Assessment?

Instruction is derived from assessment. Assessment occurs at the beginning, throughout, and at the end of the unit. Pre-assessment, formative assessment, and summative assessment are regular components of the teaching and learning cycle. Assessment helps the teacher/instructor plan for the next class and understand the progress of the diverse student population. It is an integral part of instruction, and differentiated assessment can inform instructional decisions and show student progress (Mohammad & Kaur, 2014). Assessment should be inclusive of all students, including low achievers and high achievers. It should not be a one-size-fits-all approach, but rather differentiated to match students' readiness, interests, and learning profiles.

Tomlinson (1995) suggests that in a heterogeneous classroom, teachers use tiered assignments to meet the various needs of their students. Tiering assessments is particularly helpful when teachers want to ensure that students with different levels of learning proficiency are working with the same core concepts and essential knowledge and skills. In other words, tiering assessment is based on a readiness-based strategy. Readiness refers to knowing where students are in their learning journey, recognizing their current knowledge and skills. For example, a student struggling with abstract concepts in science or abstract thinking still needs to grasp important concepts and principles in a given question, phenomena, or situation. On the other hand, a student who is well advanced beyond grade expectations in the same subject needs to be challenged and engaged at a higher level when working with the same essential content. Therefore, a one-size-fits-all assessment is unlikely to benefit struggling or high-level students in comprehending key concepts. By using tiered assessments that vary in complexity, abstractness, open-endedness, and independence, all students can focus on fundamental knowledge, understanding, and skills. The teacher increases the likelihood that each student will achieve important skills and understanding by maintaining the assessment's focus and offering varying degrees of difficulty.

Tiered instruction and activities provide an effective way to address the different levels of students while building on and deepening fundamental skills and knowledge. This has been found to support better student performance across subjects (Galloway, 2018; Suarez, 2007). Studies have shown that when students have good performance in tier 1, they will need less extra support and instruction in tiers 2 and 3 (Galloway, 2018). This approach focuses on the necessary skills for students to achieve mastery while allowing them to set higher goals to reach more complex levels of mastery, and as they are exposed to different tiers, students can develop a complex set of skills ranging from memorization to designing, analyzing, reasoning, and justification; in addition to its positive impact on students' understanding and achievement, using tiered assessments also supports their emotional development by empowering them to make their own choices, which boosts their confidence and autonomy in the learning process, further motivating them to tackle more challenging tasks and enhancing their sense of being addressed by the teacher in terms of their needs and interests, further elevating their motivation and confidence (Suarez, 2007). This approach focuses on the necessary skills for students to achieve mastery while allowing them to set higher goals to reach more complex levels of mastery, and as they are exposed to different tiers, students can develop a complex set of skills ranging from memorization to designing, analyzing, reasoning, and justification; in addition to its positive impact on students' understanding and achievement, using tiered assessments also supports their emotional development by empowering them to make their own choices, which boosts their confidence and autonomy in the learning process, further motivating them to tackle more challenging tasks and enhancing their sense of being addressed by the teacher in terms of their needs and interests, further elevating their motivation and confidence (Suarez, 2007).

Furthermore, the usage of tiered assessments and tasks can positively impact teachers, who feel that they are meeting their students' needs while addressing curriculum standards and allowing for deeper learning (Suarez, 2007). When teachers design tiered assessments, they feel more confident in challenging their students' needs while providing opportunities for success in achieving and exceeding the standards (Levy, 2008; Suarez, 2007).

Three-tiered assessment is found to be more reliable than two-tiered and one-tiered assessments in determining students' comprehension and lack of knowledge, and it can effectively highlight students' alternative conceptions, especially when using open-ended questions; it serves as an effective tool for educators to assess prior-to and post-instruction,

allowing them to effectively plan and teach different concepts (Cetin-Dindar & Geban, 2011). Considering these benefits, traffic light-colored tiered assessment can be advantageous for both teachers and students.

Colored Tiered Assessment

"The term traffic light refers to an automatically turned-on colored light that helps control traffic" (Munna 2021), meaning traffic light colors can be used for tiered assessments and activities. It has been shown that the use of color in educational materials is important for evoking a range of emotions and grabbing students' attention (Chang, Xu & Watt, 2018). With the aid of color, students may pay more attention to specific information, which increases the likelihood that the information will be retained in long-term and short-term memory (Dzulkifli & Mustafar 2013). For instance, warm colors like red, orange, and yellow have been identified as the best colors to draw students' attention and encourage their active involvement in lessons (Wilson 1966). In other words, cool colors (such as green, blue, and purple) soothe, and warm colors (such as red, orange, yellow) stimulate (Clarke & Costall 2008). Furthermore, due to earlier color experiences or presumptions about colors connected to cultural norms and life events, learners may interpret colors differently. On the other hand, traffic light colors have the same meaning worldwide. Green color: the driver can start driving or keep driving; Yellow color: the signal is about to turn red, and the driver needs to be prepared; Red: the driver has to stop. Therefore, these colors can be used for differentiated assessment for different cultures too. Green, yellow, and red colors have the following meanings similar to traffic light colors as seen in Table 1. In traffic lights, green means go or pass (no stress); yellow means be careful and maintain your attention in case red lights turn on; red means stop (need to be on alert). In actual traffic light usage, yellow also transitions from red to green, this role is utilized in our tiered assessment model to maintain a clear and straightforward progression of difficulty and vice versa.

Traffic lights are helpful because they assist in the development of students' self-reflection skills. They serve as an excellent tool for creating personal development plans that enable students to actively engage and participate based on their individual abilities and knowledge. The traffic light model encourages self-learning responsibility, which is crucial for cognitive and emotional growth, and promotes a proactive learning culture (Munna, 2021).

Table 1. Meanings of green, yellow, and red colors (adapted from psychology of colors, 2020)

GREEN	YELLOW	RED
Enhance focus Create calmness Improve memory Relieve stress	Encourage creativity Maintain attention Create positive feelings Boost mood Increase joy	Encourage creativity Inspire action Grab attention Increase alertness

In terms of tiered assessment, a question will have three levels. The first level is the green level, in which students will be calm and not feel any stress because the problem-solving tasks and questions are very basic and appropriate for this level. The use of the color green has been found to be physically relaxing and encourages positive feelings of calmness and comfort (Kexiu, et al., 2021). At this level, students' success depends on their understanding and application of the required basic knowledge and skills. They can easily focus, and this level can

make them feel confident in their ability to solve the problem and pass this question. Green level problems fulfill a thorough grade level proficiency standard.

The second level is the yellow level. At this level, students need to be creative and attentive. They will feel positive and joyful because they have already solved the problem/question at the green level. The color yellow has been found to increase motivation and intellectual activity (Al-Ayash, et al., 2016). Furthermore, students often report feeling more relaxed, cheerful, and alert when exposed to the color yellow (Al-Ayash, et al., 2016). Problem/question solving tasks are advanced and complex, though not as much as at the red level. Students' success depends on applying and expanding their skills to solve complex question or problems.

The third level is the red level. Students need to be more creative, have inspiration, pay more attention, and be more alert to be able to solve the problem/question at this level. Some students might become anxious at this level and pause for some time because problem/question-solving tasks are advanced and complex. Students' success depends on their ability to apply their creativity and extend their skills.

In general, the colors green, blue, and black are used for differentiated assessments or activities. Green (low level), blue (middle level), and black (high level) are used for tiered assessment (Suarez, 2007). However, we propose using traffic light colors because they are more attractive, attention-grabbing, and relatable to students' daily lives, as explained above.

Designing Traffic Colored Tiered Assessment (product)

The following questions in STEM are designed based on a differentiation framework using traffic-light-colored tiered questioning. In some questions, it may not be possible to integrate all subjects of STEM; sometimes only math and science or science and technology. As mentioned above, we will use the color green for the low level, yellow for the middle level, and red for the high level. Teachers can decide on the distribution of points for each level question. For example, let's consider question 1 on page 8: Teachers can assign points to each level according to the level of complexity (see example in Table 2). If a question is harder, it will receive more points. Of course, partial credits can also be used for grading. On the other hand, sometimes it is better to do the opposite because it can improve struggling students' motivation. They can feel that they have competence and can develop themselves more, which can lead to positive attitudes towards the subject matter.

Table 2. Point distribution example for question 1

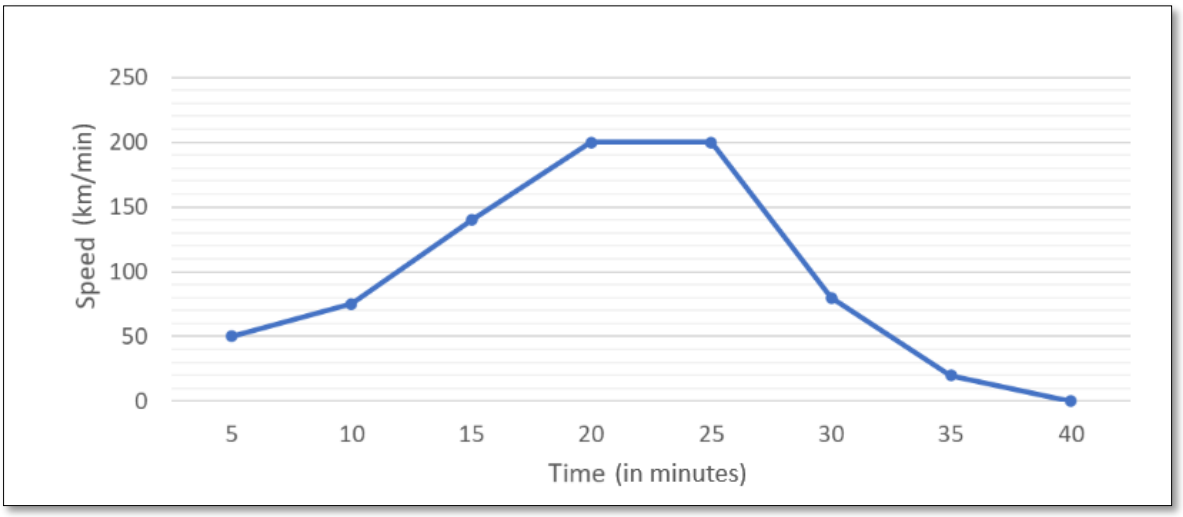
Total	Green	Yellow	Red
12	3.5	4	4.5
12	4.5	4	3.5

There is a misunderstanding among teachers who are not very familiar with tiered assessment. They think that students should choose one of the questions, such as a green level or a red level. However, tiered assessment requires students to answer all questions at different levels. Another important point is that teachers should not administer these questions separately.

They should be a part of a series of regular questions. For example, Question 1 (not tiered), Question 2 (tiered), Question 3 (not tiered).

Question 1 (Math, Science, Technology)

Your sister and you are coming home from shopping, and you have a physics exam tomorrow. You want your sister to help you study topics and practice a couple of questions together. You are driving, and your sister is sitting in the car. She decides to start helping you by pulling out her tablet and opening the "numbers" app to record data during your road trip. Based on the data, she then creates a nice graph for you to practice some questions.



Green	**When did the car reach the speed of 50km/min?**
Yellow	**What is the time interval where speed is positive?**
Red	**When did the car acceleration reach zero? Justify your answer.**

We provide detailed examples from STEM activities to demonstrate the practical application of traffic light-colored tiered assessments in STEM education. For instance, in a physics lesson on motion, a tiered assessment might include:

- Green Level: Basic questions assessing fundamental concepts (e.g., 'When did the car reach a speed of 50 km/h?')
- Yellow Level: Intermediate questions requiring deeper understanding and application (e.g., 'What is the time interval where the speed is positive?')
- Red Level: Advanced questions involving critical thinking and problem-solving (e.g., 'When did the car acceleration reach zero? Justify your answer.')

These tiered questions not only assess different levels of understanding but also encourage students to engage with STEM concepts at varying degrees of complexity, thereby supporting differentiated learning and assessment.

Question 2 (Math, Science, Technology)

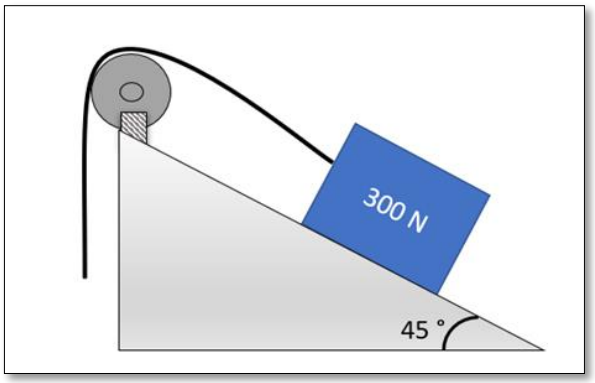
One month ago, you conducted an activity with plants in the science lab. You exposed mint and coriander seeds to red and blue lights. Each week, you measured the length of the plants using the "measure" app on your smartphone. You recorded all the data in your tablet using the "numbers" app, as shown in the table below. The table displays the length of 2 mint plants and 2 coriander plants that were placed under red and blue light for 3 weeks.

length / plant	Mint plant		Coriander plants	
	Red light	Blue light	Red light	Blue light
1 week	4 cm	4.5 cm	3 cm	3.4 cm
2 weeks	5 cm	6 cm	4.1 cm	5.3 cm
3 weeks	6 cm	8 cm	5.1 cm	8.5 cm

Green	Which plant grew more in 3 weeks?
Yellow	Specify the dependent, independent and control variables in this experiment.
Red	Draw the best graph to represent the changes in the plants.

Question 3 (Math, Science, Engineering)

You have a box filled with your old books that weighs 300 N. You want to create a pulley system on an inclined plane to transport the box to a higher level in your home using a rope and a pulley. After obtaining all the necessary materials, you have successfully designed the pulley system on the inclined plane (please refer to the figure below). While working on this project, your sister asked for your assistance with her physics exam. Since you are already immersed in physics due to designing the system, you decided to ask your sister questions to help her practice for her exam.



Green	**What are the forces acting on the box in the system? Please show them in the figure.**
Yellow	**How much force is needed to move the box? Please show all your work.**
Red	**How can you design a system that can carry the box with less force? Please draw it and justify your answer.**

The activities carried out in this study were designed to create a practical framework for implementing traffic light-colored tiered assessments in STEM education. The activities included:

We developed a series of tiered questions across different STEM subjects. These questions were categorized into three levels (green, yellow, and red) to align with the traffic light metaphor. Each level of questions was designed to address varying degrees of complexity and cognitive demand, ensuring that students at different levels of understanding could engage with the material meaningfully. The tiered questions were used in a classroom setting during a post-graduate course. Teachers were provided with training on how to administer these questions and collect feedback from students. The feedback was used to refine the questions and ensure they were appropriately challenging and accessible.

One of the authors conducted a teaching session with participating teachers to discuss the implementation process, share best practices, and address any challenges encountered. This session was instrumental in refining the approach and ensuring that teachers felt supported throughout the implementation. These practical steps could be implemented to effectively develop traffic light-colored tiered assessments in STEM education.

DISCUSSION AND RECOMMENDATIONS

This paper aims to provide examples of traffic light-colored tiered questions for students at various grade levels that incorporate all the components of STEM education. This approach emphasizes the importance of differentiation and the theoretical framework of tiered assessment. Despite its many advantages in building students' fundamental skills and allowing for more complex thinking (Richards & Omdal, 2007). This paper focused on creating tiered assessment tasks that align with STEM education principles. STEM education emphasizes the integration of science, technology, engineering, and mathematics to prepare students for the challenges of the modern world. Our tiered questions are designed to promote critical thinking, problem-solving, and application of interdisciplinary knowledge.

For instance, in the plant growth activity, students applied scientific methods and mathematical analysis to understand biological processes, integrating technology for data collection and analysis. In the pulley system design challenge, students used engineering principles and physics concepts to solve a practical problem, fostering an understanding of how these disciplines intersect in real-world applications.

Research indicates that integrating STEM education through differentiated instruction can enhance student engagement and achievement, particularly in developing higher-order thinking skills and preparing students for future STEM careers (Bahrain SDGs 2030). By incorporating tiered assessments, we aim to provide all students with opportunities to engage in meaningful, challenging, and relevant learning experiences, regardless of their starting points.

Nonetheless, there is still some reluctance and resistance to adopting tiered assessments. Teachers, especially new ones, may experience difficulties when preparing tiered assessment tasks (Roberts, & Inman, 2023). Challenges include formulating questions that address different levels, grading, and administering them effectively (Richards & Omdal, 2007). Some teachers might think students should choose only one of the three questions.

In this paper, we have developed several traffic light-colored tiered questions in STEM to help illustrate how teachers can design, grade, and administer these types of questions. We believe that implementing tiered assessment, especially in STEM, may require additional teacher training to effectively prepare teachers. Research indicates that targeted professional development can significantly enhance teachers' confidence and competence in implementing differentiated instruction (Al-Shaboul et al., 2021; Richards & Omdal, 2007; Tomlinson, 1995).

One way to support teachers in implementing tiered assessment in STEM is through Post-Graduate Diploma Education programs, many of which include differentiation courses. These programs provide teachers with a solid background in differentiation and differentiation practices that can be applied in their teaching. These programs help enhance teachers' knowledge and skills (Al-Shaboul et al., 2021; Richards & Omdal, 2007). Another way to support teachers is by conducting workshops on differentiation in schools. These workshops can provide a hands-on opportunity for teachers to examine their practice and develop their own tiered assessment tasks. Additionally, creating professional learning communities that provide support, sample tiered assessment tasks, and resources for teachers can help eliminate some of the reluctance towards implementing differentiation and tiered assessment (Tomlinson, 1995).

REFERENCES

Al-Ayash, A., Kane, R. T., Smith, D., & Green-Armytage, P. (2016). The influence of color on student emotion, heart rate, and performance in learning environments. *Color Research and Application*, *41*(2), 196–205.

Al-Shaboul, Y., Al-Azaizeh, M., & Al-Dosari, N. (2021). Differentiated instruction between application and constraints: Teachers' perspective. *European Journal of Educational Research*, *10*(1), 127-143. https://doi.org/10.12973/eujer.10.1.127

Bahrain SDGs 2030 (2024). Goal Four: Ensure inclusive and equitable quality education and promote lifelong learning opportunities for all. SDGs. https://www.sdgs.gov.bh/Goal/?ID=6Ychy0CpynYWsaQZK4fYrQ==

Boekaerts, M. (2010). The crucial role of motivation and emotion in classroom learning. In H. Dumont, D. Istance, & F. Benavides (Eds.), *The nature of learning: Using research to inspire practice*, (pp 91-111).OECD.

Council for the Accreditation of Educator Preparation (CAEP) (2022). *Introduction to the initial teacher preparation standards 2022*. CAEP. https://caepnet.org/standards/2022-itp/introduction

Cetin-Dindar, A., & Geban, O. (2011). Development of a three-tier test to assess high school students' understanding of acids and bases. *Procedia - Social and Behavioral Sciences*, *15*, 600–604.

Chang, B., Xu, R., & Watt, T. R. (2018). *The impact of colors on learning*. In *Proceedings of the Adult Education Research Conference 2018*. University of Victoria, Canada. New Prairie Press. https://newprairiepress.org/aerc/2018/papers/30

Clarke, T. & Costall, A. (2008). The emotional connotations of color: A qualitative investigation. *Color Research & Applications*, *33* (5), 406-410.

Dzulkifli, M.A., & Mustafar, M. F. (2013). The influence of colour on memory performance: a review. Malays Journal of Medical Sciences, *20*(2), 3-9.

Galloway, M. (2018). *The Effectiveness of Tiered Instruction in Elementary Schools* (Publication No. 10975130) [Dissertation, Trident University International]. Trident University International ProQuest Dissertations Publishing.

Gardner, H. (1983). *Frames of mind: A theory of multiple intelligence*s. New York: Basic Books.

Ginja, T. G., & Chen, X. (2020). Teacher educators' perspectives and experiences towards differentiated instruction. *International Journal of Instruction*, *13*(4), 781-798. https://doi.org/10.29333/iji.2020.13448a

Herner-Patnode, L.,& Lee, H-J. (2021). Differentiated instruction to teach Mathematics: Through the Lens of Responsive Teaching. *Mathematics Teacher Education and Development*, *23*(3), 6-25.

Hogan, E. R. (2009). Differentiated instruction and tiered assignments. *Mathematical and Computing Sciences Masters.* https://fisherpub.sjf.edu/mathcs_etd_masters/77

Idrus, F., Asri, N. A. Z., & Baharom, N. N. (2021). Has differentiated instruction gone 'awry' in online teaching and learning? *Journal of Language Teaching and Research*, *12*(3), 501-510. http://dx.doi.org/10.17507/jltr.1203.21

Kexiu, L., Elsadek, M., Liu, B., & Fujii, E. (2021). Foliage colors improve relaxation and emotional status of university students from different countries. *Heliyon*, 7(1),1-9. 10.1016/j.heliyon.2021.e06131

Koehler, S. (2010). *Effects of differentiating for readiness, interest and learning profile on engagement and understanding* (Publication No.91) [Master thesis, St. John Fisher College]. Fisher Digital Publications.

Koeze, A. (2007). *Differentiated instruction: The effect on student achievement in an elementary school* [Doctoral Dissertations, Eastern Michigan University] http://commons.emich.edu/theses/31

Levy, H. M. (2008). Meeting the needs of all students through differentiated instruction: Helping every child reach and exceed standards. *The Clearing House: A Journal of Educational Strategies, Issues and Ideas*, *81*(4), 161-164.

Lewis, S. G., & Batts, K. (2005). How to implement differentiated instruction? Adjust, adjust, adjust. *The Learning Professional*, *26*(4), 26.

Mavidou, A., & Kakana, D. (2019). Differentiated Instruction in Practice: Curriculum Adjustments in Kindergarten. *Creative Education*, *10*, 535-554. https://doi.org/10.4236/ce.2019.103039

Mizell, H. (2010). *Why professional development matters*. Oxford, OH: Learning Forward. https://learningforward.org/wp-content/uploads/2017/08/professional-development-matters.pdf

Mänty, K., Järvenoja, H., & Törmänen, T. (2020). Socio-emotional interaction in collaborative learning: Combining individual emotional experiences and group-level emotion regulation. *International Journal of Educational Research, 102*.

Mohammad, N. & Kaur, A. (2014). Differentiated assessment: A new paradigm in assessment practices for diverse learners. *International Journal of Education and Applied Sciences, 1*, 167-174.

Morgan, H. (2014). Maximizing student success with differentiated learning. *The Clearing House, 87*, 34-38. https://doi.org/10.1080/00098655.2013.832130

Munna, A. S. (2021). Self-control using traffic lights toolkit for academic success. *Advances in Social Sciences Research Journal*, *8*(12), 93–95. https://doi.org/10.14738/assrj.812.11352

OECD. (2019). *OECD future of education and skills 2030: OECD learning compass 2030*. Retrieved from https://www.oecd.org/en/about/projects/future-of-education-and-skills-2030.html#about

OECD. (2019). *PISA 2018 results (Volume I): What students know and can do*. OECD Publishing. https://doi.org/10.1787/5f07c754-en

Pozas, M., Letzel, V., & Schneider, C. (2020). Teachers and differentiated instruction: exploring differentiation practices to address student diversity. *Journal of Research in Special Educational Needs*, *20*(3), 217-230.

Roberts, J. L., & Inman, T. F. (2023). *Strategies for differentiating instruction: Best practices for the classroom*. Routledge.

Richards, M. R. E., & Omdal, S. N. (2007). Effects of tiered instruction on academic performance in a secondary science course. *Journal of Advanced Academics*, 18, 424–453

Suarez, D. (2017). Differentiation by Challenge: Using A Tiered Program of Instruction in mathematics. In W. Powell & O. Kusuma-Powell (Eds), *Making the difference: Differentiation in international schools*, (pp.199–227).

Grantlarsonproductions. (2020, June 17). *The psychology of color: How do colors facilitate classroom learning?* Retrieved September 3, 2022, from https://www.grantlarsonproductions.com/blog/the-psychology-of-color-how-do-colors-facilitate-classroom-learning

TIMMS (2019). International Results in Mathematics and Science. Retrieved September 26, 2021, from https://timss2019.org/reports/

Tomlinson, C. A. (1995). *How to differentiate instruction in mixed ability classrooms*. Alexandria, VA: ASCD.

Tomlinson, C. A. (1999b). *The differentiated classroom: Responding to the needs of all learners*. Alexandria, VA: Association for Supervision and Curriculum Development.

Tomlinson, C.A. (2001). *How to differentiate instruction in mixed ability classrooms* (2nd ed.). Alexandria, VA: ASCD

Tomlinson, C. A., & Imbeau, M. B. (2010). *Leading and managing a differentiated classroom*. Alexandria, VA: ASCD.

Tomlinson, C. A. (2014). *The Differentiated classroom: Responding to the needs of all learners*. (2nd ed.). ASCD, Alexandria.

Tomlinson, C. A., & Imbeau, M. B. (2023). *Leading and managing a differentiated classroom*. Ascd.

Wilson, G. D. (1966). Arousal properties of red versus green. *Perceptual and Motor Skills, 23*(3), 947–949. https://doi.org/10.2466/pms.1966.23.3.947

Wormeli, R. (2023). *Differentiation: From planning to practice, grades 6-12.* Routledge.