What kind of science do educators present to learners in South African classes?

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Abstract

Designing school curricula in SA took on an insightful phase since 1976 when learners rejected Afrikaans as a medium of instruction. The South African Department of Education (DoE) has tried to align curricula with the new constitution with consternation about the kind of product that curricula will graduate from school.

I narrate personal, observations about, and understanding of the science curricula, as a science education student, a science educator, and a manager of projects on science educator development. My comments were supported by class visits, during which I used a Science Teaching Observation Schedule (STOS) and recorded events in 31 science classrooms, as well as by interactions with educators during workshops.

My observations revealed that few educators remember common names in psychology such as Piaget, were sceptical about Indigenous Knowledge Systems (IKS), and none would say anything about the Nature of Science. Neither could they articulate the reasons behind new National Curriculum Statements. Educators blend philosophies and psychologies in science classrooms inadvertently, but neither do the DoE, nor many educator training institutions mention the traditional epistemologies. This could be one of the reasons for poor science teaching.

Introduction

At the time I studied for educational qualifications (late 80s & early 90s), educator training included the *Nature of Science'* (NOS) and *Psychology of Education.* I was then grilled to articulate the theoretical frameworks that informed the way I planned my lessons – whose school of thought and what perceptions of science and learning I held, and how these manifested themselves in my lessons. It was a requirement by both the educational institutions and the Department of Education that I should be able to defend my classroom practices upon firm theoretical grounds. This was not the case when I started to tutor at educational institutions (late 90s) up to today. Linnerman, Lynch, Kurup, & Bantwini (2002: 205-210) raise similar issues.

Currently, the South African Department of Education (DoE) in defining Life Sciences states:

> *The subject Life Sciences involves the systematic study of life in the changing natural and human-made environment. This systematic study involves critical inquiry, reflection, and the understanding of concepts and processes and their application in society* DoE (2003: 9).

The DoE (2005: 8) under the title 'what is physical sciences?' offers explanations:

> *Physical Sciences investigate physical and chemical phenomena. … through scientific inquiry, application of scientific models, theories and laws in order to explain and predict events …. All scientific and technological knowledge, including Indigenous Knowledge Systems (IKS), is used to address challenges facing society. ….*

That is, there is no direct definition of science in these DoE documents, giving the impression that those philosophies and psychologies are now possibly irrelevant vintages or are too sophisticated for practitioners to understand. Consequently, educators cannot place their lessons in any traditional epistemology, and present to learners, a blend of philosophies and psychologies, albeit riddled with problems: or are they? It could be that *'modern'* classroom practices preclude theories on the NOS and the Psychology of Learning - may be that's the new way of conducting science in classrooms. Thus, not withstanding the standards of some of the schools and educational institutions, and bearing in mind that Indigenous Knowledge (IK) forms part of science lessons, learners might be receiving a science that is traditionally incomprehensible.

Source of information

Besides a number of qualifications within SA, I taught science in SA for 13 years (1983-1996) and have, since 1997, been involved in the in-service development of science educators at the Centre for the Advancement of Science and Mathematics Education (CASME), under Rhodes University, and at KwaZulu Natal University for the past 9 years. At CASME, I obtained data from the evaluation of the Kgatelopele Project in Limpopo (2001), and through interviews, questionnaire, and class visits during the Dinaledi project in the Eastern Cape, KwaZulu Natal and Mpumalanga (2001-2005), the Jula Carnegie Project in KwaZulu Natal (2000-2004), and the New Zealand Project in KwaZulu Natal (2004-2006).

Factors contributing to poor teaching of science

Of course, some educators are products of dismal education practices under Bantu Education, which rarely considered science a necessity for 3^{rd} class citizens of SA. Apparently, problems have continued since then (at least since 1988; MacDonald & Rogan, 1988) and are revisited periodically (e.g., Jennings R., & Everett, D. 1996; Ogunniyi, 1996; Manzini, 2000; Muwanga-Zake, 1998, 2000, 2004). Science educators in South Africa are aware of some of the problems, such as long syllabi, useless objectives, illogical sequencing of topics in the syllabus, examinations that test for facts, and a curriculum development process that does not recognise educator inputs (Sanders, 2002: 85; Muwanga-Zake, 2004: 15).

For example, the matter of long syllabi is illustrated by Grade 11 science work. Work Schedule (DoE, 2005: 16) recommends *4 hours per week* for *Physical Sciences* in the NCS. In Week 11, that is in 4 hours. Consider that an educator is advised to deal with Newton's 2^{nd} Law, momentum and impulse practically in realistic contexts, and to enable learners to *apply problem solving strategies to do calculations of acceleration and force* (DoE, 2005: 23). Without laboratory assistants, it is the educator's duty to set up equipment, to ensure participation by each learner, and then to clean up equipment. One of the Assessment Standards at Grade 11 to follow these activities requires learners to:

> *Compare data and construct meaning to explain findings; Draw conclusions and recognise inconsistencies in the data; and Assess the value of the experimental process and communicate findings.* The NCS states that *the attainment is evident when the learner, for example: Draws meaning from graphs; Explains findings; and in a 'paper', discusses possible variables that could influence the results.* (DoE, 2003)

These are not easy to accomplish in 4 hours, especially with, which can reach 51 learners per educator (Muwanga-Zake, 2004: 15).

What quality of educators do we have in science classrooms?

Class observations indicate a dearth of learners' participation and ideas; lessons, even practical ones, are often educator-centred (Appendix 1). As stated in the above, this apparent indication of poor teaching has been topical for a long time – it happens where the standard of the science educator is questionable.

Higher institutions for Education often admit what other scientific professional courses, such as Engineering, have rejected on financial or academic grounds. Among 104 science educators in a Carnegie project, only 6 were graduates and 98 had studied science at the Standard Grade. 20 out of 26 biology educators studied this subject to Matric (Muwanga-Zake, 2004: 15). On addition, it appears educational institutions have not informed educators about the NOS (E.g., Mkhwanazi, Mkhwanazi, Rollnick, & Bradley 2002: 260-264; Fabiano, 1998: 137). In concord, none of the 104 educators could discuss the NOS. Asked to answer the question '*What is Science?'*, educators described the Learning Outcomes and or listed science subjects – and only 3 out of 104 gave these answers. The worry is, what are the educators' perceptions of science and how do they teach a subject they cannot attempt to define?

Problems with practical work

On the one hand, the DoE officials assure everyone that they have poured millions into laboratory equipment. On the other hand school principals claim that the budget from which they ought to purchase laboratory equipment is shared to buy other equipment for school management and teaching. The price of kits in relation to school budgets has not helped either of the two camps, and practical work suffers. If there is equipment; it is badly managed, gathering dust, broken or neatly stored away, few of which educators can name or know how to use and its use. Educators seldom know what they have because they do not keep inventories and keep equipment anywhere; from a principal's office, classroom, to the staff room. This situation compels educators to demonstrate experiments within time constraints, such that many practical exercises oversimplify relationships.

From the above, it would seem that the educators' demand for science equipment and laboratories is spot-on. But, apparently, a more critical problem lies in the educators' lack of practical competencies. While the 104 educators in the Carnegie project workshop saw the relevance of in-service educator development, their incompetence was not prioritised. Yet, only 10% of the 104 Carnegie project educators said they had done all recommended practical exercises either during their schooling, training, or with their learners. Preferably, educators should clamour for practical skills ('learning to do'), the management of laboratories, the knowledge of the NOS and the NCS, as well as conceptual understanding of science, instead of demanding kits.

A blend of science philosophies in curricula and class

Not withstanding their shortcomings with regard to practical work, inevitably therefore, the educators' classroom practices can be explained as a blend of philosophies, and vary between educators (Appendix 1) thus, learners might be obtaining a contentious incoherent image of science.

Science lessons based on inquiry through processes and methods are popular (DoE, 2003: 12; DoE, 2005: 8;Aristotle quoted in Wartofsky, 1968: 291) Aristotle's ideas have persisted (e.g., Thomson & Stewart, 2003: 161-162; Gibbons, 2000: 3) and tend to define science as scientific inquiry. SA emphasises hands-on processes in Learning Outcome 1 (DoE, 2003: 12), and abstractions such as critical analysis and problem solving on these grounds.

But no one (at least from the DoE) has comfortably unpacked a process to enable a logical assessment. For example, assessing a learner's critical thinking (DoE, 2003: 23), requires, in the first instance, a educator to think critically, and then to set tasks that actually require critical thought. Inevitably, the identification or unpacking of such an abstraction requires a philosophical base or understanding its psychological constitution. So are problem solving, reflective skills, and others (DoE, 2005: 8), which happen concurrently to complicate the assessment. I get worried when a educator assures me that s/he can indeed identify and assess some of these processes without the ability to define science.

Albeit without clear distinctions from processes, are the science methods, which are apparently a collection of processes. So highly regarded by Dewey (in McComas, Clough, & Almazroa, 1998: 7), methods are ways of ordering and testing knowledge in the course of a scientific inquiry (Henry 1975: 62; Linnerman, *et al.*, 2002: 205-210), and so are obligatory in scientific research or lesson in SA. Methods can be hypothetical–deductive (i.e., be guided from a hypothesis to a conclusion. Or methods can be inductive (i.e., start from simple evidence to a study and generalisations (Medawar, 1969: 23-26; O'Hear, 1989: 12); only they are in a positivist manner handed down to the apprentice.

In South African classrooms within the frameworks of empiricism, positivism, and causality as defined in, for example Russell (1929: 387), Medawar (1969: 14-21), and Pecorino (2001), learners follow methods using worksheets: testing hypotheses and theories; experimenting; and observing phenomena. Seldom is there room for intuition or revelation (Wikipedia, 2006) that characterise some aspects of indigenous knowledge systems. That is, South African science demand exposure to some logically pre-arranged (often prescribed) experiences and accurate data, to enable learners to make inferences, deductions and conclusions (DoE, 2003: 12), and assumes that the path from evidence to theory or from theory to evidence can be prescribed and followed verbatim in ways well described by Sutton (1996: 2) and Einstein (1940: 253). Positivist-objectivist strategies expect universal compliance with established models and norms, with insignificant traces of individual human differences so as to uphold the principle of causality (as understood from Galileo, Hume, and Mill). I.e., should the cause happen, the effect would most probably occur, given similar conditions and excluding human factors (Feigl, 1953: 408; Nagel, 1951; Russell, 1929: 390; Wartofsky, 1968; Medawar, 1969). Laws based on causality have yielded the equations and diagrams as well as contrived problems that learners are told to solve.

However, laws also enable contrived and *logical* explanations or hypotheses, commonly posited in South African classes. Contrived activities called experiments (Medawar, 1969: 34-39), some classical (Lederman, 1998) that take the place of the real life experiences for the majority of learners are used, to test causal relationships (Wartofsky, 1968: 206). Unfortunately the DoE and educators now expect experiments to yield most of the processes and knowledge; this has made laboratory experiments standard features of school science (White, 1996: 761; Jenkins, 1999: 21-22). It appears that the laboratory is a site for *modern* ways of science that instils curiosity, understanding, and produce development-minded scientists. Thus educators in SA demand laboratories without which they assertively defend their theoretical persuasion of science in class.

According to White (1996: 761), there ought to be clear goals of laboratory teaching; educators might state expected outcomes from a laboratory exercise, albeit with proofs and therefore intellectual restrictions upon learners in SA. Most educators are deficient of confidence to expose learners to unrestricted open environment experiences, free of laid out procedures – learner autonomy divulges educator limitations. Therefore, it is safer for educators to use worksheets (Fosnot, 1996: 8), but already designed to necessitate educator workshops. Worksheets safely guide one to acceptable results (Popper, 1974) especially within prescribed paradigms (Kuhn, 1974) that for example confine practical science to laboratories and reject discrepant data. This covert positivism fails unconventional methods of doing research – alas, it expects textbook held *truths*.

Teaching about experiments and rationalism

Practical work is yet to be examined directly, and knowledge *about* practical work contributes only about 40% of total marks. Therefore, one can pass matric without ever experiencing a practical exercise. Thus learners are fed with *truths* about practicals. That is, educators model reality for learners use and set problems for learners to solve. These are recorded as episodes of *problem solving* in educator and learner portfolios. Learners fail should they not reproduce the models. The atomic structure as taught at Grade 10 is an example of a logical and abstract model.

Modelling the world for learners especially upon the Euclidian geometric system, deduced from abstract innate ideas or prior knowledge (*a priori*), independent of sensory experience is arguably characteristic of rationalism, (O'Hear, 1989; Popper, 1974). Theorists such as Stratford (1997: 4), Sanders (2002), and Sanders & Khanyane (2002) have noted that models form the basis of teaching science. That is, rationalism inadvertently is misused to rescue educators from hands-on practical exercises.

Dissatisfaction with positivism or objectivism

It seems that the liberation struggle against apartheid, which included curriculum issues with regard to Afrikaans, in the mind of educators was not expected to transform science curricula, since few understand the rationale behind the new strategies in teaching science. Indeed many politically active educators show petite interest in the development of the NCS. Nonetheless there are some common elements between anti apartheid agendas and the dissatisfaction with positivism, objectivism, as well as behaviourist models that demand compliance with pre-determined objectives and norms. Thus one can argue that the NCS is in line with critical realism, which, according to Nichols & Allen-Brown (2001) challenges the taken for granted and control of subjects. According to Giroux (in Atwater, 1996: 823) the critical theory challenges *hegemonic ideologies*, and liberates the voices of subordinate groups, who in the case of SA include those who were 2nd and 3rd class citizens during apartheid. The NCS seems to borrow from critical realism in discouraging absolute truths, objectivism, and the systems that claim to bring these about because it acknowledges realities in different cultures or IKS and contexts. Therefore, the educators' confusion with positioning IKS in science curricula is expected because educators rely on absolute *truths*, while the NCS attempts to free learners from rational objectivism. Oddly, most educators seek and do actually give learners the freedom of expression politically (it is a constitutional right) but control learners' freedom of thought.

Science and culture in South African classrooms

The positivist stance in science classrooms, which produced most educators, is likely to be incompatible with Indigenous Knowledge Systems (IKS). Yet, Learning Outcome 3 in the NCS, *inter alia* apparently regards IKS. The confusion that this has caused can be accessed in discussions with most educators, who consider 'education' to be analogous to positivist science, and to a great measure modernist dispositions. Re-conceptualising IKS along, for example, empirical science, calls upon educators to model their indigenous knowledge into equations. Expectedly, explaining to educators, the chemistry behind the traditional ways of preparing soap during the *Science Week* of 2006 was met with scepticism. Paradoxically, educators are not explicit about their confusion, and so do not show to learners the cultural biases in *science,* as Manzini (2000: 21) observes:

> *…educators seem oblivious of the cultural bias of the present curriculum. They do not think critically about the concepts, aims, approaches, and resources it advocates. They merely try to transmit the curriculum …. They find themselves as accomplices in the cultural genocide, albeit inadvertently.*

That, observation is culture-sensitive (Atwater, 1996; Lederman, 1998) against the positivist assumption of a scientist's freedom of mind (Bernard as cited in Duhem, 1953: 235) makes one wonder why the DoE chose to re-define IKS within science (DoE, 2003: 12). That is, it disquieting to expect learners to understand their IK through a foreign-based and undefined blend of science philosophies and practices or even to anticipate that IK, within science, will contribute towards redressing the past educational imbalances (DoE, 2003: 2).

Learning strategies in the context of science education in SA

In practice, it can be a dilemma to decide which of the learning theories and the NOS ought to be dominant in a science lesson (e.g., in Wilson, 1995), especially where a desired science philosophy or IKS contradicts a recommended teaching strategy, such as constructivism. The DoE seems to believe Ramsey (1975: 96) who observed that teaching is not necessarily informed by learning theories; so it does not reveal learning theories, with the consequence that educators too are silent about them, and one finds a cocktail of learning theories in a single lesson.

Atwater (1996: 830) notes that *power and control are two important elements in determining the science curriculum*. That is how the Christian National Education (CNE) and Bantu Education (BE) with the then popular Fundamental Pedagogics guided Blacks in matters of knowledge (Enslin, 1984), into obedient and submissive labour (Christie & Collins, 1984). This conformist stance made science a closed system, which, in my opinion, Popper (1974), and Kuhn (1974) question. In contradiction to the spirit of the NCS that strives for 'a*n education system that does not exist to simply serve a market* (DoE, 2003: 5), the DoE in practice and educators, in a behaviourist way, still relate science to employment.

Hence, behaviourist strategies have persevered prevalently in science classes since these can be linked with Fundamental Pedagogics in SA. Importantly, a common assumption in both is that learners are blank slates, or rather are not creative in relation to new knowledge or situations. The sequencing of stimuli and reward in class is after all expected at places of work. The obedient learner or employee is rewarded generously with marks or promotion. (It is also noteworthy that *tabula rasa* and empiricism, share the assumption of a blank mind, until some experiences invade that mind). Thus, nothing compels educators to mind learners' constructs, or practical problems; they re-enforce textbook-held or own truths or rather employer-desired attributes. (Again, note the behaviourist association of stimuli and behaviour and the positivist principle of causality).

There were some injections of cognitive measures during the 1990s, when in SA apparently Bloom's behavioural objectives (e.g., in Biehler & Snowman, 1993: 293) became cognitive concrete and mental processes, as well as science processes (Margenau, 1974: 751), which, Piagetian theories on reasoning patterns relate with *cognitive development* (Brotherton &

Preece, 1996: 65). Apparently, Bruner's and Piaget's psychology has guided much of the NCS. For example, learner age influences what can be studied in given situations (Anderson, Reder, & Simon, 1996). The cognitive load (capacity of the brain in handling processes and knowledge, Wilson, 1995) is reduced through year schemes that focus upon a few elements at a time to allow adequate mental processing (Hannafin & Sullivan, 1995).

Constructivism in the learning of science

Theorists and the NCS acknowledge cognitive and constructivist strategies in science learning (E.g., Campbell, 1998; Tsai, 2000). Examples include group work to enable learner discussions, even though, in contradiction, some educators order their grouped learners to silence. Learners should identify relevant problems (Duffy & Cunningham, 2001: 179) and be provided with tools to solve those problems. This augurs well with science processes and hands-on activities (Campbell, 1998). Additional constructivist measures include continuous assessment (Yore, 2001), sometimes misunderstood as continuous testing, and project work (Hein & Lee, 2000: 1), although educators seem to be short of projects that are relevant. In contradiction, lessons were educator-centred (Appendix 1), and rarely provoked learners conceptual schemes (Geelan, 2000: 4; Yumuk, 2002: 142).

Figure 2: Possibilities of overlaps between learning theories and science philosophies in South African science classes

		Learning theories		
	Learning space – class activities	**Behaviourism** (Fundamental pedagogics) - instructor designs a learning = behavioural change. Desired behaviour re-enforced by extrinsic motivation; Combine a sequence of stimulus and response Causality	**Cognitivism** Learning = change in schema structure; Concrete to abstract; Age matters; Experiential learning; Multiple intelligence; Situated cognition; Cognitive load; Cognitive conflict = conceptual change; Spatial skills	**Constructivism** Learners are not blank and use prior knowledge and experiences to construct new meaning. They also help each other to agree on meaning
Science philosophy	**Rationalism** Knowledge deduced from reason, abstract innate ideas or prior knowledge (*a priori*), independent of sensory experience - reason and logic	Learners are given rules for solving contrived problems	Knowledge must be suited to age; toddlers don't understand Ohm's law; Schema constructed from logical deductions; Science processes - mental	Learners find their own way of solving problems in their lives; Debate; (Philosophically – a way of constructing reality)
	Empiricism *Tabula rasa;* all knowledge is achieved *a posteriori* through our senses or observation	Learners follow worksheets No ideas from learners – learners fed with facts	Psychomotor skills are age-bound and experience matters. Apply relationships to solve current problems; Science processes - concrete	E.g., Open environments that allow learners to test their constructs; (Philosophically – a way of constructing reality)
	Positivism Precise, certain and objective; no subjectivity and human ideology, history and intervention or intuition Experiences must be validated	Rules to be followed are well laid out Data must be precise – no human error Must provide acceptable evidence	Science processes – mental and concrete	Triangulation = social constructs?; (Philosophically – a way of constructing reality)
	Post positivism Individual experiences are valid realities; Hypothesise-deduce; Critical realism: Triangulation	?	?	*Interpretative (idiosyncratic); Negotiated meaning =socially constructed meaning Negotiated assessment*

An argument for integrating learning strategies

Integrated epistemologies seem to be popular, bearing on the arguments that learning theories are complementary, and each explains some aspects of learning. Atwater (1996: 831) focuses on this intercourse in the statement that *no one epistemology can serve to explain what happens in science learning and teaching*. Others with similar suggestions include Jonassen, Howland, Moore & Marra (2003: 2-9), Burton, Moore, & Magliaro (2001: 65).

Challenges to SA

Where do we go from an undefined science epistemology – an epistemology subject to individual educator misinterpretation? What kind of scientist will the NCS produce? Unfortunately for SA, few implementers of curricula, the obverse that define perceptions of science for learners; that is few educators, are equipped to contribute to curriculum design and implementation. The DoE as well as educator training institutions might have to re-introduce definitions of the NOS in the NCS, educator courses, and during the workshops. A healthy position is where educators are able to articulate reasons for the way they practice science in class. Educators should confidently manage learners' daring hypotheses (Poper (1974: 978-984) in open environments (Doll, 1989: 246), and liberate themselves from paradigms (Kuhn, 1974) that stifle learners' intellects. Possibly then, shall SA produce the desired innovators who can develop SA faster and create jobs.

Conclusion – what Nature of Science (NOS) is in South African classes?

Although there are disagreements on which science philosophy is most appropriate (Popper, 1974: 1015; Medawar, 1969: 24), choices and blending of the philosophies and psychologies should be debated. The multifaceted *Nature of Science* should not discourage the questions 'What is Science?' and therefore 'How should science be taught'? Science, and for that matter any other subject, is difficult to define but educators should hold a figment of the NOS.

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Appendix 1 Science Lesson Observation Schedule (STOS) – 7 different classes on different topics in KwaZulu Natal during September 2003 - 2005

Appendix 1 below shows a modified Science Teaching Observation Schedule (STOS) I used in 7 Grade 10 to 12 science classrooms, randomly selected from the Dinaledi and the New Zealand projects participants. The reality might be worse than what the schedule reveals because educators prepared for these class observations. I sat in classrooms lessons, with a blank STOS form, and video-recorded consenting educators. I then entered a symbol representing the activity I observed at intervals of 2 minutes, and checked some of my data against video records. The numerical coefficients against the symbols indicate the frequency of that particular activity at that time. For example, 6F after 6 minutes (Appendix 1) indicates that educators supplied facts in 6 different classrooms.

ACTIVITY OBSERVED	SEQUENCE OF EVENTS – 2 MINUTE INTERVALS (Just place the 'first letter (s)' of the activity observed)																													
	2	4	6	8	10	12	14	16	18	20	22	24	26	28	30	32	34	36	38	40	42	44	46	48	50	52	54	56	58	60
1. Educator statements/questions • Facts or closed (F) • Investigative problems (P) • Procedures (Pc) • Open-ended (O)	8F	5F	6F/o	3F/o	5F	2F/P	2F/Pc	F	F/Pc	P/Pc	F	F	F	F		F	F	F/P	F/P									Pc	Pc	
2. What do learners do with educator's ideas? • Question them (Q) • Discuss / modify them (D)							Q	Q/D	Q/D	D		O																		
3. Learners' ideas?					1	1	1						1	1	1			1	1											
4. Questioning techniques • Recall, repetition, factual answer (R) • Elaboration, justification or explanation from learners (E) • Open-ended (O)	6R	6R/O	7R	R/E	2R/2O/E	R/2O	R/O	O	O							R	R	E		O		R			R					
5. The educator and learners' ideas ? • Question and discuss them (Q) • Modify them (D) • Put them into practical work (W)				W															Q	Q	W	W	D	D						
6. Practical work				1	1	1	2	1	2	1	2	3	3	2	2	2	2	2	1	1	2	1	1	1	1					
7. Does the educator initiate all activities? (√)		1	1	1	1	1	1	2	1	1	1	1	1					1	1											
8. Skills among learners? • Observation (O) • Psychomotor (Ps) • Problem solving (Pr) • Hypothesising (H)			2O	O O	2Ps/O	3Ps/2O	3O	Ps/3O	Ps/4O	Ps/4O	2Ps/2O	Ps/3O	Ps/2O	Ps/3O	Ps/2O	Ps/O	Ps/O	Ps/2O	Ps/2O	Ps/2O	Ps/O/H	Ps/H	Ps/H	2H	2H	2H				
9. Problems with the kits / Programme (√)																														
10 Assistance – • Between learners (Bl) • Assistance - Educator-learner (Tl)					Tl				2Bl/Tl	2Bl/Tl	2Bl/Tl	Bl	Bl	Bl	Bl	Bl	Bl	Bl	Bl	Bl	Bl	Bl	Bl	Bl	Bl					
11 Group work (GW) Individual work (IW) Educator demonstration (TD)	2IW	2IW	2IW/Td	2IW	2IW	2IW	2IW	2IW	2IW/GW	2IW/Td	2IW	3IW	3IW/GW	IW/GW	IW/GW	IW/GW	IW/GW	IW/GW	IW	Td	Td/GW	GW	IW/GW	IW/GW	IW/GW	IW/GW	IW	IW	IW	IW
12. Enjoyment (E)			3	2	3	3	3	2	2	2	2	2	2	2	2	2	2	2	1		2	2	3	3	3	1				