PROJECTS ON LEARNING ENGAGEMENTS IN AFFECTIVE SCIENCE EDUCATION (PLEASE)

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Paper presented at the 3rd Redesigning Pedagogy International Conference
2nd June 2009, Singapore
Abstract

Whenever Bloom’s Taxonomy is taught in pre-service teacher training courses, trainee teachers are introduced to a comprehensive spread of learning objectives. They are encouraged to deliver these objectives to their future students. If we, as experienced teachers, are to pause and think about how much time and effort we have put into meeting these objectives in our teaching career, it will come as no surprise that objectives in the affective domain are often overlooked or considered poor, distant cousins of those in the cognitive and psychomotor domains. Although the focus now is still on academic excellence, voices supporting a more balanced approach to educating our future generations are growing louder. It is time to seriously think about lifting the profile of the affective domain. This paper introduces a research-practice initiative on infusing affective education in Singapore science classrooms. It proposes to work on translating recommendations from research and practices in affective education into science lessons in both primary and secondary schools while keeping the focus on the cognitive and psychomotor objectives intact. This three-year long initiative aims (1) to produce curricular materials and engaged learning pedagogy for developing positive learning attitudes, values and skills (including soft skills) among students while meeting learning objectives in the cognitive and psychomotor domains; and, (2) to explore the impact of affective education in preparing students for a career in science and technology. The approach is to co-ordinate and document short term classroom-based research projects and practice experiences by teachers in schools (hence the term “Projects” in the title). Findings and recommendations from these projects could then be used to build a case for a more structured programme to develop science students into competent Science and Technology professionals who are also compassionate, responsible and resilient citizens of the world.
The Growing Importance of Affective Science Education

Whenever Bloom’s Taxonomy is taught in pre-service teacher training courses, trainee teachers are introduced to a comprehensive spread of learning objectives (Baker, Almerico & Thornton, 2007; Bleicher, 2007). Often, they are encouraged to deliver these objectives to their students on their permanent posting to schools. Given the focus on achievement in academic and co-curricular areas like competitions in uniformed groups, the arts and aesthetics, there is really little time for teachers to explore ways to raise students’ awareness of good and positive social values and habits. Yet embracing, cultivating or being aware of these values and habits are important to the learning experiences of the students, especially with calls by employers today for schools, institutions and universities to teach their students important life skills, sometimes referred to as soft skills (Andrews & Higson, 2008; Buhler, 2001; Elredge, 2006) or, specifically as the 21st century skills (Lemke, 2002).

Some experienced teachers might have tried delivering learning objectives within the affective domain, often as a personal commitment or as part of the school’s social emotional learning programme. Some other teachers might have overlooked these objectives, considering these as poor, distant cousins to those in the cognitive and psychomotor domains which are officially assessed. Yet, the science syllabuses at all levels contain explicitly described aims and learning objectives in the affective domain. Table 1 shows some of the affective curricular statements in the science syllabuses, all of which have been clearly crafted to reflect the current needs of society and the industry.
Table 1

Sample affective learning objectives/statements in the Singapore school science syllabuses.

Level: Primary Science  (MOE, 2008b)

(1) “The Primary Science Syllabus aims to: .. provide primary students with experiences which build on their interest\textsuperscript{1} in and stimulate their curiosity about their environment… (and) provide students with opportunities to develop skills, habits of mind and attitudes necessary for scientific inquiry (p.4)”.

(2) “In scientific inquiry, the adoption of certain mental attitudes such as Curiosity, Creativity, Objectivity, Integrity, Open-mindedness, Perseverance and Responsibility is advocated. Students can also discuss the ethical implications of science and technology (p.9 & 14)”

(3) Learning outcomes listed in the column “ethics and attitudes” on p.18-45).


(1) Statements like those found in the Primary Science syllabuses can be found throughout the LSS syllabuses, particularly under the section of “AIMS” on p.4.

(2) “It is hoped that teachers will incorporate the social, environmental, economic and technological aspects of science whenever possible throughout the syllabus (see Aims (iv) and (v)). Where appropriate, students should also have opportunities to discuss the ethical implications of science and technology (p.4).”

(3) Learning outcomes listed in the column “ethics and attitudes” on p.19-39).


“... (2) develop abilities and skills that... (2.1) are relevant to the study and practice of science; (2.2) are useful in everyday life; (2.3) encourage efficient and safe practice; (2.4) encourage effective communication. (3) develop attitudes relevant to science such as (3.1) accuracy and precision; (3.2) objectivity; (3.3) integrity; (3.4) enquiry; (3.5) initiative; (3.6) inventiveness. (4) stimulate interest in and care for the environment. (5) promote an awareness that (5.1) the study and practice of science are co-operative and cumulative activities, and are subject to social, economic, technological, ethical and cultural influences and limitations; (5.2) the applications of sciences may be both beneficial and detrimental to the individual, the community and the environment (p.1-2).”


(1) Statements like those found in the 5072 Chemistry syllabus can be found throughout the H2 Chemistry syllabus, particularly under the section of “AIMS” on p.1-2.

(2) “INTRODUCTION. …the need for students to develop skills that will be of long term value in an increasingly technological world rather than focusing on large quantities of factual material which may have only short term relevance (p.1).”

\textsuperscript{1} italic words – emphasis, that of the author’s
The tight school curricular schedules are often leaving teachers and students hardly
time to involve themselves in more explicit learning opportunities within the Affective
Domain. However, it would be unfair to claim that schools (hence teachers) are not doing
much to deliver these learning objectives in the syllabuses. Despite the constraint of time and
resources (including human resources), school-based integration of curricular and enrichment
programmes are abound in Singapore schools as efforts are made to “marry” the
cognitive/psychomotor domains and the affective domain the various science enrichment
programmes (Ministry of Education [MOE], 2007; Tan, Goh, & Chia, 2006.). Such
programmes are often supported at school or even at the policy level (MOE, 2008). Although
these programmes and policies can make a deep positive impact on the overall learning
experiences of specially targeted groups of students, it is at the frontline (during lesson
delivery) that the affective domain objectives can be delivered to produce concrete
achievement and lasting impact on a wider scale. The problem is that teachers may find the
tension of having to simultaneously meet syllabus requirements and nurturing students’ social
and emotional learning development overwhelming. However, if teachers do not take the
delivery of objectives in the different domains as a competition for their class times, for
example, if social emotional learning, or SEL, is not positioned “as a counterweight to
cognitive development (MOE, 2007, p.5)”, then the situation would not be that tense. One
possible approach is to integrate learning opportunities for students such that the cognitive
and affective domains’ objectives can be achieved effectively by teaching concepts using
strategies that can build awareness in the affective traits. This may be done using engaged
pedagogy and strategically crafted curricular materials to integrate learning such that the
cognitive and affective domains’ learning objectives maybe achieved simultaneously. Since
schools already have very good support from the Ministry of Education in pedagogy and
curricular development through programmes like PETALS and SAIL (MOE, 2008a).
would be helpful if teachers, educators and researchers have access to subject-specific information on activities in pedagogy, curricular materials development and research that integrate learning objectives in the various domains. This paper is an introduction to such an initiative.

**Significance and objectives of PLEASE**

PLEASE is a research-practice initiative on how affective education in Singapore science classrooms and laboratories are, or may be, integrated. It proposes to work on translating recommendations from research and practices in affective education into science lessons in both primary and secondary schools while keeping the focus on the cognitive and psychomotor objectives intact. This three-year long initiative aims to

1. produce curricular materials and engaged learning pedagogy for developing positive learning attitudes, values and skills (including soft skills) among students while meeting learning objectives in the cognitive and psychomotor domains; and,
2. to explore the impact of affective education in preparing students for a career in science and technology.

The objectives of PLEASE are

1. to establish teaching practices for effective integration of learning objectives in the various domains (PEDAGOGY),
2. to develop curricular materials (for examples, written tasks, experiments, and teaching-learning aids) that may be used by teachers to teach, and students to
learn, science concepts through the use of analogies in daily life events or through the use of science inquiry learning processes (CURRICLUM), and,

(3) to study the impact of these teaching practices and curricular materials on their effectiveness in raising students’ awareness, level of acceptance (embracing) and frequency of practice in affective traits involving positive social values, habits and soft skills (RESEARCH).

Some Published Work in Affective Science Education

In 1956, Benjamin Bloom, a well known educational psychologist from the University of Chicago, proposed three sets of learning objectives, namely, in three domain areas of learning: the affective, cognitive and the psychomotor domains (Anderson, 2001; Bloom, 1956). Each set comprised a hierarchical list of objectives from which the learner will progress from mastering the basics to achieving knowledge and skills described by the learning objectives higher up the hierarchy. This should provide students with learning opportunities that would develop them holistically (Anderson, 2001). Then, in 1964, together with Bloom and Masia, Krathwohl came up a set of educational objectives that are more specific to the affective domain (Krathwohl, Bloom & Masia, 1964). The focus is on characterising each objective as the learner’s internalisation of his/her affect toward the learning process such that it has become part of the learner’s innate learning behaviour or preference. In all, Krathwohl’s list has five main objectives in ascending order of degree of internalisation: receiving (being sensitive to the existence of the learning situation); responding (committed to an responsive engagement with that situation); valuing (willing to be perceived by others as valuing ideas or phenomena pertaining to the learning situation); organization (to harmoniously relate acquired values to those already held); and,
characterisation by value or value set (to consistently display evidences of internalisation of the values in his/her engagement with any learning situation) (George Mason University [GMU], 2009).

For the decades that followed, educators and teachers, both in schools and in adult learning organisations, had adopted this taxonomy of learning objectives as a guide to their learning and teaching programmes. The affective domain is of growing importance and this can be observed from the many reports and articles in the literature. However, few captured the imagination of science educators bent on making affective education a major part of the school curriculum except for several well known contemporary educators like Professor Thomas Koballa (United States), Professor Reuven Lazarowitz (Israel) and Professor Steve Alsop (Canada). Their works in affective science education are summarised in Table 2.

Table 2
Key contemporary work on affective science education.

<table>
<thead>
<tr>
<th>Educator/researcher</th>
<th>Title of Work</th>
<th>Main focus in science education</th>
<th>Affiliated Institution</th>
</tr>
</thead>
<tbody>
<tr>
<td>Professor Thomas</td>
<td>Student Motivations and Attitudes: The Role of the Affective Domain in Geoscience Learning</td>
<td>Geoscience</td>
<td>University of Georgia, United States</td>
</tr>
<tr>
<td>Koballa</td>
<td><a href="http://serc.carleton.edu/NAGTWorkshops/affective/workshop07/participants/16284.html">Website: http://serc.carleton.edu/NAGTWorkshops/affective/workshop07/participants/16284.html</a></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Professor Reuven</td>
<td>Cognitive and affective domains of high school students’ instruction.</td>
<td>Biology by inquiry using computer assisted learning, cooperative and individualized approach.</td>
<td>Israel Institute of Technology</td>
</tr>
<tr>
<td>Lazarowitz</td>
<td><a href="http://edu.technion.ac.il/Faculty/Faculty.asp?FM=rlazar">Website: http://edu.technion.ac.il/Faculty/Faculty.asp?FM=rlazar</a></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Professor Steve</td>
<td>Bridging the Cartesian Divide: Science Education and Affect (Alsop, 2005).</td>
<td>Emotional aspects of science education.</td>
<td>York University, Canada</td>
</tr>
<tr>
<td>Alsop</td>
<td><a href="http://www.yorku.ca/irisinfo/wp/?page_id=428">Website: http://www.yorku.ca/irisinfo/wp/?page_id=428</a></td>
<td></td>
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</table>
Major works on affective education in eastern cultures (covering educational systems in East Asia and Southeast Asia) are less accessible, and on science education specifically, there is hardly any significant report. Several pieces of work, however, did surface in the literature search. These are usually standalone work dealing mostly with classroom discourses (Yung & Tao, 2004), curricular reviews (Tan, Goh & Chia, 2006; Wang, 1998); or related to postgraduate studies (Cheng, 2008). There is thus much to be explored and many opportunities for experimentation in the areas of Affective Science Education.

The three arms of PLEASE

The present initiative has just been rolled out in February 2009 as a school outreach programme. It involves a publicity effort to inform schools about the options available to classroom science teachers and the opportunities for them to practise and share their teaching experiences within the affective domain. As it is envisaged that teachers in schools are very concerned about the academic achievements of their students at year end school or national examinations, the strategy adopted for this three-year initiative will be low-profile and minimally intrusive to the daily teaching-learning routines of both teachers and students. Teachers will work with researchers involved with PLEASE on an understanding that any project initiated will be small in scale and manageable in terms of resources. This will be done during normal curriculum time and will address the cognitive/psychomotor and affective learning needs of students. To do this, PLEASE will be implemented with three “arms”, namely, (a) pedagogy, (b) curriculum and (c) research. For the first and second year, the projects will involve mainly the first two arms. Upon satisfactory review of the activities and with evidences of good resource support, research projects will then be officially
launched from year three or later, although small-scale action research projects may be conducted anytime from now.

(a) *The Pedagogy arm*

This arm concerns the establishment of pedagogical strategies to infuse the affective domain into the science lesson. It will involve teachers identifying “teachable moments” (a term used in the Ministry of Education’s Social and Emotional Learning Programme. These are moments in which the teacher can see a good or close link between the science concept being taught and a daily life event which students can associate with. Examples of these are shown in the PLEASE brochure (see website at reference section; Tan, 2009).

(b) *The Curriculum arm*

On the curricular front, teachers similarly *do not* need to set aside extra time on normal teaching days to develop teaching materials or student learning worksheets. Instead, they will be engaged in crafting teaching materials during scheduled workshops and try these out in class at their own convenient times. Essentially, these materials could be teaching aids (as in charts, models or even games) or simply worksheets crafted from reference textbooks or past examination questions. The crafting of these learning-teaching materials will follow as closely to the prescribed syllabuses as possible and will infuse inquiry learning elements where possible. An example of an inquiry science affective worksheet, presented at the STAS 2009 workshop (Tan, 2009), may be obtained from the author (Title of worksheet: “Newton’s Affective Worksheet”).
(c) **The Research arm**

This will be the last arm to work on in the current period of initiation. With pieces of evidences collected from field experiences (projects run by teachers in collaboration with the researchers over the first two years), research studies in form of comparative analyses of affective learning class communities or intervention strategies to measure gain of a specified affect factor in the learning of the students will be conducted. As of now, the main activity under this arm is the on-going literature search and review in the affective domain of science education. Despite this being an early stage of the initiative, small-scale school-based action research in affective science education are also being currently explored in schools.

**A brief report on the early activities of PLEASE**

(a) **Pedagogy**

As a prelude to the roll-out of PLEASE, a seminar was delivered in November 2008 for about 40 science teachers from a north zone school cluster (Tan, 2008). The teachers participated in a short on-the-spot survey about their perceptions on teaching science in the affective domain. The results of the informal survey are presented in Annex A.

(b) **Curriculum**

A hands-on workshop was conducted for about 12 secondary school science teachers at the Annual STAS Day Teachers’ Seminar on 5\textsuperscript{th} April 2009. In that workshop, teachers contributed ideas on how several science topics can be taught with an inclusion of an affective element. These ideas are currently being collated and re-developed for other forthcoming school-based workshops on curricular development.
Research

A total of 96 pre-service chemistry teachers had just completed a survey (in May 2009) on their perceptions of implementing Affective Science Education in schools. They responded to a 27-item questionnaire with statements presented on a 5-point Likert-like scale. The same questionnaire is also being administered to trained teachers. Details of the questionnaire and the analysis of their responses will be reported at a later date.

Funding Plans for PLEASE

PLEASE is presently a low-profile initiative. Interested organisations (schools and educational institutions) and individuals (teachers, trainee teachers, graduate students, researchers and educators), local or international, are most welcome to explore potential opportunities for collaborative work in one or more of the three arms of PLEASE. There are plans to source for funds and grants to support the various activities in the coming months and in the future stages of PLEASE. Besides research activities, these funds would help support the organisation of school-based workshops and seminars, publications, conferences for graduate students working on affective science education and for invitations of visiting professors, educators and consultants in affective education to collaborate. The “Projects” (as the title of this initiative indicates) will be focused on finding appropriate responses, suggestions, ideas or answers to these two key questions:

1. How affective (for example, how “curious” or how “responsible”) are students in their learning of science in school?

2. How best can students be developed in the various affective traits (values, habits or soft skills) through the learning-teaching activities of science in school?
Conclusion

Although the projects in the three arms of PLEASE are yet to be implemented, the past three months (from launching to the time of writing this paper) had been eventful and productive. In March 2009, the Ministry of Education released the Primary Education Review and Implementation Report (or PERI Report), and announced that more effort and resources will be put into developing values and soft skills among primary school students.

“the Committee thus recommends that primary education be refined (through the) greater use of engaging pedagogies in delivering the curriculum and teaching skills and values..(and other ways) (MOE, 2009, p.29)”

The timely release of the PERI report underlines the importance the government places on affective education, especially in inculcating good values and positive social habits among citizens at a young age. PLEASE can be a small contributor to catalysing the reforms in pedagogy and curriculum within the affective domain, particularly in Science Education. With concerted efforts by teachers and researchers, it should not be too difficult to provide effective and holistic learning opportunities for our school students so that they will graduate over that period of time in school as both knowledgeable and skilful citizens with a compassionate heart and a responsible character.
Annex A:

Results of informal survey on teachers’ perception on teaching affective science (Tan, 2008).

[These results are not to be conclusively interpreted but are presented here as a preliminary indication of trained teachers’ perceptions of the how’s and what’s of affective science education. A more detailed and structured survey is now underway.]

Figure A1: On teaching and assessing attitudes and values in the science curriculum

Figure A2: Perceptions on teaching affective skills to students in Singapore schools
References


http://reflect.myplace.nie.edu.sg/N7Talk.pdf


