



ARTÍCULOS

UTOPIA Y PRAXIS LATINOAMERICANA. AÑO: 24, n° EXTRA 6, 2019, pp. 85-96
REVISTA INTERNACIONAL DE FILOSOFÍA Y TEORÍA SOCIAL
CESA-FCES-UNIVERSIDAD DEL ZULIA. MARACAIBO-VENEZUELA.
ISSN 1315-5216 / ISSN-e: 2477-9555

Critical thinking and reflective practice in the science education practicum in Kuwait

Pensamiento crítico y práctica reflexiva en el desarrollo de la educación científica en Kuwait

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ABSTRACT

This is a speculative paper linking critical thinking to reflective practice in science education teaching practicum for the prospective teachers of science in Kuwait. The writer has identified that student teachers lack in a critical thinking approach to teaching sciences, promoting science literacy, and critically linking science to society and technology, definition of critical thinking has been interpreted in a context of reflective practice, with a redefinition of the factors contributing to unexamined, uncritically absorbed assumptions about teaching and learning. The paper has also shed light on how critical thinking can be evaluated in the teaching practice component.

Keywords: Critical thinking, reflective practice, science literacy, teaching practicum.

RESUMEN

Este es un documento especulativo que vincula el pensamiento crítico con la práctica reflexiva en la práctica de la enseñanza de la educación científica para los futuros profesores de ciencias en Kuwait. El escritor ha identificado que los estudiantes docentes carecen de un enfoque de pensamiento crítico para enseñar ciencias, promover la alfabetización científica y vincular críticamente la ciencia con la sociedad y la tecnología. La definición del pensamiento crítico se ha interpretado en un contexto de práctica reflexiva, con una redefinición de los factores, contribuyendo a suposiciones no examinadas, absorbidas sin crítica sobre la enseñanza y el aprendizaje. El documento también ha arrojado luz sobre cómo se puede evaluar el pensamiento crítico en el componente de práctica docente.

Palabras clave: alfabetización científica, pensamiento crítico, práctica docente, práctica reflexiva.

Recibido: 15-11-2019 • Aceptado: 18-11-2019



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1. INTRODUCTION

An informal investigation into the nature of science teachers' practice in the College of Education at Kuwait indicates that student teachers lack pro-environmental attitudes, which are presumably due to carelessness and a thoughtless way of thinking about the sciences.

Therefore, given that the core of education has assumedly been learning to learn (meta-learning) and learning to think for oneself and collaborative learning, thus learning critical thinking that is conducive to reflective practice in the area of environmentalism will be an essential goal of our teaching programs and teaching practice, especially in the area of science education. It is argued that the future now belongs to societies that organize themselves for learning, so nations that want high incomes and full employment must develop policies that emphasize the acquisition of knowledge and skills by everyone, not just a selected few (Marshall & Tucker: 1992), hence, the significance of future teachers' programs and practice. In pre-service teacher programs (PRESET), a tendency towards critical thinking and reflective practice is now replacing traditional methods of knowledge and skill acquisition, given the massive smorgasbord of knowledge available in the post-information era.

Critical thinking is a process of purposeful, self-regulatory judgment- a process that reasons consideration to evidence, context, conceptualizations, methods, and criteria (American Philosophical Association: 1990, pp.315-423). In this context; (Gunn et al.: 2008, pp.165-183)

The need to develop creative thinking and critical thinkers is growing progressively more important. Technological changes have improved communication, health management, and lifestyle. Unfortunately, rapid change comes with a cost as future citizens will be required to make even greater moral and ethical decisions for themselves, for others and the planet. As science educators, it is our responsibility to assist students in thinking critically about what science is what it represents, and whether its impact is for the greater good.

Therefore, the link between reflective practice, which is an *ad hoc* process of evaluation and reinforcement of skills and information acquired or in the process of acquisition, is closely linked to critical thinking. Those two processes of critical thinking and reflective practice in PRESETS provide an understanding of the methods, principles, theories, and ways of achieving knowledge, which is proper to the different intellectual realms. (Facione: 1998). In addition, these two processes furnish the student teachers with an encounter with the cultural, artistic and spiritual dimensions of life, and, hence, the evolution of one's decision-making to a level of principled integrity. However, the realization of ways prone to generating a proactive attitude towards sciences requires rigorous pro-science education programs for future teachers who will shortly take over the responsibility of educating the younger generations in the state of Kuwait.

As well, mindful scholarship requires that student teachers engage in the process of critical thinking learned through the teaching practicum. Furthermore, working in the science teaching practicum for prospective teachers of science in Kuwait should provide opportunities to promote reflective practice in ways that extend the prospective teachers' contributions to ecology, environmental awareness, science literacy, and social studies of science, technology, and society (STS). In this vein, critical pedagogy and reflective practice have come together to stimulate the current researcher to consciously examine the complexity of the student teachers' social position and critical perceptions of the ecological, environmental, and scientific situations covered in the science books in Kuwait schools.

We have an educational problem. It is not a problem about the shortage in information and data about environmental problems and challenges. The problem, as Whiston (2000) notes, "may be more of information overload rather than a paucity of data from which to choose". This was not the case a few decades earlier when environmentalists were struggling to assemble their information regarding the environment, ecology, and systems of interaction with our environment vis-à-vis science literacy and science role in society.

Therefore, this study seeks to lay the theoretical foundations of a teaching practicum for student teachers of science in Kuwait that takes as its basis critical thinking and reflective practice as the methodological approach to teaching science in Kuwait schools. The study based on an environmental consciousness survey that gathered data from seniors at the Faculty of Education at Kuwait University, the results of which indicate a necessary reshaping of teaching practica to be grounded in critical thinking and reflective practice.

The concept of 'reflective practice' has received considerable attention in the education literature, where it is described as the method *par excellence* to learn from field-based practicum situations and advance the art and practice of teaching, especially in the sciences. So influential are the writings on reflective practice, that it has now been identified as a prerequisite competency for pre-service and beginning practitioners around the world, and urge enough for us here in Kuwait to follow suit. To date, nearly no empirical studies have been undertaken to examine what reflective practice is, how individuals use reflective thinking, and how it contributes to learning, especially in terms of critical thinking. The discourse in the literature, particularly among science educators, has become increasingly muddled and justifies the question as to whether there is a shared and common understanding of the concept of reflective thinking.

Reflection requires critical thinking: I will call reflective practice, which involves critical thinking *critical reflection*. Time to think back over things, to ponder, to make connections, to analyze, assimilate, and make sense of a situation is what constitutes critical reflection. Science teachers and social studies teachers as well are primarily responsible for the students' awareness and perception of their environment and the role of science in society and hence the significance of science literacy involving critical reflection on society, and societal and environmental problems. However, as stated in the problem of this study, it is not appropriate to raise and develop scientific and environmental awareness through cramming information. Awareness, as used in the study, is not confined solitarily to a state of mental perception; it goes far beyond to include a mental attitude, which is pro-environmental and motivates the individuals to behave in a friendly fashion towards the environment. For developing this attitudinal system, critical thinking is instrumental. This is what critical reflection is supposed to play in our practicum, for reflection involves critically appraising situations and events that have occurred and trying to make sense of them so that practice can improve in the future.

Reflective practice based on critical thinking, or what I have already called *critical reflection*, is an interesting and important concept in the literature on teaching and learning in higher education.

Reflective practice involves thinking about and learning from our practice and the practices of others, to gain new perspectives on the dilemmas and contradictions inherent in our educational situations, improve judgment, and increase the probability of taking informed action when situations are complex, unique and uncertain. With ongoing reflection, our student teachers' practice can develop into a systematic inquiry that begins alone with a reflection on their own teaching and learning experiences but becomes collective when informed by interactions with colleagues, students, and theoretical literature. However, teaching practices in our practicum here in Kuwait often reflect an unquestioned acceptance of values, norms, and practices defined by others about what is "in the best interests" of students and teachers, and a lack of awareness of alternative practices set in an authoritative environment that lacks in critical thinking and critical reflection for later practices. Both uncritically assimilated practices and new alternatives need critical examination from several perspectives so that the learning and teaching strategies one uses are consistent with their values, beliefs, and assumptions about learning: this is the core problem that our practicum falls short of. In this context, (MacKinnon: 2006, pp.433-445) mentions words of a student

If I actually constructed the entire map, rather than taking your map to start with, you would see how my ideas flow one to the other; in a sense it doesn't matter how you might teach it, I may learn quite differently than you anticipated; my map would give you a window into how your lecture is "received" and processed; that could be a very useful tool for the instructor.

The following diagram illustrates this dilemma:

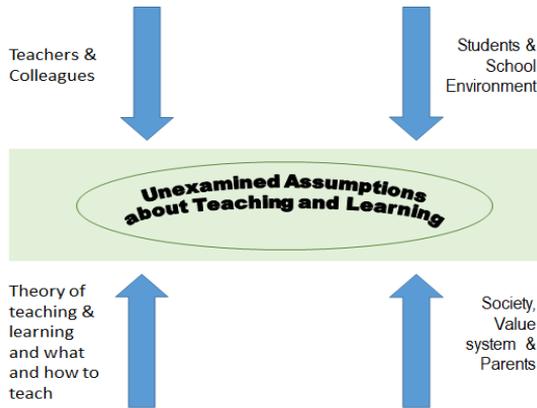


Figure 1. The Dilemma of Unexamined Assumptions

Student teachers have built-in assumptions about learning and teaching, which are usually absorbed in an unexamined fashion from four sources: 1) their educators and peers; 2) their students in the field practice and the school environment; 3) the theory that they study uncritically at the college of education as well as the content material and methods of teaching the subject matter; 4) and the whole underpinning value system prevalent in society or communicated by their pupils' parents in schools.

Reflective practice begins with critical reflection in which the science educator and the student-teacher or beginning science teachers question and examine their own subjectively held ideas and assumptions about learning and teaching. In addition, examining their own positive and negative learning experiences can help them understand why they are inclined towards specific ways of doing things and avoiding others. It helps them to develop and communicate the rationale that underlies the teaching and learning strategies they use or are recommended for them. The rationale is an organizing vision that provides direction, purpose, and meaning, prioritizing what is important in for teaching, and informing the actions they may take - a set of critically examined core beliefs, values, and assumptions about why they do what they do in the way that they do it.

Critical thinking is a process of purposeful, self-regulatory judgment. In this process, consideration of the evidence, context, conceptualizations, methods, and criteria are reasoned (Facione: 1990, p.423). The process involves specific skills, basic amongst which are analysis, inferencing, interpretation, and evaluation.

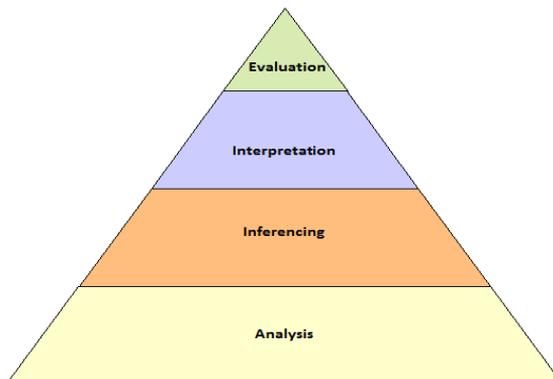


Figure 2. Core Critical Thinking Skills

The internal and personal process of defining phenomena, establishing criteria, evaluating information, and choosing what is probably right and "safe" to believe is essential to critical thinking. This involves the use of logic and inferencing skills, which are principally based on analysis and interpretation of science phenomena. There is some research to support the notion that reasoning can be taught, and that it is "possible to train such foundations of reasoning as to how to use dimensions to analyze and organize similarities and differences and how to identify the structure of simple propositions in science and technology vis-à-vis society.

Chance (1986) defines critical thinking as "the ability to analyze facts, generate and organize ideas, defend opinions, make comparisons, draw inferences, evaluate arguments, and solve problems". Tama (1989) sees it as a way of reasoning that demands adequate support of one's life and an unwillingness to be persuaded unless support is forthcoming. Hickey (1990) adds that it "involves analytical thinking to evaluate what is read". Mertes (1991) elaborates on the previous definition by Hickey viewing critical thinking as a conscious and deliberate process that is used to interpret or evaluate information and experiences with a set of reflective attitudes and abilities that guide the rational beliefs and actions.

Scriven & Paul (1992) further elaborates on the concept explaining that critical thinking is the intellectually disciplined process of actively and skillfully conceptualizing, applying, analyzing, synthesizing, and or evaluating information gathered from, or generated by observation, experience reflection, reasoning, or communication (Ennis: 1992). Scriven & Paul's definition complimented or explained by Ennis (1992) is similar in many ways to the model of critical thinking proposed by Facione in 1998. However, critical thinkers acknowledge that there is no single correct way to understand and evaluate arguments and that all attempts are not necessarily successful (Mayer & Goodchild: 1995).

Since critical thinking can be defined in several different ways consistent with each other, we should not put much weight on any one definition. Definitions are at best scaffolding for the mind. With this qualification in mind, here is a bit of scaffolding: critical thinking is thinking about your thinking while you are thinking in order to make your thinking better. Two things are crucial: 1) Critical thinking is not just thinking, but thinking which entails self-improvement and, 2) This improvement comes from skill in using standards by which one appropriately assesses thinking. To put it briefly, it is self-improvement (in thinking) through standards (that assess thinking).

Why do we look forward to a critically reflective approach to instruction? Oliver & Utermohlen (1995) see students as too often passive receptors of information. Through technology, the amount of information available today is massive. This information explosion is likely to continue in the future. Students need a guide to weed through the information and not just passively accept it. Students need to "develop and effectively apply critical thinking skills to their academic studies, to the complex problems that they will face, and to the critical choices they will be forced to make as a result of the information explosion and other rapid technological changes" (Oliver & Utermohlen: 1995).

2. METHODS

Assessment of the credibility of statements or other representations which are accounts or descriptions or a person's perception, experience, situation, judgment, belief, or opinions, and assessment of the logical strength of the actual or intended inferential relationships among statements, descriptions, questions or other forms of representation.

1- Analysis: Identifying the intended and actual inferential relationships among statements, questions concepts, description, or other forms of representation intended to express belief, judgment, experiences, reasons, information, or opinions.

Evaluation and synthesis are two types of thinking that have much in common but are quite different in purpose. The evaluation, which partially equivalent to critical thinking, focuses on making an assessment on

judgment based on an analysis of a statement or proposition. Synthesis, which is partially equivalent to creative thinking, requires an individual to look at parts and relationships (analysis) and then to put these together in a new and original form. Research evidence suggests that this equivalent but the different relationship between critical/evaluative and creative synthetic thinking is appropriate. Huitt (1992) classified techniques used in problem-solving and decision making into two groups, roughly corresponding to the critical, creative dichotomy. The first set of techniques tend to be linear and serial, more structured, more rational and analytical, and more goal-oriented; these techniques are often taught as part of critical thinking exercises. The distinction corresponds to what is sometimes referred to as left-brain thinking (analytical, serial, logical, objective) as compared to right-brain thinking (global, parallel, emotional, subjective) (Springer & Deutsch: 1993).

Given that critical thinking is the general method of all the sciences, mathematics, logic, philosophy, and other related intellectual activities, one could well spend the rest of one's life getting to know this activity and coming to better polish one's skills.

Corbet has specified critical thinking skills as follows:

1. Coming to understand that the smallest unit of "meaning" is not the CLAIM or SENTENCE or BELIEF, but the ARGUMENT.
2. Recognizing the thesis.
3. Recognizing the argument.
4. Recognizing and assessing the logic of the argument.
5. Practicing negative criticism which is to show or discover that some part of the argument is mistaken or otherwise inadequate.
6. Practicing positive criticism which is not simply to agree. Rather, it can be to shore up some part of the argument that is weak.
7. Positive criticism may also be to anticipate the most serious objections which are likely to be raised and to build a defense against them within the rules of critical thinking.
8. Understanding and using the distinction between theme (or topic) and thesis (or main belief).
9. Understanding and using the concept of a "prima facie" claim.
10. Understanding and using a counter-argument.
11. Understanding and using a paradigm case.
12. Understanding, recognizing and using the distinction between chronological order and logical order.
13. Understanding and using the distinction between the "context of discovery" the "context of proof."

To reiterate, critical thinking and reflective pedagogy are crucially central to science education. By itself, however, reflection is not necessarily critical (Marcus: 1988). And since there is not a particularly exclusive component, called critical thinking education in the teaching practicum of prospective teachers in Kuwait, it could pervade the teaching practicum of science teachers in the fashion of critical thinking skills and reflective practice formatted in exercises and activities to brush up on their active knowledge and their critical thinking skills in the sciences for science literacy purposes.

This could happen through collaborations in and beyond the teaching practicum to promote a vision of critical science and environmental education that extends from improving the teaching of science and science literacy, scientific concepts, and methods to the involvement of citizens in community-based research. More substantially, it is in the physical and biological science courses, students and teachers (or student teachers *in our case*) experience the rigor and practice of scientific inquiry through classroom and lab work. They learn to consider analytically the methods of describing, predicting understanding, and explaining physical and biological phenomena, i.e., the representations of the environment. In these courses, students confront the

social, economic, political, and ethical implications of science and ecology as well as the dilemmas that crop up due to misuse of science and technology.

We need to start with the present science education faculty and science teachers in schools who are our stakeholders in the process of teaching practice. Accreditation expectations are such that science educators must develop their own definitions of critical thinking, determine criteria, measure outcomes, and revise the curriculum in light of their own conceptions. However, science educators also need to achieve a consensus about methods and tools to be used for the evaluation of critical thinking. In this context, (Swafford & Rafferty; 2016, pp.13-17) "FCS educators help individuals use critical thinking to make informed decisions about daily life occurrences."

In this context also, Dexter et al. (1997) call for standardization of a conception of critical thinking and make an application in a manner that faculty could more readily utilize the theoretical information. For example, they accepted the APA Delphi study definition of critical thinking, a theoretical composite of multi-disciplinary perspectives. They applied this definition at the operational level for the six identified components, i.e., interpretation, analysis, evaluation, inference, explanation, and self-regulation. Competency outcomes were identified for each critical thinking component and for each differentiated level for each of the four educational programs. While standards differ at each educational level, Dexter et al. (1997) state the faculty needs to have a consensus about what behaviors demonstrate each of the six components of critical thinking. While admittedly a "cookbook" approach to teaching critical thinking, Dexter et al. state they are seeking to raise the "average level of student instruction . . ." by faculty who are not specialists in critical thinking. The change in focus to critical thinking needs to occur in a decentralized manner so that faculties are cognitively open to new paradigms and perspectives.

A great deal of attention has been devoted to the topic of reflection and the development of reflective practitioners (Barth: 1990; Powell: 2000, pp.96-111). Powell (2000) notes that "reflective practice is the practice of colleagues joining together to observe and analyze the consequences for students learning of different teaching behaviors and materials in order to gain insights that will result in the continuous evaluation and modification of pedagogy". To engage in critical reflection requires "moving beyond the acquisition of new knowledge and understanding, into, values, and perspectives". In other words, reflective practice of teaching is developing collegiality rather than new knowledge, and by collegiality, we mean a critical towards learning and teaching. Little (1982) who first introduce the concept of collegiality as a cornerstone of reflective practice, comprises four specific teacher behaviors:

1. teachers talk about teaching, and these conversations are frequent, continuous, concrete and precise;
2. teachers observe each other engaged in the practice of teaching;
3. teachers work on curriculum together, designing, researching and evaluating the substance of what is taught; and
4. Teachers teach each other what they know about teaching and learning. Craft knowledge is revealed, articulated, and shared.

Therefore, assisting adults in undertaking critical reflection is a frequently espoused aim of adult education (e.g., Marcus: 1988), but it is a goal that is not easily achieved. Usually, people do not engage in giving, receiving, and not to mention probing feedback, which is at the core of reflective practice and hence the impediment to reflective practice. Powell (2000) calls the reason for this "*leviathan inertia*" when teachers are profoundly resistant to change. Meyers in an experiment elicited different layman interpretations of what critical reflective practice virtually means: according to his informants,

- Critical thinking is a learnable skill with teachers and peers serving as resources.
- Problems, questions, and issues serve as the source of motivation for the learner.
- Courses are assignment centered rather than text or lecture oriented.
- Goals, methods, and evaluation emphasize using content rather than simply acquiring it.
- Students need to formulate and justify their ideas in writing.
- Students collaborate to learn and enhance their thinking (Meyers: 1986).

These straightforward ideas are easily applicable to classroom settings only when both administrators and teachers model an adult learning predisposition for their student teachers. Therefore, teachers must refocus their thinking away from individual mastery of the resources and the product of competency to a focus on teaching the process of information discovery within the learner's own contextual meaning, especially in sciences.

Lack of a common definition for critical reflection has also led to the interchangeable use of the terms reflection and critical reflection that may "tacitly belie the different ideologies which can underpin reflective practice". When discussing the origins of reflection in education, the ideas of Dewey, Schön, and Mezirow are most frequently mentioned but only Mezirow seems to emphasize the critical nature of reflection. When adult educators write about critical reflection, they frequently cite critical reflection as an element of Mezirow's work on transformative learning. The effect on students who are encouraged to engage in critical reflection is another issue that emerges in the literature. The phrase "tales from the dark side" (Marcus: 1988) is used to describe the experiences of a group of adult education graduate students who engaged in activities designed to foster critical reflection. They found that critical reflection led to self-doubt, feelings of isolation, and uncertainty.

Critical reflection in a group context can also be unsettling as described by Haddock, who "was confronted and challenged by others. . . and who then found it[difficult to avoid examining personal values and the extent to which they affect attitudes, beliefs and ideas which one holds on to". Adult learners who engage in activities to facilitate critical reflection must be supported in their efforts. Another issue related to the experiences of students who engage in critical reflection has to do with the kind of teaching that supports critical reflection. As described by Foley and Millar, it is labor-intensive and may require a restructuring of existing curricula. In addition, not all learners may be predisposed to engage in critical reflection, which can be problematic. Teachers should also be prepared to support adult learners as they struggle with the dark side of critical reflection, a role that they may find uncomfortable. Teaching adults to be critically reflective can be a rewarding experience that results in critical reflection on the part of the instructor.

3. RESULTS

The following model proposes a structure of a critical thinking paradigm associated with the reflective practice for student teachers at Kuwait who will be involved in science teaching with a particular reference to pro-environmental consciousness-raising predisposition and STS orientation:

This model proposes three aspects of critical thinking that must be considered all in one package: these aspects are affective, cognitive, and behavioral.

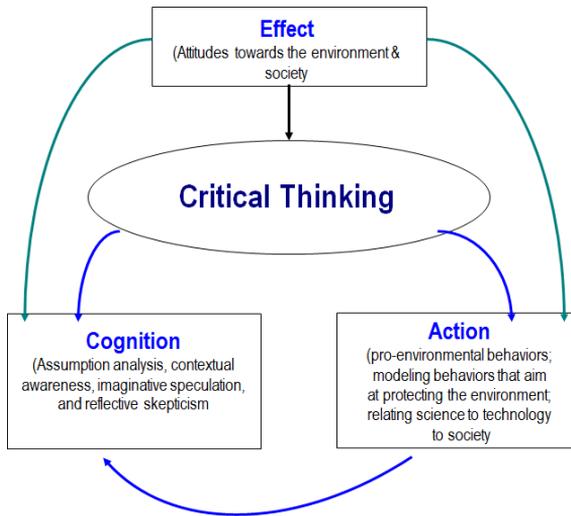


Figure 4. Standards for Intellectual Assessment

The model appropriates the definition by Mertes (1991) and Scriven & Paul (1992) in which included are beliefs and behaviors. The starting point is cognition. A stimulating piece of environmental / science- society knowledge presents an argument or proposition (Here is the level of cognition). Here, students are enabled to infer a conclusion from one or multiple premises. To do so requires examining logical relationships among statements or data.

There is then an affective disposition to use critical thinking that must activate the critical thinking processes, As a result of critical thinking a previously held belief is confirmed or a new belief is established. For critical thinkers are skeptical, open-minded, value fair-mindedness, respect evidence and reasoning, respect clarity and precision, look at different points of view and will change positions when reason leads them to do so. Finally, to think well is to impose discipline and restraint on our thinking-by means of intellectual standards in order to raise thinking to a level of "reflection and perfection" or quality that is not natural or likely in undisciplined, spontaneous thought. The dimension of critical thinking least understood is that of intellectual standards. Most teachers were not taught how to assess thinking through standards; indeed, often the thinking of teachers themselves is much "undisciplined" and reflects a lack of internalized intellectual standards. To think critically, must apply criteria. We need to have conditions that must be met for something to be judged as believable. Although the argument can be made that each subject area has different criteria, some standards apply to all subjects. "... an assertion must... be based on relevant, accurate facts; based on credible sources; precise; unbiased; free from logical fallacies; logically consistent; and strongly reasoned" (Beyer: 1995).

Having looked at what reflective practice is about; let us turn to the practical application of critical reflective practice. To put the model to practice, one borrows Taylor's "kitbag of strategies" for reflection which can include audiotaping, videotaping, creative music, singing, dancing, drawing, montage, poetry, painting, pottery, quilting - as well as writing. The important thing is that the form the educator/ teacher uses to express themselves provides them with space and opportunity to think back over an event and to apply the learning you gain to their future practice.

The following figure sums up the elements of critical reflective practice:

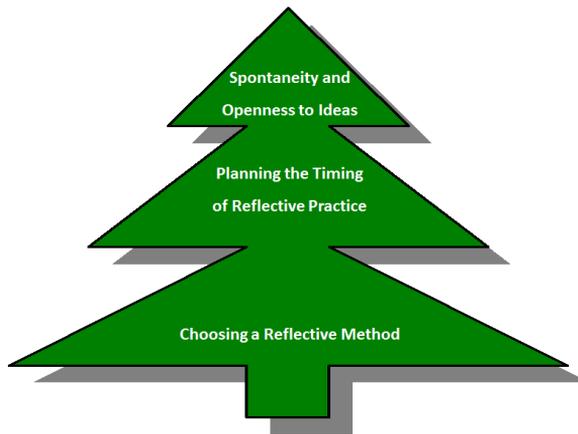


Figure 5. Elements of critical reflective practice

- Be spontaneous and open to new ideas:
Firstly, student teachers should be asked to be open and honest about what they think is right from a scientific point of view and tell it as they feel it. They should express themselves freely. These are their reflections and they are legitimate for them. If they are writing, they should be asked not to be constrained by the formalities of grammar, punctuation, spelling - it is more important to get to the heart of the issue by simply writing. As well, they should be asked to be open to ideas: sometimes they may find answers as they reflect, but do not jump on these insights as being absolute answers. They should try to leave ideas open and treat them as tentatively as possible. Jumping to conclusions may inhibit further insights and solutions, so be prepared for twists and turns in their thinking, and allow that some questions may have to remain unanswered for a while.
- Plan the timing of reflective practice:
Secondly, people function best at different times of the day - some are early birds, others prefer to work at night. Some people prefer to work under the constraint of time limits while others fail to do so. Time to reflect should be quality time for our student teachers.
- Choose a reflective method:
Student teachers need to keep a record of their practice diary (or notes) for review. Maybe there is something in the "kitbag of strategies" mentioned earlier that will suit them, or perhaps they prefer to reflect when they are studying science or teaching it at schools.

4. CONCLUSION

This paper has dealt with two major themes in the area of teacher education with particular reference to the case of science educators in their pre-service education programme, the practicum component provided by the College of Education in Kuwait. These are critical thinking and reflective practice as two interwoven processes involved in orienting the student teachers to develop benevolent attitudes towards the sciences in their pupils as well as brushing up on the student teachers' practices of teaching in the practicum component of the science teacher education component. It seems that in an age of informatics and explosion in science knowledge both science teachers and students of science have to develop critical thinking skills about teaching and learning processes. A tentative model for critical reflective practice as applied to science education is proposed in this paper.

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