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Teaching Neurodiverse Students Science Online Using Literature and Assistive Technology

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Abstract: *This paper explores the challenges faced by neurodiverse students when learning science online and examines the role of literature and assistive technology (AT) in overcoming these obstacles. Through case studies and literature reviews, the paper highlights how tailored approaches to teaching can enhance engagement and comprehension for neurodiverse learners. This paper challenges how scientific terminology in online education is taught to neurodiverse students. It explores how students can build knowledge and ignite interest in science through poetry, historical scientific discoveries, and critical reasoning. A crucial consideration when learning science is that students be presented with literature that invites them to think of everyday experiences using, for example, their senses and linking these with scientific concepts presented in classes. In this case, it is important to consider students' learning styles, preferences, and interests. It is suggested that action research will include virtual reality (VR), appropriate narratives, cooperative breakout rooms, and visuals such as PowerPoint slides to engage neurodiverse students. It is suggested that teachers explore these using breakout rooms online for meaningful interaction among students with diverse needs. Additionally, teachers would gather evidence for improving students' learning by conducting a Strengths, Weaknesses, Opportunities, Threats (SWOT) analysis of their workplace. This would be longitudinal as action research takes place.*

Keywords: neurodiversity, assistive technology (AT), literature, science, education

INTRODUCTION

There is current evidence that more students with neurodiversity are being diagnosed, and with support from Diagnostic Student Assessments, they can complete courses in higher education (HE) on time. As with HE, secondary education and alternative provision schools have made significant progress in supporting and teaching students online. This is relevant because online technology allows educators to tailor their support for groups and individuals in remote and local locations.

Students in secondary school must study science subjects such as Chemistry, Biology, and Physics at the GCSE level, and those in higher education (HE) as part of degrees like Psychology. However, some students' motivation to learn may stem from various reasons, including an interest in specific topics and aspirations for future careers unrelated to science. It is acknowledged that science subjects are based on facts, and while some students excel in mastering these, others may prefer to make connections between facts, ideas, or topics that resonate with them. When topics ignite the imagination, students can form meaningful associations with science.

Nonetheless, memory skills for facts should be emphasised. Where neurodiverse students struggle with executive functioning, reading, writing, organising information, and working memory, science education can become challenging. This is because science involves abstract ideas, such as how chemical reactions occur and the nature of gravity. These concepts can be complex for neurodiverse learners to comprehend. The solution for teachers typically involves presenting concrete examples with visual aids.

Neurodiverse conditions vary, and online teachers should ideally have opportunities to develop effective teaching strategies. Online teaching fosters breakout rooms as they enable thoughtful interactions between students. In this context, teaching students the purpose of language and how to use it appropriately is one way to meet students' needs. For instance, skills in conversation, active listening, and turn-taking should be emphasised. In such situations, online teaching should enable students to use their imagination and creativity. Therefore, addressing students' cognitive and learning difficulties is crucial for creating an inclusive and effective learning environment. One powerful strategy is cooperative learning, such as group work that allows students to reteach lessons to one another. This approach not only reinforces understanding but can also reduce anxiety and frustration, which often hinder learning outcomes. Encouraging class discussions, particularly around real-world scientific problems like global warming, can help students actively engage with the material and develop critical thinking skills. This reflective, discussion-based approach may particularly benefit neurodiverse learners, including those with attention deficit hyperactivity disorder (ADHD) and autism, who may thrive in interactive and socially engaging settings. When thoughtfully facilitated, social interaction can foster cognitive, emotional, and social development. Teachers might employ strategies like acronyms and word associations to support memory and retention, making complex information more accessible.

The question is posed: How can students create their own explanations of scientific facts by connecting science concepts with their everyday lives or thinking? An examination is conducted on the use of English Literature to help students develop their conceptual understanding of science topics. Consequently, questions arise regarding how science subjects can be taught using English Literature and whether this approach would enhance students' enjoyment and interest in Chemistry, Physics, and Biology. Therefore, another question is: can combining science and literature help students engage more deeply with science subjects? To answer these questions, an analysis of examples illustrating how teachers can introduce science topics by connecting students with literature is conducted, as it is believed that scientific concepts may be embedded in writings. Additionally, it is envisioned that assistive technology (AT), such as software or product systems, can be utilised to enhance, maintain, or improve students' learning capabilities and outcomes.

This paper proposes that linking literature with science teaching is a way to enhance scientific knowledge. The assumption is that students can use their imagination to create images related to scientific concepts and explanations, which may help them remember facts and relevant terminology across various topics. The role of imagination in conveying scientific concepts is well established, as exemplified by Albert Einstein's theories of motion and time. Einstein proposed that people should imagine a train traveling quickly along an embankment. He suggested that a person on the embankment is likely to perceive the train as shorter than a person on the train, and this, according to Einstein, is due to a change in space caused by motion rather than an optical illusion. (Einstein, 1950). Thus, the imaginative minds of students learning scientific concepts can be a powerful tool in helping them understand their perceptions and grasp the intricacies of scientific concepts.

LITERATURE AND SCIENCE EDUCATION

Teachers recognise that books focusing on science fiction, biographies of scientists, and historical accounts of scientific discoveries can be effectively utilised to explore ideas and concepts. For example, 'The Martian' may serve as a resource for introducing students to scientific approaches to problem-solving. The author Andy Weir (2015) tells the story of Mark Watney, an astronaut stranded on Mars, who must find ways to survive. The National Aeronautics and Space Administration (NASA) attempts to bring him back to Earth. According to the

British Council (2025), the book combines humour, suspense, and scientific accuracy, making it useful for practicing and improving reading skills. Others, such as Hollenbeck (2020) and Flynn and Hardman (2019), report that students who do not study advanced science benefit from literary works that communicate science to the general public, including children and scholars. The authors note that students demonstrated a greater understanding of science after reading science fiction. Therefore, fiction can help make science accessible to those who may find scientific facts intangible. It is suggested that fiction and novels provide neurodiverse students with a way to engage their imagination, curiosity, empathy, and awareness of global concepts in science. Furthermore, literature can attract neurodiverse students who benefit from learning through graphic illustrations. Furthermore, the organisation of how non-fiction is presented may benefit neurodiverse students.

The conclusion is consequently made that there is a strong connection between English literature, which contains scientific concepts, and the acquisition of interest and progress in science classes. That is, incorporating stories with facts can be a powerful tool. Alsup (2015) reports that many scholars speculated that storytelling (understanding our experiences and relating these to others) is a way of making individuals unique as humans. Retelling stories containing scientific facts to others may be beneficial to the learner of these facts, but also to those with whom the storyteller engages. However, A National Literary Trust (2022) report, authored by Cole, Picton, and Clark, states that children and young people choose to read non-fiction to be better educated, satisfy their curiosity, develop social connections, and support their well-being. They also report that readers tend to be more environmentally aware and take action, such as joining an organisation and participating in environmental events or campaigns; therefore, literature can be a powerful tool that enhances the capabilities of learners. Yet, science can appear disconnected from the real world, so for some, an understanding of scientific concepts may be misunderstood or rendered irrelevant. That is, some learners may struggle with acquiring scientific concepts. Simpson et al. (2017), for example, report that traditional teaching methods, using textbooks and lectures, may lack interest for students and are insufficient in helping them understand the world they live in. Therefore, the following provides an exposition of how poetry challenges beliefs, opens world views of the uses of scientific concepts, and may improve memory for these.

Examples of Science Merging with Literature

Some authors oppose commonly held opinions. For example, Lyell's Principles of Geology (1992) contests the view that the Earth's land masses and oceans had changed in small ways over time. Instead, he argued that the surface of the planet is changing incessantly. The author pointed out that the northern hemisphere was once a vast ocean with small islands and asserted that it would return to its original form. Lyell further explained that the movement of land areas would cause climate changes and influence the climate of the hemispheres. Therefore, the ecosystem of vegetation and animal life would be hindered. Lyell introduced Tennyson's poem as a way of presenting the geological phenomenon.

For Tennyson-

There rolls the deep where grew the tree.
O earth, what changes has thou seen!
There where the long street roars, hath been
The stillness of the central sea'.
The hills are shadows, and they flow
From form to form, and nothing stands;
They melt like mist, the solid lands,
Like clouds, they shape themselves and go'.

Lyell

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An analysis of the following poem by students will aim to initiate conversations about science topics in ecology, conservation, and the evolution of the Earth over time. A two-part poem, the Botanic Garden, conveyed the Big Bang Theory of the universe: -

'.....the mass starts into a million suns,
Earth round each sun with quick explosions burst,
And the second planet issue is from the first.

Darwin, E. (1789-91). The Botanic Garden

The Big Bang Theory proposes that the universe was created thirteen and a half thousand million years ago with a massive explosion, and space has been expanding since then.

A man said to the universe.
"Sir, I exist."
"However, replied the universe,
"The fact has not created in me
A sense of obligation

Teaching the Universe, Stephen Crane, in Auden's (2015) Best Loved Poems, p. 152)

That man's existence occurred due to the Big Bang, which Stephen Crane made; that is, man alone exists. Conversations emerge about the night sky and the origin of stars, which William Bourdillon's poem could introduce as a point for discussion.

The Night has a thousand eyes,
And the day but one,
Yet the light of the bright world dies
With the dying sun

The Night Has a Thousand Eyes, William Bourdillon, in Auden's (2015) Best Loved Poems, p. 209)

Around any mass (or energy), spacetime is curved. According to Albert Einstein's theory of general relativity, time can be warped in intense gravitational fields or at high speeds. Clocks also tick differently in different environments, depending on gravitational pull. The closer the clock is to the source of gravitation, the slower time passes; the farther away the clock is from the source of gravitation, the faster time passes. For example, the International Space Station (ISS) clocks run slightly slower than Earth's. This explains why astronauts age more slowly, by 0.007 seconds every six months. Issues arising from how ageing is defined and perceived, and how the brain ages and conceptualises the world, may depend on the planet humans inhabit. This could be an area of discussion and may have repercussions for learning new areas of science, as it stirs emotions through poetic imagery. A poem could begin with Dr Seuss's Explanation of Einstein's Theory of Relativity: -

Time and Space determine where you go,
Mass and energy determine how you glow,
Energy and time determine how you flow,
Mass and space determine how you grow

When teaching ecosystems and food webs, a teacher may use the following poems to elicit discussions about animal behaviour.

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The Eagle

He clasps the crag with crooked hands;
Close to the sun in lonely lands,
Ring'd with the azure world, he stands.
The wrinkled sea beneath him crawls;
He watches from his mountain walls,
And like a thunderbolt, he falls

Alfred, Lord Tennyson

Emotions in poetry bring thought to ecosystems and the nature of the wild. For example, what should landowners do in the event of rabbit overpopulation?

The Snare

I hear a sudden cry of pain!
There is a rabbit in the snare:
Now I hear the cry again,
But I cannot tell from where

James Stephens

When teaching the psychology of stress, it may help students think about the busy environments they live in, as in:

O dear! How disgusting is life!
To improve it O what can we do?
Most disgusting is hustle and strife,
And of all things, an ill-fitting she,
O bother an ill-fitting shoe!

Edward Lear

It is suggested that creative mediums, such as poetry, can develop interest and attention while sparking students' prior knowledge as they connect with new scientific concepts introduced to them. This may enable scientific facts to be readily recalled and applied. Additionally, when the meanings of words found in poems are discussed prior to presenting the poems, students may be better able to listen to these words when the poems are introduced. The implications of the words will be explored in science classes, as students' explanations and understanding of scientific concepts are essential for progress in science-based courses. Indeed, Bradbury (2014) argues that recognising how literature explains scientific concepts and, it is suggested, vice versa, would assist students' access to science subject specialisms.

It is widely acknowledged that integrating assistive technology (AT) and literature can create inclusive learning environments for students with diverse learning needs. However, it is less clear how this can be effectively achieved in classrooms and online settings. Nevertheless, it is widely believed that AT can empower students with conditions such as dyslexia or dysgraphia by transforming spoken language into written text, promoting

greater independence in their learning. By integrating AT with literature, teachers can make lessons more engaging for neurodiverse students. The assistive technologies that can enhance science lessons include text-to-speech software, which allows students to listen to scientific texts, making them accessible to those who are dyslexic or have visual disabilities. Other technologies that can support neurodiverse students include interactive whiteboards, screen magnifiers, interactive storybooks that relate to scientific concepts, and multimedia resources such as videos, animations, and simulations that help students visualise scientific processes.

STUDENT SUPPORT USING ASSISTIVE TECHNOLOGY

Recent developments in supporting neurodiverse students reveal a plethora of procedures, processes, and Apps. However, it is unclear how literature can be an adjunct to learning science in the AT environment. Earlier research recognises that appropriate support from teachers is necessary for implementing learning when using technology. Rapanta et al (2021) assert that digital learning must be feasible as it enables students to associate with scientific ideas. Additionally, Momani et al. (2023) assert that technology can lead to academic success, and this requires the use of appropriate strategies by teachers. The authors acknowledge the incorporation of virtual reality (VR) simulation as a technology that could be integrated in teaching science scenarios, as it fosters the development of metacognitive strategies. Neurodiverse students must acquire such strategies, and according to Momani et al. (2023), a discussion should focus on how digital teaching can be focused on students with different neurodiverse conditions and from various socio-economic backgrounds.

A literature review conducted by Cimer (2007) identifies principles of effective teaching—the first deals with students' existing ideas and conceptions. Teachers should be aware of foundational strategies that can support students in acquiring new, relevant knowledge. This, according to Cimer can be facilitated through Information and Communication Technology (ICT), discussions, question-and-answer sessions, and practical activities like field trips and simulations—all of which help students apply conceptual knowledge across different contexts. Cimer emphasises the importance of cooperative group learning and timely teacher feedback in supporting student learning. Complementing Cimer's perspective, Krontiris-Litowitz (2013) highlights research showing that students benefit from using literacy and information processing techniques when applying science in practical ways. However, she also notes that students may find it challenging to develop these learning skills (Coil et al., 2010). To address this, Krontiris-Litowitz (2013) suggests that learning outcomes improve when teachers clearly communicate objectives and design assignments that are aligned.

Assistive Technology (AT) is closely allied with ICT as it describes systems that support individuals, such as neurodiverse individuals. An argument posed is that the learning of science topics can be enhanced by incorporating English Literature. However, how this can be effectively integrated with AT remains to be established. Tutoring programs can provide personalised instruction to individuals with literacy difficulties, helping them learn independently. Their individual needs are met where they work and or study. For example, businesses are utilising AT-powered customer service chatbots and marketing automation. However, as in schools where there are neurodiverse students, it would be necessary for students to be supported by staff who are knowledgeable in using AT. This is because the cognitions of students who are dyslexic or have ADHD, for example, require such intervention. A review is made of ways in which AT can be a useful support.

At a cognitive level, AT can support working memory (WM) by reducing memory loads by providing a structured framework, organising and prioritising information, and assisting people's preferences. This is important because memory overload affects the ability to plan and retain information (Mcloughlin et al., 2002). Dawson et al. (2018) noted that students can use Google Docs, voice typing (a built-in dictation tool for free writing), and Text Help. Others, such as OneNote, may be helpful for students when they want to reduce unnecessary information and transfer relevant information to long-term memory (LTM). To enable this, AT can be suitable for students' learning preferences: visual, auditory, tactile, and kinaesthetic. Retaining information is supported this way (McLaren, 2016; Crabb, 2016).

However, teachers will consider students' preferences when considering techniques to improve memory. Some individuals learn more effectively through imagination, while others learn best by listening. Nevertheless, in all cases, students must break down information into pieces and understand their learning styles. Teachers may choose to support preferences and learning in a step-by-step way. In such cases, teachers will encourage students to use their skills to organise information so that it is easily accessible. This may involve using templates that are already prepared for specific topics or those that students can develop themselves. Categorising information structures may encourage students to access authors' thoughts and ideas. Introducing tables, flow charts, diagrams, and assistive technology apps will assist students. AT can help students make connections between information, making it more meaningful and facilitating quick recall (Skemp, 1989). Mind maps, for example, can enhance the organisation and retrieval of information. Students will learn about the meaning and structure of arguments and receive support in drafting and proofreading their texts by Grammarly, for example.

Students may use AT to assist with literacy challenges, such as slower reading speeds and comprehension. The use of text-to-speech and speech-to-text software, including Read and Write, can help individuals with literacy difficulties understand what they read. When using word processing, Rello and Beza-Yates (2017) report that fonts such as Dyslexie, Lexia Readable, Arial, Calibri, and Verdana can enhance reading speed and reduce fatigue. Many of these fonts are accessible during word processing. Additionally, headings and styles provide structure, helping readers navigate the content in Word. According to the British Dyslexic Association (BDA, 2023), font size should be 20% larger than standard text. Dawson et al. (2018) suggest that individuals who use word processors utilise their preferences to increase text size, particularly with shorter words. This reduces the overcrowding of words. According to Schneps et al. (2013), learners can then keep track of texts.

When reading longer texts, a suggestion is that students should be selective and so would not need to read everything in a journal article or book. Teachers can help them identify key elements that the reader can decide to analyse in more depth. Skimming and scanning the text is vital before reading for deeper understanding. Skimming is a method of reading quickly to gain an overview before engaging in in-depth reading. Students decide which part of the texts they would like to spend time with. They may read the first and last paragraphs to gather the main points and then note these in a summary. Scanning is when students look for a particular word or phrase within a text or want to understand the layout of a text, including the number of sections and where topics are covered. This will help the reader decide whether to continue reading and assess the text's helpfulness. Students who have difficulty retelling a story or a text need to learn how to summarise. They could ask themselves questions, answer them, and be familiar with different text structures to enable them to summarise. They should take notes of the main ideas or points made and write the summary in their own words. Therefore, skimming and scanning texts are key skills neurodiverse students should have.

Revising notes taken in lessons can be a challenging experience for some neurodiverse students. Dyslexia Action (2019) offers a variety of resources that neurodiverse students can use. Assistive technology (AT) enables students to engage in learning and retention. For example, text-to-speech software allows students to listen to the words of a text while revising. When students record themselves discussing a subject or reading aloud, they can listen to these recordings' multiple times. Students may choose to use PowerPoint slides to organise an assignment brief and for revision purposes. Other resources for revising include apps that can be used to create flashcards, as well as for notetaking and exam scheduling. Additionally, mind maps assist in planning an assignment brief.

Furthermore, students need to be aware of metacognitive strategies, enabling them to make learning tasks and reflection more active. Some resources encourage this approach. Students can grasp a range of information through sorting activities when solving problems, such as using Cards. These promote thinking and dialogue. By breaking down tasks into manageable parts (which teachers can support), learners gain a representation that helps them think about larger structures and frameworks. Furthermore, visual reminders, such as prompts, can enable learners to monitor their work by providing visual cues to overcome obstacles. An example is a grid that can be used to suggest techniques for enhancing 3D depth in drawing objects, including light, shade, and

perspective. Other templates that students can use include a reference list, and students can quickly identify and access sources of information online. Nevertheless, students may prefer to discuss their ideas for a project or write an assignment, and may categorise information and structures in this process. In this case, writing frames may assist students in formulating clearer ideas and using them to create spider diagrams, as well as a notebook for making linear notes. Another use of AT is ProStudy. This enables the capture of information from various resources and helps determine what is helpful for students (Dyslexia Action, 2019).

Assistive technology enhances writing skills, as individuals with Specific Learning Differences (SpLDs) can identify and correct grammatical and spelling errors. Furthermore, bold emphasis on headings and proper text alignment, including paragraph spacing, is recommended. Some students prefer using single-colour backgrounds to enhance accessibility, allowing them to select their preferred colours. Individuals may avoid patterns or images and prefer dark text on a non-white background, as white can be glaring, while cream and soft pastel colours are easier on the eyes (Ability Net, 2025). Finally, Word offers left alignment to improve text structure, making locating the beginning and end of each line easier and ensuring spaces between words. Those with dyslexia should avoid using multiple colours, write in short sentences (60-70 characters), and use headings to break up text (Ability Net, 2025).

When teachers use AT in their workplace, they can perform tasks and their jobs more effectively, as they can be provided with timely feedback on their work. This is achieved by automating tasks that are difficult for them to complete (McKnight & Davies, 2013). Teachers may become further motivated to use AT by relating the ongoing benefits to students. Exam access arrangements enable neurodiverse students to take examinations and demonstrate their knowledge and skills without compromising the rigour of assessments. The Joint Council for Qualifications (JCQ, 2020) Access Arrangements Regulations outline the conditions of use for individuals who utilise AT, such as voice recognition software and word processors equipped with spell checkers. AT is available in various forms during the examination process, including computer readers, word processors, voice-to-text software, and reading pens, among other tools.

In summary, AT can be used across subjects and during examinations. However, the mode of teaching science topics using AT is not well-documented. Assistive technology is, however, recognised as supporting neurodiverse students. Nevertheless, AT's application in literature-based science teaching requires more exploration. The following provides examples of how this may be achieved.

TEACHING EXAMPLES: MERGING LITERATURE AND ASSISTIVE TECHNOLOGY

To discuss teaching examples, the following case studies are presented:

Case Study 1**:** A teacher is supporting a student who has a diagnosis of Dyspraxia. Their emotional regulation is weak and can be overloaded with sensory details.

Case study 2: A student with Autistic Spectrum Condition (ASC) constantly becomes frustrated with others who have different opinions, and they are resistant to any interventions the student makes.

Case Study 3: A student has a dual diagnosis of attention deficit hyperactivity disorder (ADHD) as well as (ASC). The student struggles with executive dysfunction, and emotional regulation is weak. The student responds negatively with slight criticisms. The teacher is concerned about the trainee's well-being.

Across these case studies, teaching techniques may include multisensory and metacognitive strategies, as reinforcing learning can be achieved through the senses and practice. Metacognition encourages students to discover how they learn and what is most suitable for them. Nevertheless, general rules for teaching are widely recognised globally, such as the teacher providing instructions in a step-by-step manner. Instructions can be given verbally and in writing, and concepts can be written on a whiteboard for students to discuss. For students with dyslexia, small group teaching and one-to-one instruction are most suitable. Writing skills can improve with multisensory methods as students practice writing on paper, interactive whiteboards, and iPads and other

devices. Teachers also widely recognise that pre-teaching new concepts allows students to familiarise themselves with them so they can engage with learning later. Assessments may take the form of tests and quizzes that allow for circling answers, as this prevents word recall. Additionally, providing a start to a sentence will enable written responses. As it is acknowledged that dyslexia can co-occur with other specific learning differences (SpLD's), a brief discussion follows on how students with dyslexia can be taught science. Their lateral thinking skills are a strength that dyslexic students have, as shown in their ability to design experiments and contribute to providing innovative ideas. However, students with dyslexia may not be able to learn scientific vocabulary easily or grasp formulae and facts. This is usual because of weaker short-term memory (STM).

Students with co-occurring learning needs will most likely be taught to organise their studies using strategies such as highlighting information in different colours, recording classes, taking notes accompanied by pictures, and employing checklists containing essential vocabulary. Words in science can be similar and not readily distinguishable, such as 'cerebrum and cerebellum.' Additionally, abstract ideas such as 'ecosystem or respiration' may be difficult to understand. Since dyslexic students find filling in words attached to diagrams or charts challenging, these should be pre-printed. Students should be advised to keep a notebook to list common words. Scientists must read, remember, pronounce, and reproduce terms and concepts. These concepts are associated with others as well as procedures.

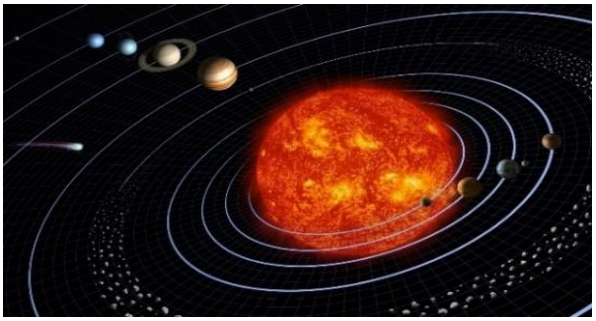
Teachers will implement strategies such as asking students to explain the meaning of concepts in their own words, and new vocabulary should be taught slowly. They will be encouraged to create bullet-point lists and types of notes and organize their work using an index, for example. These strategies will be helpful in laboratory and group work that requires students to present verbal or computer-generated results. Teachers may encourage students to use AT, such as recording apps that convert dictated information into text and speech-to-text programs. Teachers use different strategies, and a teacher implementing constructivist theories could initiate a class discussion to identify students' preconceptions and beliefs about a topic. In this case, communal learning and expanding a support team may lead to more confident learners. Additionally, storytelling offers neurodiverse learners a less rigid format, allowing them to grasp scientific phenomena through analogies and narratives. Compared to expository formats, the latter may be more cognitively accessible.

Consider the example of teaching the topic 'Space'. In this case, students learn vocabulary related to star, sun, solar system, space, asteroid, meteor, moon, galaxy, and Milky Way. Knowledge of the individual planets is also necessary: Mercury, Venus, Earth, Mars, Jupiter, Saturn, Uranus, and Neptune. The way travellers reach the planets and what they establish there are taught using the following vocabulary that enshrines the concept of space physics: astronaut, rocket, shuttle, and space station. Additionally, the teacher may choose to support students in acquiring knowledge about 'gravity'. Teachers will therefore determine the grammatical and linguistic points needed for the lesson, for example, low-level thinking skills, including knowledge, comprehension, and application, and high-level thinking skills, encompassing analysis, synthesis, and evaluation (Bloom's Taxonomy, 1956-1964). The following illustrates slides that can be utilised in online PowerPoint lessons.

Slide 1

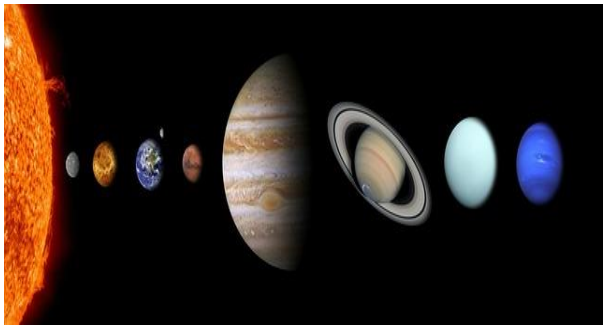
SPACE

Slide 2



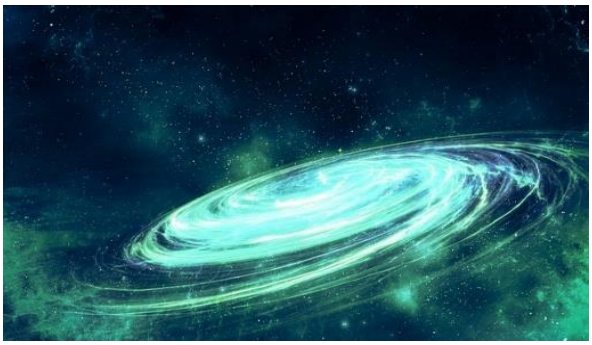
THE SOLAR SYSTEM

Slide 3



PLANETS

Slide 4



THE MILKY WAY

Each slide may be accompanied by literature on the scientific concepts it presents, such as gravity, space, the universe, and planets. Questions will be included with each slide, and while students might make errors in their answers, teachers will correct these using a whiteboard, for example. The slides above will include lesson objectives, such as 'acquire vocabulary about space'; students are expected to meet all of these objectives by the end of the lesson. Such lessons can incorporate videos and virtual reality (VR), as the latter is a technology that supports conceptual understanding and engagement through immersive experiences. For instance, students can grasp planetary distances and motions by experimenting with the solar system's elements presented virtually. In this way, a teacher can guide the students on how this is done and address their needs. Therefore, VR is one method for reducing cognitive overload for neurodiverse learners, as it makes abstract ideas tangible through interactive experiences. However, achieving long-term learning outcomes requires research since accessibility

and costs are significant factors. It is therefore important to include questions that necessitate extended writing, and students are expected to complete these before advancing to other slides that require higher conceptual understanding during online teaching.

Another example of incorporating literature with AT is introducing a narrative about a rainforest. This narrative may be partially fictional, as it tells the tale of a student lost in an ecosystem's vast expanse. The lesson will begin online by introducing students to one another and clarifying that they can communicate and discuss points made. The teacher will lead the lesson by identifying keywords such as biodiversity, species, kingdoms, extinction, conservation, and human interactions with ecosystems. Students could access VR to explore the ecosystem before the narrative is presented. This experience will help them gain a sense of the reality of an ecosystem. Students could then discuss what they have learned to reinforce their acquired knowledge. The teacher may present PowerPoint slides (see below) and ask students to discuss what they see. The teacher could pose questions, but these will need to be tailored so that students can interact positively with each other without feeling criticised by their peers or the teacher. The following present examples of PowerPoint slides of ecosystems that could be used in discussions.

Slide 1

Slide 2

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Slide 3

Explaining how each slide differs in its ecosystem will enable students to construct knowledge and develop social skills in a group setting. Through collaboration and reasoning, accurate and inaccurate statements can enhance students' understanding of why certain statements or answers are incorrect. Teachers could use a whiteboard to clarify answers posed by students, and they may choose to use a video as a tool for checking students' understanding. Students could be presented with questions first, as this helps them focus on the relevant parts of the video that follow. Furthermore, Education Technology Platforms (Ed Tech) such as Nearpod allow questions to be embedded into videos, enabling learners to choose an answer and receive instant feedback, allowing them to continue.

DISCUSSION

This paper presents arguments for implementing literature with AT when supporting students academically online. However, it is still unclear how this should be achieved, such as how lessons should be developed. This paper has made some suggestions. With new developments in AT, teachers will be aware that the possibility of offering support to neurodiverse students is constantly growing. However, neurodiversity constitutes many different forms, such as dyslexia, autism, and ADHD. Teachers will, therefore, vary lesson planning accordingly at each science subject level. That is, flexibility and adaptability is key to lesson design. For example, the Universal Design for Learning supports neurodiverse needs. It is a framework that creates flexible and inclusive environments that students with diverse needs can use. The framework aims to remove barriers when students participate in the learning process. In this way, students can engage actively in problem-solving with the implementation of practical activities. However, it is necessary for teachers to reduce the gaps between what students know about living in an environment and the wider world and the facts presented to them in science. That is, do students' observations coincide with the facts presented to them? To be effective in classrooms and in the workplace, supervisors and teachers need to manage learners' beliefs about their competence in using AT, and this may require practical support. Additionally, teachers will address social and emotional barriers that give rise to social isolation and feelings of not having appropriate learning styles for science topics.

Bridging the Gap Between Society and Science

The concepts enshrined in scientific explanations can remain an ambiguous assertion for many, and this may be accentuated among neurodiverse students. This is evident when scientific explanations oppose judgment. A contention is that students may grasp relevant concepts for topics through means they can engage with, such as the introduction of storytelling through literature. This may be in the form of storytelling as authors relate these in books and poetry, and these capture the imagination of students. Teachers may find it necessary to negotiate cooperative frameworks where students find it comfortable to interact with one another. This is important

because students learn from each other, as well as teachers, and it is suggested that this improves memory for facts. The following presents an example of how students' knowledge of everyday judgment can be combined with scientific concepts.

Karl Sigmund (1993) identifies that presenting people with games (which may be online) helps them understand the rules of behaviour in communities, such as cooperation. To illustrate the association between science and society, teachers could present scenarios, such as considering the travel of beings dissimilar to humans across the galaxy, for example, the eventual arrival of beings from the Milky Way to Earth. Students could be asked to create their own stories based on the literature presented in class and the scientific terminology they have learned. Then, they will be asked to consider how new life can integrate with communities and how they might learn societal rules of behaviour. The product of this exercise for the teacher is that relevant scientific constructs are used in appropriate ways, such as travelling in spaceships across galaxies, which requires navigating and understanding the concept of 'gravity'. Furthermore, cooperation and individual gain are based on rules of behaviour, so it is relevant for students to know the processes of engagement with others in society and the benefits resulting from them. Teachers can create many different scenarios, and students may prefer some according to their interests in science topics. The teacher(s) will have to deduce the possibilities for each student and use these across groups of science lessons.

Cognitive Challenges

However, students who use AT may encounter barriers. This includes personal aspects, such as levels of self-efficacy (one's belief in their ability to succeed or complete a task; Bandura, 1994), hence confidence in using technology. Some individuals may have limited IT skills training, inadequate internet access, or insufficient technical support. The digital support that neurodiverse students receive may strengthen their confidence and self-efficacy. For example, teachers should use language that conveys a positive interest in students' outcomes and avoid procedures that may lead to students seeing that they have made more errors than expected. To avoid this, teachers could use games, quizzes, and tick boxes as assessment tools to boost students' self-confidence.

When students enter the workplace, and those in part-time education who use AT, must communicate easily with information technology (IT) support staff and teachers. Other learning support staff must also have access to such IT assistance. Consequently, people who use AT must possess the necessary skills to study and perform their work effectively in their place of employment. Therefore, a skills audit or screening is required to clarify to students, support tutors, and adults in the workplace that training in specific uses of AT may be necessary.

Challenging Social/Emotional Barriers

A consideration is that breakout rooms online can be used to build rewards, enhance social dynamics, and improve speaking and listening skills (Slavin, 2010). That is, students are supported in mastering concepts. Gillies and Ashman (2003) concluded that when diverse individuals interact, cooperation is promoted. Scaffolding can support the diverse classroom in organising ideas during discussions by using a task planner, connecting misconceptions, and employing a writing frame. Nevertheless, a common argument in the literature is that addressing pupils' learning style preferences is a tool teachers can use to develop the resilience and confidence of learners. Teaching one-on-one online may be less problematic than teaching a large group of students with diverse learning styles. However, teachers may consider rotating learning style approaches, such as developing a lesson with a visual focus using videos, diagrams, and pictures, and then moving forward using other styles, such as read-write and kinaesthetic approaches. This may motivate students and raise their interest in science topics (Bolte et al., 2013).

Nevertheless, it may be appropriate for teachers to conduct SWOT analyses to evaluate their workplace critically. This will enable them to analyse the conditions necessary for offering online support to neurodiverse students with the implementation of AT and, if appropriate, literature when teaching science. My supervisor carried out a SWOT analysis at my place of work, where I am an online teacher. The following emerged.

Strengths

Assistive Technology (AT) integrated into a visual classroom is a platform used for teaching. This ensures that all students can engage with online learning. AT can, therefore, bridge communication gaps and improve accessibility. This is useful when supporting neurodiverse students. Online lessons mean that students are not disadvantaged and may help them develop confidence, which is helpful if they must return to the school classroom. Additionally, remote learning ensures that students have the same long-term tutors or teachers, allowing them to build students' confidence over time. This supports students in care who may not remain in the same home and/or school over time.

Remote learning incorporates a screen reader, which reads texts to students, such as the whole page or specific words. Students with visual impairments and those who are neurodiverse, such as those with dyslexia, benefit. Furthermore, students can communicate with their tutors using either their microphone, speaker, or chat box. Emojis alert teachers when students struggle, representing their feelings during learning.

Weaknesses

The teacher relies on someone to assist students in accessing technology. This may involve screen sharing, taking an assessment, turning on the audio and microphone, and using the chat box. Additionally, tutors generally do not meet with students, and students do not meet with tutors (for safety reasons). This removes extra non-verbal information from tutors, who may need to know how students react or feel (although learners can use emojis).

Opportunities

When considering AT for students, it is essential to anticipate and research their specific needs. This knowledge will help AT developers produce programs tailored to the needs of online remote learners. It is vital that company directors and administrative staff of online tutoring companies are comfortable listening to feedback from students, tutors, and customers, such as schools, to better understand how they can utilise AT effectively.

Threats

However, it is essential for companies offering online learning to stay current on technological advancements, ensuring they remain competitive. Tutors and others will stay current with new developments and follow the latest guidance to support neurodiverse students.

It is evident that this SWOT analysis aims to alleviate social and cultural barriers, and AT is helpful in this respect. Teaching science topics using carefully chosen literature may contribute to this.

CONCLUSION

Teachers will select literature appropriately according to their lesson plans, considering students' interests and preferences and the types of support needed for their requirements. With the evolution of technology, teachers will stay current with developments that may benefit the age ranges they teach. Some AT used in HE may be too advanced for school students. Therefore, the benefits of literature for learners across the domain of 'schools' cannot be realised without thoroughly investigating its use alongside various types of assistive technology. It is anticipated that action research will be conducted to address the gaps in the research, including exploring ways VR can be integrated during online lessons for schools and HE institutions. Additionally, further exploration of how digital technology might enhance learning for students from diverse socio-economic status (SES) backgrounds is needed. Research must also examine how resources can be utilised in lessons to benefit neurodiverse groups. For example, PowerPoint slides or VR must be created to appeal to a diverse range of students from various SES who may attend classes and have various needs. Finally, research should be carried out to investigate the outcomes of more robust longitudinal studies on the impact of integrating AT and literature in online science education for neurodiverse students.

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