

‘THE ART OF SCIENCE’: EMPOWERING TEACHERS TO UTILISE ARTISTIC METHODS IN THE TEACHING AND LEARNING OF NATURAL SCIENCES AND TECHNOLOGY IN THE INTERMEDIATE PHASE

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ABSTRACT

Intermediate Phase (IP) Natural Sciences and Technology (NST) teachers are encouraged to, “use a variety of ways” to promote learning in NST (DBE, 2011, p. 8). This study aimed at assisting participating teachers to develop an Art-infused¹ pedagogy, via an Educative Curriculum Material (ECM). An ECM is a resource that fosters learning for both teacher and learner. Ten NST teachers volunteered for this one-year qualitative, interpretive case study. Data were gathered via individual pre- and post-intervention interviews. Participants reported that learners demonstrated increased levels of engagement while developing literacy and critical thinking capabilities. Time and resource constraints were identified as potential concerns, as was a teacher’s perception of his/her own artistic abilities. Results suggest that with effective training, artistic activities could be utilised to promote learning in NST.

Key words: Educative Curriculum Materials, Natural Sciences, Artistic methods, Teacher training, Teacher capacity development.

INTRODUCTION

Children acquire knowledge in a varied and dynamic manner, therefore, to foster effective learning of (NST), teachers should be equipped, and encouraged to teach, utilising diverse pedagogical approaches. Evidence from a number of sources, namely: Trends in Mathematics and Science Study (TIMSS), Southern and Eastern African Consortium for Monitoring Educational Quality (SACMEQ), the Annual National Assessments (ANAs), suggest that South African school children are underperforming in Science (Bilbao-Osorio, Dutta, & Lanvin, 2013; DBE, 2015; Reddy et al., 2012; Spaull, 2013). One contributing factor might be that NST teachers lack sufficient subject content knowledge and pedagogic content knowledge (Meiring & Webb, 2012). A key component of ensuring quality instruction is a focus on teacher capacity development (Desimone, 2009; Krajcik & Delen, 2017; Spaull, 2013).

This article reports on a study that investigated, from a teacher’s perspective, how learning in NST might be promoted through integrating Art-methodology into the teaching of NST. The focus was on enhancing teacher practice via an Educative Curriculum Material (ECM). Effective ECMs provide teachers with the opportunity to gain knowledge while reflecting on

¹ ‘Art-infused’ or ‘Art-methodology’ refers to a NST pedagogy that includes the use of artistic activities, for example drawing and painting, while recognising the underlying thinking skills involved in the production process.

their own pedagogies (Pringle, Mesa, & Hayes, 2017) so as to promote cross-curricular learning, and the application of skills in varied educational situations (Davis & Krajcik 2005).

LITERATURE REVIEW

Educative curriculum materials (ECMs) have been billed as resources that enable teacher learning. In this study the context for this teacher learning was an innovative approach, or pedagogy, whereby the teaching of science is promoted via an Arts-infused pedagogy. The goals of the ECM were:

1. to facilitate NST teachers' understanding of the learning potential of an Art-based pedagogy.
2. to provide practical ways of applying artistic methods to their teaching.
3. to illustrate how Art and NST can be taught collaboratively.

Similarities between the disciplines of Art and Science have been identified and discussed by scholars for centuries. Leonardo da Vinci's approach to learning spanned diverse disciplines. From Art through to Engineering he acquired knowledge in an interrelated manner (Robson, Hickey, & Flanagan, 2005). The multifaceted cognitive and innovative abilities required for the mastery of Science and Mathematics were similar to those utilised in Arts learning (Burton, Horowitz & Abeles, 1999). Robson et al. (2005) identified the similarities shared by the disciplines of Art and Science and investigated the potential benefits of collaboration between these disciplines, identifying what they termed, "Joint Learning Outcomes" (JLO). JLO's are learning outcomes shared by different subjects, for example, improved observation skills, the ability to research, present ideas and reflect. Hetland, Winner, Veenema and Sheridan (2013) claim that engagement with the Arts can lead to the development of thinking skills that are seldom addressed in other academic subjects. Children are given the opportunity to develop thinking skills through studying Art, and it is these skills that can be utilised to aid learning in other subjects. Hetland et al. (2013) defined eight adaptable skills that are learned in Art classes: *The Eight Studio Habits of Mind*. Five of these thinking skills are identified as being able to promote learning in NST, namely: 1) development of craft, which promotes decision making processes and encourages intellectual flexibility through familiarity with tools and artistic methods. The NST Curriculum and Assessment Policy Statement (CAPS) states that children are required to demonstrate a proficiency in practical processes, advocating the use of materials and tools to "create, produce or investigate" (DBE, 2011, p. 9). Here practical activities might be utilised to assess a child's understanding of scientific concepts; 2) engagement and persistence i.e. the ability to remain focused on one project for an extended period of time. Approaching learning with this attitude, according to Hinton et al. (2008), is fundamental to knowledge acquisition. The NST CAPS advocates the development of a positive mind-set, suggesting that the study of NST should include opportunities for children to solve problems in a practical manner as "there are attitudes and values that underpin this ability" (DBE, 2011, p. 10); 3) envisioning, requiring a combination of knowledge and visualisation, is an ability to imagine what is not yet there and then to create it. An ability to mentally construct and manipulate images, according to Hawes, Moss, Caswell, Naqvi, and MacKinnon (2017), can be referred to as spatial reasoning skills. Kell, Lubinski, Benbow and Steiger (2013) consider spatial reasoning skills as a necessary component of innovation and scientific discovery. Spatial reasoning skills could, be developed through artistic activities, as a child is encouraged to 'see' an object in 3D before creating it; 4) observing is the ability to

see small differences in objects, to look closely and notice the underlying structure of things. Teaching children to look closely and to identify visual differences could aid learning in all subjects. Eisner (2017) claims that observational drawing requires focus on what is actually viewed rather than what is perceived. The development of observational skills is listed as a Major Process and Design Skill to be achieved through the study of NST (DBE, 2011); 5) reflection is the skill referring to the ability to consider own's work and that of others to assess it in terms of what was intended, what decisions were made and the outcomes of these decisions. Metacognition is encouraged through reflecting on your own work, where using Art in the classroom can make learning visual, and thus help children to reflect on the process of learning (Hetland et al., 2013). This reflective procedure exposes children to the idea that some problems do not have simple solutions, highlighting the multifaceted nature of learning (Foley, 2014). An ability to critically reflect on one's work is a skill that would complement several of the Major Processes and Design Skills listed in NST CAPS, for example, identifying problems, evaluating solutions and improving products (DBE, 2011, p. 12).

According to Krajcik and Delen, (2017, p. 3), "a student cannot learn the ideas of Science in isolation from the doing..." An Art-infused pedagogy may encourage NST teachers to focus on the 'doing' aspect of Science learning during lessons. For example, a NST teacher may instruct the class to draw the process of photosynthesis. The students will have to visually represent their thinking, in this way the drawing process complements the attainment of Science knowledge. To understand the nature of chlorophyll, a NST teacher may conduct an experiment leeching the 'green' from leaves and then ask the children to study leaves through painting them. The use of artistic activities may encourage a deeper understanding of Science knowledge. Including practical activities in the classroom has the added benefit of reducing the 'teacher talk-passive listener' situation (Goodlad, 1983), encouraging children to be actively involved in the learning process. James (2010) suggests that learning activities that involve doing aid the learning process and that providing educational activities that appeal to different types of intelligences/learning styles can create an empowering learning environment. While learning theories have received criticisms in terms of minimal scientific support and inconsistency, it is possible to state that "cognitive ability is multifaceted" (Willingham, Hughes, & Dobolyi, 2015, p. 267). In other words, individual children might think differently and thus might respond to learning activities in different ways. Introducing Art methodology into NST lessons could create an empowering learning environment, where the desire to learn increases as children are offered learning options that appeal to them (Deasy, 2008). Added to this, the drawing process may aid in the retention of NST content knowledge as the visual, kinaesthetic and linguistic parts of the brain are activated at the same time allowing for connections to be made across neural pathways (Hardiman, Mahinda, Bull, Carran & Shelton, 2019).

Educative Curriculum Materials (ECMs)

Educative Curriculum Materials (ECMs) are intentionally designed resources that promote teacher learning. Teachers gain knowledge of instructional approaches that can be utilised to engage learners and aid the learning process (Krajcik & Delen, 2017). The use of ECMs to promote both teacher and learner learning may provide a platform where knowledge can be applied in a diverse manner, through a variety of learning techniques (Ball & Cohen, 1996;

Davis & Krajcik, 2005). Teachers need robust subject matter knowledge, but they also need to develop pedagogical content knowledge (PCK). Gudmundsdottir and Shulman, (1987, p. 8) define PCK as:

That special amalgam of content and pedagogy that is uniquely the providence of teachers...PCK...represents the blending of content and pedagogy into an understanding of how particular topics, problems, or issues are organized, represented, and adapted to diverse interests and abilities of learners, and presented for instruction.

Essentially, PCK refers to a teacher's ability to synthesise knowledge of teaching experience gained while teaching with an understanding of the unique needs of specific children, resulting in an effective teaching strategy. Teachers with high levels of PCK are able to adapt teaching approaches to suit different educational situations, making choices that create effective learning environments. While ECMs might be effective tools to encourage both teacher and student learning, the teacher's pedagogical design capacity ultimately defines the effectiveness of the ECM (Bismack, Arias, Davis, & Palincsar; 2014). Brown (2009) defines a teacher's pedagogical design capacity as the ability to adapt the learning opportunities presented in an ECM to specific contexts. According to Davis and Krajcik (2005), teachers need to understand the rationale behind the information presented in an ECM and have the skills necessary to effectively present the learning goals. This approach to education provides an avenue for teachers to develop alongside the children in their respective classes. Meiring and Webb (2012) concluded that the use of ECMs promoted pre-service teacher's confidence levels in teaching Science. The use of an Art-based ECM could provide an innovative way of promoting learning in NST through "supporting teachers in learning new instructional practices" (Krajcik & Delen, 2017, p. 1).

METHODOLOGY

To empower NST teachers to utilise artistic methods in the teaching of NST an ECM was designed that focused on teacher learning and the application of skills in real-life educational practice. This ECM, termed 'The Art-education intervention' consisted of three parts: 1) a questionnaire, 2) semi-structured interview questions and 3) a PowerPoint presentation. During the individual intervention sessions, each participant was taught artistic skills (e.g. pencil and watercolour paint) through practical processes and introduced to some of the underlying thinking skills that can be developed through artistic activities (Hetland et al. 2013). The empirical evidence generated for the present study was based on the perceptions of ten NST teachers. This qualitative, interpretive study sought to emphasise the multiple perspectives of ten NST teachers while addressing similarities between cases (Creswell & Poth, 2018). Pre- and post-intervention interviews were conducted, audio recorded and analysed. Data were gathered systematically using semi-structured interview questions and an interactive questionnaire that required participants to draw and reflect. Analysis of data included a rigorous and creative approach, where case-based themes were generated through illuminating shared ideas raised by the participants themselves.

Research Question

According to the perceptions of ten Natural Sciences and Technology (NST) teachers, how might utilising artistic activities promote learning in NST?

Findings from Deasy (2008) and Westraadt (2011), suggest that the educational value of Art is not fully understood by all primary school teachers. Thus, pre-intervention data analysis focused on determining the participants' current exposure to Art, perception of Art and confidence level in teaching utilising artistic activities. This identified how participants understood and possibly utilised artistic processes before being exposed to an intervention designed to enhance these skills. Post-intervention data documented the participants' experiences of the ECM, focusing on the skills that the teachers developed, including their understanding of the concept of Process Art² and JLO's. The participants taught interdisciplinary (Art and NST) lessons during a period of approximately a month after engaging with the ECM. Final interviews gathered data concerning how participants utilised and interpreted what they had learnt and experienced in the ECM.

Research instruments

The ECM included hands-on experience with artistic methods as well as discussion-based learning facilitated by a PowerPoint presentation. At the end of the PowerPoint presentation participants were asked to teach a lesson designed to integrate the learning outcomes of Art and NST i.e. an interdisciplinary lesson. Termed, 'The Structure of Plants and Contour line' children were taught the basic structure of plants, e.g. roots, stems, leaves, seeds and fruits (NST), while learning about different line types (Art). The goals include the ability to verbally describe the visual differences in plants and communicate these findings (JLO). The cognitive development encouraged through this lesson is a deeper understanding of the natural world (JLO). Finally, the learning process included drawing, designing, measuring and comparing (JLO). Ideas regarding pedagogical approaches for this lesson were shared and Grade specific worksheets and lesson plans were provided.

Demographics

Ten participants from four different schools took part in the study. These teachers varied in age, teaching experience, gender and teaching style/pedagogies. This diverse sample can be viewed as an asset in terms of data, as the perceptions represented portray opinions from different contexts and personal situations. Thus, emphasis was placed on the uniqueness of each case while investigating possible links between cases (Yin, 2017). The function of this analysis was not to make generalisations but rather to highlight shared ideas. The ECM process was conducted at the participant's school, thus providing the opportunity to investigate each case within its context, thereby acknowledging the real-life situation of each teacher (Yin, 2017).

Ethical clearance for this study was given by the ethics committee (ref: H16-EDU-CPD-009).

² Process Art highlights the skills developed during the artistic process rather than only focusing on the final product (Hetland et al., 2013)

RESULT AND DISCUSSION

Interviews before the intervention highlighted three areas of interest, namely: exposure to Art; perceptions of using Art in teaching, and personal artistic confidence. Data suggested that all the participants were exposed to some form of artistic activities prior to the Art-education intervention, however, only two participants experienced practical training in utilising artistic activities in the classroom, suggesting that the educational value of Art has not been explicitly taught or currently exploited in schools (Deasy, 2008; Robson et al., 2005; Westraadt, 2011). From discussions with the participants concerning their perceptions and preconceptions of Art it was possible to conclude that a teacher's perception of Art could impact on their willingness to integrate artistic methods into their teaching pedagogy. For eight participants, Art appeared to be something separate to themselves. To them, Art is something that you find at an exhibition, hanging on the wall to be viewed, a picture that you copy or an activity that takes place in an Art classroom. These data suggest that most of the participants perceived Art as a specialist skill that was not part of their pedagogical approach to teaching NST. The purpose of this line of inquiry was twofold; first, to provide an opportunity for the participants to recognise and voice their own perceptions of Art, and second, to discuss the use of the term, 'artistic activities'. Here, artistic activities refer to any practical activity that aids learning, such as drawing, painting, poster design and model building, as well as the critical thinking processes involved in their production. This perception of Art demystifies the concept of Art, making it more accessible to the individual. Art is then viewed as an activity where tools such as watercolour and pencils could be utilised to aid in the teaching of NST.

Participants were unanimous in believing that artistic activities provide an opportunity for all children to feel successful in the classroom. Two participants recognised Art as a place where 'non-academic' children can succeed, claiming that *"You don't have to be super bright to get something down on paper"*, *"Nice place for other children to succeed, those that don't get full marks for Maths tests and essays."* (P2) and *"Non-academic children enjoy artistic activities more."* (P3). A possible underlying perception of these two participants might be that artistic activities don't require academic abilities. Art might be a place where children who may not have a high logistical or linguistic intelligence may shine, however, perceiving this success as a non-academic ability suggests that the educational value of Art might not be fully understood (Deasy, 2008; Robson et al., 2005; Westraadt, 2011). Thus, a goal of the Art-education intervention was to introduce and allow teachers to experience the learning benefits associate with Art, facilitating a deeper understanding of an Art-based pedagogy.

During the drawing activity, (part of the intervention/ECM), participants expressed doubts about their artistic capacities. Only P1 was completely comfortable when asked to draw. The other nine participants were either disparaging of their own abilities, intimidated by the fear of judgement, or initially bewildered by the concept of being asked to draw 'anything'. A disappointment in the final product can be a limiting factor in creative activities, as a person may feel disheartened. One way to counteract this is by focussing on the Process of Art making, where skills development such as focus, persistence and observation are key. The participants were introduced to this Process Art theory during the Art-education ECM. The three

participants who expressed disappointment in their drawings were able to identify this emotion and discussions were had as to whether children in their classes experience a similar emotion.

Before participants utilised the teaching of NST via an Arts-based pedagogy³ they identified time, or rather lack thereof, as a major potential impediment to implementing such a strategy in their own classrooms. This concern revolved around three aspects of ‘time’. First, the erosion of academic time due to other school commitments, second, the expectations of CAPS and third, preparation time. Participants are aware that artistic activities take time to prepare and that a lesson utilising such activities will take longer to teach. *“To do something artistically with someone will take time”* (P9). P5 encapsulated a teacher’s dilemma:

So, the question for teachers is, do I just want to get it done, the syllabus, or do I want to enhance their learning? So, if I’m going to paint... it’s going to take a whole other lesson, another hour, that I have to find to do it, whereas just showing the video and showing the slide and fill in the worksheet, is far less time. But what I need to say is, which creates longer learning and effectiveness? You have to weigh up, should I rather teach it better, or just sausage machine, just get it done. Teaching is not just cram the mind with things we forget in a month’s time (P5).

If a teacher perceives an activity as valuable and worth the time, then the activity will be included. Thus, a goal of the intervention was to utilise an ECM to demonstrate some of the learning benefits associated with artistic activities. In this way, teachers learnt to value artistic activities, despite the time challenge.

Post-intervention data suggests an Art-infused pedagogy promoted the development of spatial reasoning skills. The ability to Envision, to imagine something that is not yet in existence, is a skill that can be developed through artistic activities (Hetland et al., 2013). During discussions four participants linked the ability to envision with spatial reasoning skills, making specific reference to the ability to visualise objects, for example, *“mentally rotate boxes”* (P5). While there are a variety of definitions, spatial reasoning skills can be broadly defined as, “the cognitive skill of forming and manipulating mental images” (Hawes et al., 2017, p. 238). An ability to mentally visualise, construct and deconstruct could be useful skill in the study of NST. Indeed, Wai, Lubinski, and Benbow (2009) state that spatial reasoning skills play a primary role in determining which students join and succeed in STEM (Science, Technology, Engineering, Mathematics) disciplines. Thus, utilising artistic activities that focus on the development of spatial reasoning skills could be beneficial to learning in NST. Examples being: *“Like using leaves to explain symmetry”* (P8) and *“understanding the properties of light through imagining where the shadow would be”* (P7). An ability to envision, to use your imagination, is thus a cognitive skill that can be developed and a necessary skill for innovation (Kell et al., 2013).

³ The terms ‘Art-infused pedagogy’ and ‘Art-based pedagogy’ are used interchangeably throughout the article. These terms are synonyms and refer to an NST pedagogy that includes the use of artistic activities. For the purpose of this research project, artistic activities refer to any practical activity that aids learning, such as drawing, painting, poster design and model building, as well as the critical thinking processes involved in their production.

A skill or trait that participants experienced, and noted in their own teaching, was how the Arts-based pedagogy promoted the construct of Persistence. An ability to engage and persist is defined by Winner et al. (2006) as the capacity to remain focused on one activity for an extended period of time, while viewing obstacles as opportunities for discovery rather than reasons to give up (persistence). Participants P10 and P4 stated that the children in their classes were fearful of making mistakes. This is a critical issue as it is not possible to create something new, to innovate or be creative, or even to perform at to your potential, if you are fearful of making mistakes (Hinton, Miyamoto, & Della-Chiesa, 2008). Art activities could provide children with the set of circumstances to make mistakes, learn from them and, more importantly, view mistakes as learning opportunities. This attitude could complement their ability to conduct experiments in NST, where persistence and the embracing of learning through mistakes could be seen as a necessary requirement.

Participant P1 stated that the children in her class are often disappointed with their drawings, thus the ability to work through disappointment becomes the skill. Added to this, a child who is disappointed with his/her drawing may be encouraged to formulate a plan to improve their drawing skills, rather than giving up. Focusing on skills development introduces children to the learning opportunities that may not be obviously stated in each task. In this case, persistence is a skill that is useful in every aspect of life and a positive mental attitude is fundamental to learning (Hinton et al., 2008; Juan, Hannan, & Namome, 2018). This skills development approach to education is illustrated by P9, he says, *“A High School Physics teacher once told me that his best students were Art students because they were able to visualise problems and persist through them”*.

According to Hetland et al. (2013), the ability to reflect refers to an analysis of one’s own work in terms of decisions made and subsequent outcomes. Participant P6 highlighted the fact that the children in her class do not put effort into evaluative tasks. This statement suggests that there has been insufficient emphasis placed on the value of this skill and that children might not understand the learning potential of self-assessment. The ability to self-evaluate is essential to academic success in all disciplines, it is during the evaluation process that you discover mistakes and improve your technique, thus gaining knowledge about the task and yourself (Eisner, 2017). Utilising artistic activities in the classroom provides children with the opportunity to assess their own work and to critically reflect on the creative process. There is a big difference between teaching Art in a process-based manner versus in a product-focused manner, where you can *“teach skills that help them [children] in real life”* (P6). Or in P7’s words; *“It’s about preparing them for life.”* Four participants specifically stated that artistic activities could provide children with the opportunity to develop skills that would be beneficial to their holistic development.

Including a drawing activity in NST lessons provided an opportunity for the participants to closely observe the children in their class, thus developing their own observational skills and creating a metacognition space, while *“learning about the child”* (P4). The teachers reported improved motivation in some children as well as fewer discipline issues (P5 & P8). Seven participants pointed out an increased focus and engagement in the children which they attributed to the practical nature of the learning process. These results support findings from

Deasy (2008) and Robson et al. (2005), that artistic activities can create an empowering learning environment because they appeal to different learning styles and intelligence profiles. The development of observational skills is listed as a Major Process and Design Skill to be achieved through the study of NST (DBE, 2011). Four participants (P1, P4, P5 & P9) reported that the children in their respective classes developed observational skills during the interdisciplinary lesson. In P9's words, *"We made a connection between Art and Science and the importance of careful observation... they really started looking at the veins. Were they single or did they branch out? What do the edges of the leaf look like? Often, they [the children] just paint the thing, rather than looking for the subtleties in it."* Added to this, P4 and P9 noticed that the use of watercolour paint exposed children to a wide range of colours and tones, contributing to the development of their ability to see, describe and visually represent colour variations.

Fisher (2001) argues that developing thinking skills through classroom discussion can facilitate improved literacy levels. This can be achieved by asking open-ended questions that elicit individual opinions. Two participants (P1 & P9) asked open-ended questions such as; *"What does cropping do?"* (P1) and *"What is beauty?"* (P9), during the drawing activity, while P4 generated class discussion through a *"brainstorming"* activity. Therefore, utilising artistic activities in the classroom, may provide the opportunity for the development thinking and literacy skills through the use of open-ended questions and discussion.

The learning opportunities, for both teacher and child, of an Art-infused pedagogy are illustrated by P8: *"I have 30 years and 7 months teaching experience, and this was something special - this was one of my best lessons ever."* Participant P4 stated: *"So, they [the children] made the links... it was like oh! Wow! We can actually do Maths and Art and Science all at once... for me that was light-bulb moment."* The children in P4's class were encouraged to 'see' the connections between subjects, thus developing thinking skills and achieving Specific Aim 2 in NST: the promotion of connecting of ideas (DBE, 2011). She continues, *"And since then they [the children] have been putting the energy into their Design Tech... this is like what we were doing before linking Maths and Science and Art, and now we're doing it with Technology."* The children made connections during the interdisciplinary lesson, and they were able to apply this learning in new situations. Four participants commented that taking part in this study had facilitated metacognition on their part, where the benefits of an interrelated learning style were highlighted. In P4's words, *"Well I think probably you've made me go through my train of thought... We should be mixing our Sciences with our Design Tech."* Thus, their perceptions of Art and Science did not change but they were 'reminded'. This result is consistent with findings from Pringle et al. (2017) who concluded that the use of ECMs provided teachers with the opportunity to revise pedagogical practices.

CONCLUSIONS

The empirical evidence generated during the study suggests that, while a participant's previous practical experience/training could have contributed to their ability to integrate artistic activities in the classroom in terms of prior knowledge and possible comfort through experience, the training that the participants received in the ECM was sufficient to prepare them to teach the interdisciplinary lesson. However, a shift in perception is required. In P5's

words; “*And that’s a big shift then... rather how it [Art] can be used to compliment, enhance, motivate even, inspire you know, what we’re learning.*” She saw how the children responded with increased motivation and engagement and thus, was able to shift her perception of Art as external to her teaching pedagogy to an integrated and valued tool. Skills gained through the ECM positively affected five participants’ perceptions of their ability to integrate Art into the teaching of NST. The participants were able to adapt the artistic skills gained during the ECM to other areas of the curriculum, e.g. building space models (P1), life cycles (P4), painting lightbulbs (P5), line width to indicate levels of electricity (P7) and butterflies (P8). Added to this, the participants were able to adjust the interdisciplinary lesson to suit the needs of their class within their specific school environment, thus demonstrating that the ECM was successful in supporting the teachers PCK. Utilising artistic activities in the classroom promotes the use of open-ended questions, which in turn facilitates individual and class discussions where literacy skills can be enhanced through communication. Added to this, the use of artistic terminology (line, texture and colour) can facilitate the description of what is observed. Thus, artistic activities can provide both the opportunity for children to closely observe objects and the vocabulary to describe what they see.

Time constraints remain a stumbling block, in P10’s words, “*Yeah, I definitely think there is value [Art and Science integration], especially if you’re in an environment where you’re not so pressed for time. I would like to try incorporate it further.*”

Findings from the present case-study suggest that an Art-infused pedagogy can be utilised to foster a delight in the learning of NST. Artistic activities could be utilised to provide the ‘spark’ that gets children to engage with the NST content. Results suggest that judicious use of different approaches may enhance learning, with the use of artistic methodologies illustrating a very real potential to promote learning and understanding of NST in the Intermediate Phase.

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