Singapore Teachers' Perceptions of Integrating Social Values and Life Skills into Primary School Science Lessons

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ABSTRACT

Affective learning involves learners' emotions and belief systems. How the teacher facilitates affective learning has important implications for how enduring student learning experiences are and how parents view teacher effectiveness in school. The literature has reported that teaching and learning within the affective domain often face issues related to effectiveness, validity and teachers' readiness-to-teach. Despite such obstacles, learning in the affective and cognitive domains remains important. Teachers often have to choose between spending time preparing students for examinations and making efforts to influence students affectively in class. Usually the former prevails. It would be helpful if teachers had an "acceptable pedagogy" to practise effectively in both domains of learning. This paper shares the perceptions of sixty experienced Singapore Primary Science teachers who were introduced to the use of analogy, an established school science pedagogy, to raise awareness among students in positive social values and life skills during science lessons. Teachers who used this pedagogy to integrate learning in both the cognitive and affective domains in earlier work reported observing positive changes in student behaviour. The strategy is to capitalise on students' learning energy during a science lesson so as to provide a seamless transition towards discussing values and life skills in class. After completing a course on integrating science and affective learning, teachers' perceptions of the use of this pedagogy were collected and analysed. The teachers recognised the use of analogies as effective "teachable moments" supporting student learning in both the cognitive and affective domains. They indicated confidence in and support for the use of this pedagogy to engage students actively in the affective learning domain. Thus, integrating learning science concepts and discussing the associated value or life skill may then be considered an "acceptable pedagogy." As this pedagogy does not impinge on time and resources used in the learning of science in school, it is hoped that teachers, students, and parents are more likely to support its use in class.

Keywords: affective learning domain; life skills; primary school science; social values
Subject classification codes: primary science; values education

INTRODUCTION

Singapore is an island city-state with a land area of 718.3 square kilometres. As a young sovereign nation with no sustainable natural resources nor a hinterland to fall back on, her progress in economic and international status in the past 50 years has largely depended on the performance of her people, a multi-racial and multi-cultural population of about 5.4 million, comprising Chinese (74.1%), Malays (13.4%), Indians (9.2%) and other races (Department of Statistics, Singapore, 2015).

In economic, industrial and business terms, she is performing at the level of a first world nation, and in areas such as health and education, Singapore has done very well too (Coughlan, 2015; Economic Development Board, 2016; Haseltine, 2013; Spring Singapore, 2015). Despite her rapid economic growth and progress as a nation, and in common with many other successful economies around the world, concern and interest in developing her people in a holistic manner are often at the top of the government's agenda in national and economic development exercises (Lee, Goh, Fredricksen & Tan, 2008; Shanmugaratnam, 2010; Vasil, 2000).

Development gives national well-being and progress, but there are also pressing societal issues that arise from development which need to be addressed. For example, in the midst of pursuing progress, people and businesses tend to be negligent and ignorant of other important issues, such as those related to the environment (Omoju, 2014) and the degradation of societal values (Kumar & Srivastava, 2004; Mohapatra, 2004):

> "It is really very unfortunate that the quality of life today is assessed mainly by physical/material things that one possesses. As a consequence, people have stopped thinking almost completely about their basic responsibilities to the society, and the people have totally overlooked their social commitments, and ignored the values of human life (Kumar & Srivastava, 2004, p.57)"

Science has an important role to play in addressing problems in society, which include environmental and socio-emotional issues. In particular, school science curricula around the globe have been trying to find a balance between teaching children and helping them find interest and meaning in learning science in school.

"Science education is one of several media through which society intends to transmit what it considers to be clear, worthwhile, helpful and valuable to the present and succeeding generations (UNESCO, 1993, Chapter 2)."

In recent decades, there has been a "re-emergence" of interest in the teaching, learning, and researching of values-related topics and issues in school science education (Corrigan, Dillon, & Gunstone, 2007). However, the concept of values education is complex and would require a deeper and more extensive discussion. For the purposes of this discussion on the teaching and learning of values in school, the concept of positive social values is taken to mean the generic values that are commonly taught to children in school, like honesty, integrity, responsibility, respect, and being frugal. Likewise, a detailed discussion on what are life skills may be found

in various publications and theses in the literature, especially those related to 21st Century learning and thinking skills (Fadel, 2008; P21 Partnership, 2007). In this paper, life skills are taken to mean those that are generally acquired by students through social activities in which they are involved, either inside the classroom (such as group work) or outside school hours (such as their participation in co-curricular enrichment activities or social and community-based activities). Thus, essential life skills for the students would include skills such as the being able to communicate clearly, showing mutual respect when working as a group, being reflective when faced with a learning situation or a decision-making opportunity, and being able to manage their time and resources when working on a task or preparing to sit for major examinations.

Viewed this way, school science has two important educational objectives to fulfill. The first objective is to make students employable in content disciplines when they graduate (the cognitive domain of learning), while the second objective is to instill in these same students an awareness of positive social values, life skills, hope, and a sense of responsibility to make the world they live and work in a happy, peaceful and meaningful place. These two objectives should be quite commonly found in most school science curricula. However, to deliver these objectives in a balanced manner is another matter. Given the focus on academic excellence in schools, striking a balance is not an easy goal to achieve.

In the Singapore Educational System, holistic education has always played a large part in the school curriculum (Ministry of Education, [MoE], 2014, 2016c). Despite having a wholesome curriculum, stakeholders (especially parents, employers, administrators, and policymakers) remain concerned that students in schools may be developing into what is commonly referred to as the "Strawberry Generation" (Mark & Lim, 2012). Singapore students are provided with ample learning resources and opportunities. They are generally good in their studies at school and are also resourceful and effective in terms of finding and critically appraising information (OECD, 2012). However, they may not necessarily be as capable in using these resources and information wisely and meaningfully. This situation of concern could be the result of the high emphasis on academic achievement which society places on students, causing some to become stressed, or to become engrossed in performing well in examinations to enjoy their learning (Lo,

2013; My Paper, 2013; Straits Times, 2014).

In general, students living in an examination-conscious society have little time or motivation to learn about positive social values and life skills except those that can help them do well in examinations. Indeed, it is a global issue that emphasizing academic excellence has not helped school and university graduates become ready for the world of work. It is therefore common to hear employers lamenting the fact that graduates joining the workforce are generally not "work-ready" (Harris, 2013; van Horn, 2014; Weinstein, 2014).

Given the issues facing the younger generation today, there is a need to consider how schools can help provide the necessary learning opportunities and experiences for students, especially in the cognitive and affective domains of learning, so as to adequately prepare them to be part of the workforce upon graduation. This paper is an attempt to find a balanced and effective approach towards educating our younger generation of learners in both these domains. A group of Singapore science teachers had earlier tried using a classroom pedagogy, referred to as "reversed analogy," to integrate social values and life skills in science lessons in both primary and secondary schools. They had reportedly observed among students a raised level of awareness of and an ability to initiate constructive discussions in class about positive social values and life skills (Tan & Santhansasamy, 2012; Tan, Heng & Tan, 2013).

As teachers help students learn effectively in school, this paper will also report on the perceptions of teachers who had been introduced to this pedagogy while attending a professional development programme at the National Institute of Education in Singapore. It is important to establish teachers' perceptions, ideas, and opinions on the use of the "reversed analogy" pedagogy because such knowledge will help science educators and educational researchers to understand better and to lead efforts in refreshing current school science curricula and pedagogies. Hopefully, these efforts will also produce school graduates who are competent in science and technology knowledge and skills, and who are also compassionate and responsible

global citizens.

VALUES EDUCATION IN SINGAPORE SCHOOLS

The Singapore Science Curriculum Framework supports student learning experiences in all the different learning domains (MoE, 2014). A typical student in the mainstream Singapore educational system goes through six-year primary school education. This is followed by four to six years of secondary school, leading to the completion of the Singapore-Cambridge General Certificate of Education (the Ordinary and Advanced Level Examinations at the fourth/fifth year and sixth year respectively). The subjects examined cover topics prescribed in the examination syllabuses, which are periodically reviewed to update the content, processes, and policies (MoE, 2016a).

On top of these cognitive learning opportunities, subjects such as the sciences must also ensure students have adequate exposure to the affective elements of learning. The Science Curriculum Framework (MoE, 2014, p.1) prescribes the coverage of student learning experiences in the following areas: (i) the learning of science concepts and processes in students' everyday lives, (ii) the application of this knowledge and skills in society, and (iii) the importance of learning and applying science concepts and skills in maintaining the physical and biological health of the environment.

Beyond the examination syllabuses, students are also involved in co-curricular activities, participating in sports, the aesthetics and outdoor activities outside of school hours (MoE, 2016b). There are also structured programmes incorporated into the school curricular time where students are taught or are exposed to the learning of national education, social values, citizenship education and character building (MoE, 2016b,c). One core initiative in which all schools in Singapore are actively engaged relates to the 21st Century Competencies Framework (MoE, 2016c). Central to this Framework is the inculcation of core social and personal values and life skills that are essential to developing the student as a knowledgeable, compassionate and positively contributing 21st-century global citizen.

The Singapore government's efforts to ensure that students are holistically developed in school are therefore commendable. However, as in most educational settings, teachers are the main stakeholders with the greatest on-the-job challenges to face. To educate students to pass examinations and be employable calls for much

time and effort to be spent on students.

Many students and their parents are worried about not doing well in high-stakes examinations and hence losing out on the prospects of getting a good job. Thus, teachers are expected on the one hand to help students do well in examinations (that is, their professional responsibility in the cognitive domain of learning), and on the other hand, they are also expected to ensure students are exposed to appropriate and impactful learning experiences in the affective domain (that is, in building up their character, teaching them to be socio-emotionally stable and be positive in life). For teachers, doing well professionally in both domains of learning is important but challenging (Doherty, 2014; Loughran, 2005). The challenge is especially great when it involves teaching values and life skills to students. It would, therefore, be desirable if teachers could have a supportive pedagogy that effectively and seamlessly helps them perform their professional duties well in both learning domains.

THE AFFECTIVE DOMAIN OF LEARNING: IMPORTANCE AND ISSUES

Learning has often been classified into three main domains, namely, the cognitive, the affective and the psychomotor learning domains (Bloom, 1956; Buehl, 2009; Krathwohl, Bloom & Masia, 1964). While this classification helps to facilitate lesson planning and to evaluate how well learners are making progress in a learning situation, it has also placed learning objectives in school curricula into three distinct groups. Where high-stakes assessment is concerned, the distinctions between these learning domains become even more pronounced. Thus, in a science examination, students are assessed objectively on how well they can show evidence of knowing, understanding and applying the science facts and skills that were taught to them in school. That is, students are rank-ordered in the cognitive domain based on grades or scores from the results of their test-taking. On the other hand, students are rarely, if ever, assessed on their learning achievements in the affective domain. It is difficult to assess how curious, passionate or socio-emotionally stable a student is when he or she learns science in class. To pick an exact score or a grade to represent the extent of student learning in the affective domain (especially for a norm-referenced assessment) is technically difficult. Nevertheless, learning in the affective domain is gaining importance in society (Anderson & Bourke, 2000; Popham, 2010).

Proponents of the importance of cognitive and affective learning in school, point to the implicit affective nature of learning objectives in the cognitive domain.

Krathwohl (2012) explained that "nearly all cognitive objectives have an affective component if we search for it (p.201)". It is therefore left to the teachers to induct their students into developing an interest in what they are being taught, then hope that by doing so their students will have caught certain positive attitudes related to this learning experience. These "positive" goals, however, often remain unspecified and hence cannot be objectively evaluated. Krathwohl (2012) further suggested that "in the affective domain, we are more concerned that he *does do it* when it is appropriate after he has learned that he *can do it* (p.201)." Thus, in the cognitive domain, the student would be deemed to have achieved effective learning if he or she "*can do it*." Similarly, the student would have learnt in the affective domain if he or she "*does do it*" when the need to do it arises (including situations where no formal grading is involved). In a typical school situation, assessing if a student "*can do it*" is not an issue because of the objectiveness of paper-and-pen assessment. However, the same cannot be said of assessing how well a student "*does do it*" as the learning objectives fall within the domain of emotions, habits, and feelings. Progress in these attributes of learning is not easily nor objectively measured, because the writing of learning objectives in the affective domain involved "attitudes, feelings, and emotions (which are) difficult to translate into overt, observable behaviours (Moore & Handsen, 2012, p.102)".

To help address this concern regarding how student learning in the affective domain might be assessed, it would be useful to consider strategies that are known to have helped people learn effectively. One such strategy, as proposed by management learning experts, including Steven Covey, author of the well-known book "*7 Habits of Highly Effective People*" is habit forming (Covey, 1990). Simply put, an essential criterion to form a habit is for the learner to be exposed to that habit of thinking or action on a regular basis. Thus, if a student is exposed to similar learning opportunities over a period to ensure that he or she "*does do it*," perhaps in a broader perspective student achievement in the affective domain may be more likely to be realised. That is, the teacher can help the student build a habit of learning (in the affective domain) and observe over a period if he or she "*does do it*" when an appropriate learning opportunity is presented.

The use of a pedagogy that integrates learning in both domains (referred to as an integrative pedagogy) is a strategy likely to help students build that habit of

identifying a positive social value or life skill. When students are focused on doing well in science examinations, they would usually be attentive and participative in class. The teacher can, during the same science lesson, insert a short but appropriate affective learning opportunity. Students could then be frequently exposed to such short affective learning situations. They would then be more likely to form a learning habit in the affective domain. The integrative pedagogy used in this paper is known as "reversed analogy." The use of analogies is a time-tested pedagogy to help the student understand abstract science concepts (Harrison & Coll, 2008). A common everyday experience or object (referred to as the "analog") is described and then used to illustrate how a scientific concept work or exist (referred to as the "target"). Conversely, we can also use a freshly taught science concept (referred to as the "reversed analog") to engage students to be more aware or to understand the importance of an appropriate positive social value and life skill (referred to as the "reversed target"). Table 1 shows some examples to explain how the integrative pedagogy of "reversed analogy" works.

Table 1: Uses of "Analogies" and "Reversed Analogies" in Science

Two examples on use the of an Analogy		**Two examples on the use of a Reversed Analogy**	
Analog	**Target**	**Reversed Analog**	**Reversed Target**
Lock-and-key. Only by using your own specific key can you unlock and open the door of your house.	Enzyme digestive action on food. Only a specific enzyme can act on a specific type of food.	The function of tree roots in a windy thunderstorm. In a windy thunderstorm, the healthy roots of the tree help to anchor it firmly into the soil thus preventing it from being uprooted.	Importance of good relationships with relatives and friends during a crisis. During a crisis, strong support from relatives and friends can help you overcome your difficulties and problems.
Water flows in a closed circuit. Water flows when pumped through in a closed circuit of piping.	Electrons flow in a closed circuit. Electrons, hence electricity, flow when connected to a battery in a closed circuit of wire.	We cannot see through a glass of muddy water. To be able to look through the glass we need to let the muddy sediments settle to the bottom of the water.	We cannot think clearly if our mind is confused or tired. To think clearly, for example before we make an important decision, we need to rest our mind so that we can be calm and clear-minded when making our decision.

TEACHERS' PERCEPTIONS ON THE USE OF "REVERSED ANALOGIES"

The use of reversed analogies in Singapore schools has been reported in several published articles (Tan & Santhanasamy, 2012; Tan, Heng, & Tan, 2013). These articles were shared with a group of 60 primary science teachers (each of whom have more than three years' teaching experience) attending the Advanced Diploma and Certificate in Primary Science Education Programmes at the National Institute of Education, in Singapore (class of 2014, n = 28; class of 2015, n = 32). In the programmes, the teachers took a course on Holistic Assessment in Primary Science (Course Code INS4408, 3 Academic Units, or AUs) in which one of the components was on affective learning (1 AU, or a 12-hour segment of the course) exposed them to the use of a specific science concept or skill as an analogy to help students learn about the importance of a social value or life skill. The desired learning outcome of the reversed analogy pedagogy is achieved when the teacher observes that students are able to participate in a discussion on or to provide examples of positive social values or life skills (Tan & Santhanasamy, 2012; Tan, Heng, & Tan, 2013).

The teachers in the course reported in this paper were given examples of reversed analogies such as those illustrated earlier in Table 1. They were then encouraged to imagine themselves as students being asked to suggest and discuss appropriate social values or life skills that could be illustrated by the newly taught or learnt science concept or skill. Table 2 shows examples of science concepts that can be used as reversed analogies in primary science lessons.

Table 2. Examples of reversed analogies in primary science lessons

	Science concepts or skills (Reversed Analogues)	**Positive Social Values or Life skills (Reversed Targets)**
1	Biological/Life Sciences Functions of tree roots are to anchor the tree firmly into the soil and to help the plant absorb water and nutrients [Theme: Systems; Topic: Water absorption in plants, MoE, 2014]	Positive Social Values: Strong and extensive relationships with friends and loved ones (like the roots of the tree) make our lives more emotionally and socially secure and stable (like the healthy tree roots giving it firm ground support and enough nutrients to keep it strong and healthy).
2	Physical Sciences: A rectangular block of wood is most stable if it is standing on its side with the largest surface area (centre of mass is low, close to the base). [Theme: Interactions; Topic: Forces, MoE, 2014]	Life Skills: If we develop good inter-personal relationships, we will have a large base of supporters (like standing the rectangular block of wood on its side with the largest surface area). One way to cultivate good inter-personal relationship is to be close to the people you work with (like the centre of mass of the block of wood being close to its base).

After completing the course, the teachers were asked to reflect on what they

had learnt about Affective Learning in Primary Science, including their attempts to use the integrative pedagogy of reversed analogy and other teaching strategies and activities involving inquiry, curiosity, and investigation. They wrote and submitted their responses to the following general statement, which was posed as part of their end-of-course assignment (in the format of a 300-500 word reflective essay): "*The Significance of Teaching, Learning and Assessment of Primary Science in the Affective Domain*."

From the sixty teachers' reflective responses, three main areas of concern were identified. These were: (i) learning school science in the affective domain, (ii) feasibility on the use of "reversed analogies," and, (iii) the teacher's roles in Affective Learning in Science. Table 3 lists typical samples of the teachers' perceptive responses on the affective domain of learning in primary science.

Table 3. Teachers' perceptions of affective learning in primary science.

Area of Concern: Learning school science in the affective domain

Teacher code	Teachers' Expressed Perceptions (submitted original responses)
Teacher A1	Until I attended this course, the possibility of teaching primary science in the affective domain seemed far-fetched. Now I realised that the missing component in my science lesson plans is the affective domain component. In my opinion, the science subject is a practical subject as it also has domains for skills and processes as well as ethics and attitudes for every learning objective which goes hand in hand with teaching the affective domain to pupils.
Teacher A2	This development of the affective domain of the individual is not a matter of remembering some values or ethics but the internalization of these values and ethics into the person such that over time, they are inseparable from the person and the person embodies the very values and ethics they believe.
Teacher A3	Science lessons have many teachable moments to impart values. After learning the scientific concepts, the teacher can make connections between the concepts and values to raise awareness of a value or life skill. In this case, values are not inculcated through chalk and talk method which pupils may not resonate (well) with and internalise. By linking the values with a familiar situation in Science, pupils will be able to remember the values better and resonate with the values taught as they have a familiar context to fall on.
Teacher A4	…the teaching of Primary Science in the affective domain is to me, the most challenging and mind-boggling.
Teacher A5	In many ways, the affective domain holds sway to the pupils' eagerness to study, his motivations to acquire and apply new knowledge as well as his capacity to appreciate new ideas.
Teacher A6	Being teachers, most of us are very focused on producing good results for our students and helping them achieve academic excellence. We are too focused on helping to develop students' cognitive domain that we might have overlooked the most important aspect of a student's learning, which is the affective domain.
Teacher A7	I have to confess that in my many years of teaching Science, I have never really given much thought to the affective domain in teaching the subject.

	In our earnestness to prepare students for national exams, we tend to focus more on the cognitive domain. If any aspect of affective domain is touched on during lessons, it is more incidental teachable moment than something deliberately planned.
Teacher A8	Affective Learning involves growth in the emotional domain dealing with changes in interest, attitudes, and values… the science curriculum is about nurturing student to become an inquirer,…(and involves) hands-on investigative activities, (curiosity and exploration).
Teacher A9	When a pupil comes to us at a tender age of 9, we have a strong influence on how he/she would view the world in the years to come. Many pupils have an inherent curiosity about things around them. In our quest to complete our lessons, are we suppressing such curiosity and reducing them to merely mugging on various theories and scientific knowledge?
Teacher A10	…there are only four or six science periods allocated to classroom teaching a week, and that may explain why teachers place greater importance over (sic) the attainment of cognitive learning objectives, rather than seeking to attain affective learning objectives.
Teacher A11	…in order for the teaching and learning in the affective domain to be pervasive enough to create such a large impact…we must put the assessment of it in place to motivate the pursuit of the desirable outcomes of education.
Teacher A12	….it dawned unto me on the paradox….that we need Science to study behaviours (Behavioural Sciences) and we need the right behaviours in the study of Science.
Teacher A13	…I believe that values cannot be taught within a lesson or two. Instead, it should be taught at an appropriate time or teachable moments over a period so that the students can internalise the values learned.
Teacher A14	When learners see the relevance and value of their learning in their lives, they will develop a more positive attitude towards the subject and become more motivated thinkers and problem-solvers.

(B) Area of Concern: Feasibility on the use of "reversed analogies"

Teacher code	**Teachers' Expressed Perceptions (submitted original responses)**
Teacher B1	Using science lesson to surface values, students can be more appreciative of their lives. They will reflect on how their actions or personal habits can, directly and indirectly, affect the people and environment around them.
Teacher B2	(The use of 'reversed analogies')…challenges teachers to be creative in sieving the affective teaching points behind what would usually be an ordinary science activity.
Teacher B3	Students will be able to reflect on their attitudes towards life.
Teacher B4	In schools, there is always a challenge to teach values, simply because values are not readily measurable. The actions of an individual come from his beliefs to do what is right in a given situation. With the strategies taught in this course, this challenge would be lessened. The result is that it feels more authentic and relevant without being seen as isolated teaching.
Teacher B5	I find the use of reversed analogy a refreshing and creative way to teach values or life skills to the students….By likening the science concepts to a value, the teacher engages the students in a fruitful discussion where they could voice their own opinions. I believe the students will find it more interesting and they are more likely to participate in the discussion…
Teacher B6	Perhaps it is true that we teachers concentrated all our energy and time to ensure that we do not shortchange our students academically. With such a shortage of time, students' attitudes, interests, and values in learning take a back seat.

Teacher B7	If students are not able to comprehend and understand the Science concept, it is better to avoid bringing in the affective domain as it will confuse the students further and may even cause misconceptions of science concept.
Teacher B8	Science lessons are very good opportunities to surface values, inculcate habits and the teaching of soft skills. As specific values can be linked to the science topic, the 'teaching' of values can be deliberately weaved into the lessons. An example is a lesson on the adaption of plants. The teacher could teach about how flowers do bloom in the desert, a very harsh environment. One could link it to how humans too, can bloom where they are planted (sic) because they learn to adapt.
Teacher B9	I would include a reversed analogy strategy during a lesson on elastic spring force for Primary 6 pupils. The weights added to the spring are the problems the pupils face (in life). I would then discuss the maximum mass the spring can take before it snaps, highlighting the importance of realizing their problems before 'break point' happens.

(C) Area of Concern: The teacher's roles in Affective Learning in Science

Teacher code	**Teachers' Expressed Perceptions (submitted original responses)**
Teacher C1	As science teachers, we have to realize that our responsibility is not merely imparting content knowledge into our pupils. We have to equip our pupils with ethics and attitudes so that pupils can engage in science-related issues as a reflective citizen.
Teacher C2	(Agree that we should) "teach and prepare the younger generation to be that effective 21st-century worker-citizen with an inquiring mind and a compassionate heart (Tan, 2013)". Both adjectives (inquiring and compassionate) operate in different domains.
Teacher C3	…as educators, when we explicitly draw the connections from skills used in academic subjects to real-life situations, pupils can be taught to apply these skills and values learned in the affective domain as well.
Teacher C4	As an educator, instilling the affective domain in students' learning will not be enough if there are no ways of assessing how effective their learning is. Again, how can one assess values? I believe it is a challenge to assess the affective domain. Even with well-crafted rubrics, it is sometimes unfair to place a ranking over values because what is seen at times may not be consistent with what is unseen….it is still important to find ways and means to assess the effectiveness of affective learning else there will not be any way of evaluating for improvement.
Teacher C5	I feel that these modes of (affective) assessments cannot be used on a one-off basis, but it should be conducted over a substantial length of time to ensure the validity of the indication of individual students' emotions and feelings. This is because the emotions and feeling of the assessed targets can fluctuate quickly and hence cannot be ascertained just by a one-time assessment. I also feel that there must be a certain level of "trust" between the teacher and the assessed targets (students) so that students will not have any reservations about writing down their honest views, thus not hampering the teacher's assessment.
Teacher C6	(As teachers) we do not want students to be book or examination smart but also a person with sound values who can help the people around him and care for the world he/she lives in.
Teacher C7	It is now timely for me to seriously consider taking an integrative approach to the teaching of science that balances the cognitive and affective domains….All I need is to take 5 to 10 minutes towards the end of the

	lesson for the students to discuss the lesson to draw out the value that can relate to their daily lives.
Teacher C8	Primary Science is definitely one subject that can help to shape the affective domain of students through teaching and learning as there are many activities for students to explore that are often linked to real life issues. I believe that teachers understand the importance of teaching science in the affective domains and that they do want to prepare the students to have an inquiring mind and for them to learn how to show care and concern. Equipping them with the strategies to integrate the different domains in the teaching of science may help to elevate the apprehension from teachers.
Teacher C9	It is important to focus on these two levels first ["receiving" and "responding" in the Affective Domain] before we move on to the next level which is valuing. This is because the pupils in the lower primary will need a lot of scaffolding and guidance. The valuing level could be done by the upper primary pupils such as primary 5 and 6 as they have a certain maturity level and knowledge to support and debate an idea brought up in class. Boundaries can also be set up by the teacher, so the pupils will always be respectful to each other during the discussions.
Teacher C10	In incorporating the Affective Domain in the teaching of Science, teachers must be aware of the learner's sensitivity to the existence of stimuli – awareness, willingness to receive, or selected attention (sic). We must also be aware of their resistance to responding, their organisational skills and thoughts about their values as well as act on their values with their skill set.

DISCUSSION

Currently, in Singapore, primary school teachers are not required to be university graduates, and few who are assigned to teach science in primary school have a science degree. All the teachers involved in this exercise, however, had at least three years of experience teaching science in a primary school in Singapore. Given their classroom experiences, and their participation in the 12-hour course on Affective Learning in Science Education, their responses were not expected to be academic, but rather to be well thought. They had been thorough in their reflection and had provided insights into how practising teachers see the teaching of values and life skills in school science lessons. These insights could provide useful information and ideas to science educators, researchers, and policymakers when considering research, development and implementation work in the affective learning domain in school science. From the teachers' reflective essays, their responses may generally be classified into one or more of the following strands:

On learning school science in the affective domain.

Although the teachers were all experienced practitioners, it was unlikely that they had ever thought about teaching science and values or life skills together during the same lesson (Teachers A1, A4, A7, A12 in Table 3). Also, a commonly cited reason why the area of affective learning seemed remote in school science lessons was the significant focus on academic excellence. Due to such emphasis, teachers and students spend a large part of their curricular time completing the syllabus, attempting past examination papers, and revising facts and information learnt in earlier lessons (Teachers A6, A7). Despite not giving much thought about teaching students in the affective domain before, the teachers generally agreed that learning in this domain is important and that they would be putting more thought into incorporating learning opportunities for their students in this domain from now on (Teachers A1, A2, A6, A9). By capitalising on their professional knowledge and expertise in teaching science to young learners, the teachers also offered suggestions for making learning in the affective domain impactful. There was general agreement that science lends itself to the teaching of values and life skills very well as the subject offers many opportunities to engage students in experiential learning activities, especially by linking science to their everyday life experiences (Teachers A1, A3, A8). They were confident that by engaging students in the affective learning domain, the students would be able to see relevance and meaning in what they are learning in class. This is important as it will build an attitude of curiosity, raise interest levels and create an awareness of good social habits and useful life skills (Teachers A3, A5, A8, A9, A14). However, they cautioned that the ultimate test of the impact of teaching students to learn in the affective domain still lies in how the students can be fairly and reliably evaluated on their learning. Some teachers then suggested that assessment in the affective domain, like picking up positive values, good habits and life skills, necessitate providing more time and opportunities for the students to develop the habits of learning (Teachers A11, A13).

(B) On the feasibility of using "reversed analogies"

The teachers were generally supportive of the use of this pedagogy, citing it as "a refreshing and creative way to teach values or life skills to the students (Teacher B5)". Teachers would be challenged to think up new associations (the reversed analogies) and also decide how to counter-respond to students' responses and queries about these values (Teachers B4, B5). The main factors that drew these teachers to support this pedagogy were probably, (i) the fact that teachers need not to be seen as explicitly wanting students

to learn values (Teachers B1, B2, B3), and (ii) that not much extra time and resources are needed since the affective activity can be strategically built into the routine learning activities during the science lesson (Teachers B4, B6, C7). Although it was not required of them, at least two teachers responded eagerly by suggesting how certain science concepts could be used as "reversed analogies" to raise student awareness of values in their classes (Teachers B8, B9). However, the teachers' general enthusiasm on the use of this pedagogy is not without concerns. One teacher correctly brought up the possibility that academically weaker students may not understand the science concepts being taught. If the teacher continues to use the reversed analogy pedagogy to illustrate an affective attribute in the lesson, the teacher feared students might become even more confused (Teacher B7). This is a very real issue and is, in fact, a cited limitation of the use of this pedagogy (Tan & Santhanasamy, 2012; Tan, Heng & Tan, 2013). It is best in such cases for the teacher not to use the pedagogy and remain focused on helping students learn the facts. The teachers also had other concerns, apart from their professional readiness to use the pedagogy. Although the time needed to implement this strategy is manageable (Teachers B3, B4, C7) the initial planning and mental preparation might still be eating into the time allocated to teach science to the students (Teachers A13, B6, C5, C9). The most pressing issue, however, was one not specifically targeted at the pedagogy, but the difficulty in assessing whether the student did indeed learn and embrace the value being taught (Teachers A11, C5). Assessment in the affective domain is a deep-rooted issue and will need to be carefully studied. However, more important than having a good assessment system is the impact the pedagogy has in helping students sustain their learning in a more meaningful manner. The role of implementing the pedagogy in the classroom falls squarely on the teacher.

(C) On teacher's roles in affective learning in science.

Regarding their professional roles and expectations as teachers, most of the teachers' comments were encouraging, reflecting the high affective qualities of the teaching workforce in Singapore. The teachers recognised the need for and importance of teaching positive social values and imparting life skills to their students (Teachers C2, C6, and C8). Despite the obstacles and difficulties which they faced, the teachers generally wanted to be involved in helping students do well in both science examinations and also in life (Teacher C6). As illustrated by the comment of Teacher C1, teachers do realise that their "responsibility is not merely imparting content knowledge into our

students…(but also) to equip our pupils with ethics and attitudes so pupils can engage in science-related issues as a reflective citizen (Teacher C1)."

From the general responses gathered there is a clear sense that this group of teachers took the integrative pedagogy seriously. They did support it as a possible (perhaps also "acceptable") pedagogy that can help them teach well in both domains. They saw the approach as an alignment to the Science Curriculum Framework (inquiry and content learning, MoE, 2014), the 21st Century Competency Framework (life skills) and the Character and Citizenship Education Curriculum (values education, MoE, 2016c). However, the teachers were also aware that helping students learn values and life skills effectively are just one critical part of the equation of an impactful affective learning effort in school. The other critical part is the existence of a valid, reliable and fair assessment system for the affective learning domain (Teachers C4, C5). Until a concrete system is in place that provides a valid, reliable and fair assessment of student learning in the affective learning domain, it may not be easy to achieve widespread buy-in by teachers to teach both facts and feelings even if these are to be covered in one lesson (Teachers C4, C5). After all, there is a common saying in education that "assessment drives learning." The teachers in this exercise understood this and were willing to try out the interactive pedagogy, but they probably were not sure how to judge its effectiveness, except by the anecdotal reports which they read in the published articles in this area. Thus, more research and development work in this area will need to be done.

Finally, when the teachers reflected on their experiences teaching children in primary school, they were able to suggest age-appropriate and perhaps also culturally sensitive approaches to teaching and evaluating learning of values and life skills to their children (Teachers C5, C9, C10). For instance, they knew that once students are experiencing success in their learning of science, they will become motivated to want to learn more. It is at such moments when students are most attentive that their teacher can best engage them to think about affective learning tasks. This is precisely the strategy that the integrative pedagogy of "reversed analogy" is relying on when it is used in a science lesson to help students become more affectively aware of good

social values and life skills.

CONCLUSION

The use of the integrative pedagogy of "reversed analogy" in science lessons is not entirely new. However, by reversing the analogs and the targets, students can be brought to a higher level of awareness in learning about values and life skills in the affective domain. Teachers in this reflective exercise generally expressed support for this pedagogy, citing its feasibility because of the minimal time and resources needed, and that as teachers they would be comfortable using it to impart values and life skills to their students. In fact, by using this pedagogy, they are not seen to be explicitly teaching students the values and life skills. This can be impactful and effective because students probably learn better by noticing the relevance and meaning in their learning experiences than by being explicitly told what they should be learning. Thus, by integrating the learning of science concepts with an associated value or life skill, the use of the "reversed analogy" pedagogy may be considered an "acceptable pedagogy" for the teachers to consider. As the pedagogy does not impinge on time and resources used in the learning of science in school, teachers, students, and parents are more likely to support its use in class. Whether this pedagogy can materialise as a commonly used strategy in science classrooms, to teach values and life skills, remains to be seen. More work could be done in the affective domain especially on studies involving empirical methods and assessment.

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