

# Emphasizing Morals, Values, Ethics, And Character Education In Science Education And Science Teaching

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## ABSTRACT

This article presents the rationale and arguments for the presence of morals, values, ethics and character education in science curriculum and science teaching. The author examines how rapid science and technological advancements and globalization are contributing to the complexities of social life and underpinning the importance of morals, values and ethics. In order to help conceptualize and articulate a solid theoretical framework for the development of school programs, syntheses and analyses are presented to the philosophical and pedagogical questions related to morals, ethics and character education. Various obstacles in teaching morals/ethics and implementing character education in the sciences are discussed. For universal acceptability, a comparative study between the philosophical and theoretical basis of modern Western moral education and the universal Islamic moral values and education is outlined that may be helpful for future educators and researchers. A range of teaching, learning and pedagogical techniques are proposed that may foster morals, values and ethics in students' minds and develop various skills and attributes necessary for success in the sciences.

**Keywords:** *science education; teaching; values; morals/ethics; character education*

## INTRODUCTION

People do not live their lives in moral or ethical isolation but grow up within particular moral traditions (Reiss, 1999). Liberal democracy can only flourish if its citizens hold certain moral and civic values, and manifest certain virtues (Althof & Berkowitz, 2006). In the modern era, technology is affecting society in ubiquitous fashion while maintaining its upright position, and both science and technology are also being influenced by society. The rapid advances in science and technology and increased societal complexities also underpin the importance of morals, values and ethics and their benefits to society.

Morals refer to human behavior where morality is the practical activity and, ethics describes the theoretical, systematic, and rational reflection upon that human behavior (Churchill, 1982). Values are linked to beliefs and attitudes and guide human behavior (Rennie, 2007). Morals, values, and ethics are strongly attached to society, spirituality and culture (United Nations Educational Scientific and Cultural Organization, 1991). There are three meaning of ethics. Firstly, ethics is commonly taken as a synonym for morality, the universal values and standards of conduct that every rational person wants every other to follow. Secondly, ethics is a well-established branch of philosophy that studies the sources of human values and standards, and struggle to locate them within theories of human individual and social condition. Thirdly, professional ethics, and it is not universal nor is it ethical theory; it refers to the special codes of conduct adhered to by

those who are engaged in a common pursuit. Professional ethics is an integral part of the concept of a profession (Kovac, 1996).

A wide range of misunderstandings and misconceptions surround morals, values and ethics (Churchill, 1982). Morals, values and ethics are sometime difficult to understand because the misunderstandings and misconceptions surrounding them hinder arrival at the correct explanation. The objective of moral education lies in the fact that it can develop shared feelings with others, and makes one committed to one's own personal responsibilities and actions (Campbell, 2008). Moral agency is a dual state that encompasses the teacher as a moral person engaged in ethical teaching through professional conduct and, as a moral educator who teaches students with the same core values and principles that he or she strives to uphold in practice (Campbell, 2003). Ethical knowledge can best capture the essence of teaching professionalism as it enables the teachers to appreciate the complexities of their moral agency (Campbell, 2008). Ethics is firmly connected to virtues of responsibility, trust and credibility. It should always be fair, honest, transparent, and respectful of the rights and privacy of others in society (Frank et al., 2011). Numerous sets of values exist in society.

In the context of science, three particular domains of values are present in society: the values associated with education, values of science and values of science education. These three values remain in close proximity, and interact or overlap with one another (Hildebrand, 2007). Thus science cannot be isolated from society. Values in science education include values associated with teaching science in schools, epistemic values of science, societal values and the personal values of scientists. The existence of value is not context specific. For example, western science has different values from other indigenous science value sets (Corrigan, Cooper, Keast, & King, 2010). Morality, values and ethics are always connected and interrelated to society, and attached to societal culture, which are constantly influenced by politics (Unesco, 1991; Witz, 1996).

Since the 19th century there have been rapid science and technological advancements; recently, globalization is profoundly influencing society, science education and teaching practices. Prior to the nineteenth century, science practices were centered on moral and religious values along with an appreciation of philosophical and metaphysical aspects of science education. At that time, societal activities were both supportive of, as well as supported by science practices. The positive side was that it enabled the science to work such that it influenced individual moral and spiritual evolution, besides fostering morals and higher values. But compared to that system the present system is not very supportive of science practices and is found to be significantly deteriorated. It was argued that the current science practicing ideology is strongly acting against the individual's inner moral and spiritual unfolding and fulfilment (Witz, 1996). Such opposing ideology may restrict an individual from appreciating the goodness and beauty of life and truth. Thus it cannot provide proper orientation and bases for a sound mind in a sound body that upholds morals and values; which in fact, were historically provided by society, religion, traditional cultural values and moralities.

For more than 350 years science education focused on the way that benefitted individuals and served society (Hurd, 2000). The landscape of science education and science practices has significantly changed over the last 4-5 decades. During the 1980s and 1990s significant efforts have been made to identify social and higher order thinking skills associated with science-technology literacy that may serve as a framework for developing a lived curriculum. The lived curriculum may help students to cope with changes that influence human welfare (Hurd, 1998), and foster morals, values and ethics.

Currently science educators are facing enormous challenges despite various education reforms and substantial research undertaken over the last few decades. The most important and alarming challenge is students' decreasing motivation and interest in sciences especially in the enabling sciences (Batterham, 2000; Chowdhury, 2013, 2014; Kiemer, Gröschner, Pehmer & Seidel, 2015; Tytler, 2007). In recent years students' interest in STEM (Science, Technology, Engineering and Mathematics) subjects has also dropped significantly throughout secondary education (Kiemer et al., 2015). At the same time, the rapid technological advancements and enhanced complexities in social life in the globalized world perhaps makes it more difficult to emphasize morals, values and ethics, and present them through an improved curriculum and teaching practices.

This article explains the necessity for embedding morals, values, ethics and character education in science education and science teaching. It presents the rationale and arguments, and emphasizes the nurturing of morals, values and ethics in students through an improved science education curriculum, and describes their benefits to society. The author examines how rapid science and technological advancements as well as globalization are contributing to the complexities of social life and underpinning the importance of morals, values and ethics in science education and science teaching. Syntheses and analyses are presented to the philosophical and pedagogical questions related to morals, values, ethics and character education that may help conceptualize and articulate a solid theoretical framework for developing school programs. Obstacles in teaching morals/ethics and implementing character education in the sciences are discussed.

A comparative study between the philosophical and theoretical basis of modern Western moral education and the universal Islamic moral values and education is outlined to the extent of gaining benefit and developing an enriched theoretical framework of moral and character education that may increase the universal acceptability of the Western theoretical framework of moral and character education. A range of teaching, learning and pedagogical techniques are proposed with emphases on the specific domain of science education to foster morals, values and ethics in students' minds and develop various skills and attributes necessary for success in the sciences. The proposed techniques and issues may help to improve students' moral and ethical understanding and reasoning, problem-solving, and decision-making. Successful implementation of the proposed techniques and issues may also help to reverse students' demotivation and disengagement in sciences, which are currently the most pressing needs to address. Through the proposed changes students are able to grasp the social implications of their science studies, and understand the business consequences and control the environment; they can reflect on how science and technology considerations differ from personal and political values, find various limitations of science, and acquire scientific knowledge and relate them to real-life situations or other knowledge.

### **Syntheses and Analyses of the Philosophical and Pedagogical Questions for Developing a Theoretical Framework of Moral and Character Education**

Both morals/ethics and character education require a coherent addressing of basic philosophical and pedagogical questions to conceptualize and build a solid theoretical framework; this framework in turn will enable teaching of morals, values and ethics, and implementing of character education in the sciences (Han, 2014; Lickona, 1999) through an improved science curriculum.

#### **Morals and Ethics**

Morality and ethics are part of a way of life and cannot be separated from all other aspects of life experiences (Kang & Glassman, 2010). Moral education aims at promoting students' moral development and character formation. The theoretical framework of moral education is supported by moral philosophy, moral psychology and moral educational practices (Han, 2014). Beyond the scope of promoting rational pro-social skills or virtues, moral education of real human value should cultivate the meaningful and personally formative knowledge that significantly transcend or avoid natural and/or social scientific understanding and explanation (Carr, 2014). Moral education is about an inner change, which is a spiritual matter and comes through the internalization of universal Islamic values (Halstead, 2007). Ethics is the branch of philosophy which tries to probe the reasoning behind our moral life. The critical examination and analysis through the concepts and principles of ethics help to justify our moral choices and actions (Reiss, 1999). In real-life situation 'ethics' is frequently used as a more consensual word than 'morals' which is less favored. Many students and professionals cannot find the sharp distinction between these two terms (McGavin, 2013). Recently moral thinking and moral action were explored using a Deweyan framework, and it was concluded that moral thinking or reasoning exists as social capital, and it is not a guide to moral action (Kang & Glassman, 2010). The key philosophical question for the study and promotion of moral education relies on the epistemic status of moral reflection or understanding and moral agency (Carr, 2014).

The philosophical and theoretical basis of modern Western moral education rely on significant contributions from several Western scholars, theoreticians and philosophers, notably Durkheim, Dewey, Kohlberg, Lakatos and Kant. And all of them were greatly influenced by the Greek philosophers. The foundational Western theories of moral meaning are dialectically derived between individual and society. The Western conception of the individual has deep philosophical roots in the question of whether morality is primarily a group experience or an individual phenomenon. Like Durkheim, many academics believe that moral truth is socially constructed which is qualified and formed through immersion in the social body; these academics reject the distinction between individual and social morality. Kohlberg's moral reasoning, for instance, involves the rational interaction between individual and society (Hussain, 2007).

In the Western liberal democracy, societies are becoming increasingly secular where religion and spirituality are losing their impact (Arthur & Carr, 2013) or are less valued. The technological ramifications are contributing to the complexities and stark changes in the societal structure where religion and spirituality are increasingly becoming marginalized. Evidently this situation will have an overarching effect on morals, values, ethics and virtues, and society may not get the full benefit. It is also echoed by the following statement (Gates, 2006):

*I argue that the bracketing out of religion, for whatever reason, from within the public process of educating citizens is seriously debilitating. To have any vibrancy, citizenship and education related to it must give more attention to the fundamental matter of beliefs and believing. That entails scrutinising religion as a common ingredient in the human condition, with a potential to transform, for both good and ill. I claim that the extent to which the moral roots of citizenship and citizenship education succeed in drawing on the energies of religion and refining its aberrations may even determine the operational worth and lasting outcomes of public education in any country (p. 440).*

In the historical perspective, the Western values of moral education are found constantly evolved and changed. In contrast, the universal Islamic values of moral education remained constant. From the Islamic moral educational point of view, although there are similar ground and overlaps with Western understanding, there are some clear distinctions on the understanding of the individual, societal and social morality. The critical distinction between the Islamic and the Western thought on moral education is how we define the good, and who we actually are. Islamic scholars believe that a good person possesses an integrated and ordered internal unity, wherein the soul governs the body. The moral truths derived from society cannot supersede the moral ideal of nurturing and awakening a spiritual self into a unity of being. Thus according to the Islamic view, a moral education is one in which the physical, spiritual and psychological elements are stimulated and guided towards the good and right action. The real elements of moral education are with the person and the soul within the person. The Islamic view of ideal social morality aims to build an Islamic character, and is manifested in a harmonious community of inwardly guided individuals to interact in just and noble ways (Hussain, 2007). In Islam, there is no separate discipline of ethics; and it is open to debate in determining the moral values, and the comparative importance of reason and revelation. Islam rejects the view of personal and moral autonomy, and encourages the society which has a duty to publicly uphold moral behavior and religious practices (Halstead, 2007). Islamic scholars believe that the theories of the Western moral education lack some senses of the individual where the inter-related inwardly fostered personal discovery and timeless sacred principles are absent. The Western curriculum and practices do not treat the child as a whole person, whose various characteristics and attributes must be integrated into a unified sense of self. Thus for the universal applicability of the Western models of moral education that are based on personal autonomy and notions of personal development (Hussain, 2007), the modern Islamic educational approach can offer significant intellectual inputs to bridge many gaps, to enrich and develop the modern moral educational framework. But it requires the involvement of both modern Islamic scholars and Western scholars in dialogues and discussions, and collaboration in achieving common aims.

### **Character Education**

Character education has a long history (Berkowitz, 1999). In the past, it has been viewed differently, and quite often focused more broadly. And thus it is difficult to gain the correct definition as it includes a

wide range of outcome goals, pedagogical strategies and philosophical orientations (Althof & Berkowitz, 2006; Jones, Ryan & Bohlin, 1999). Character education is essential for building a moral society, and it is the conscious effort to cultivate virtue. The psychological components of character education encompass the cognitive, affective, and behavioral aspects of morality such as, moral knowing, moral feeling, and moral action (Lickona, 1999). Because of the deficiency, character education lacks in producing systematic research outcomes. In the literature, plenty of opinions and suggestions are found surrounding character education; these indicate strong cultural and professional emphasis on character education. However, it lacks adequate scientific data to attend to the character education practices. In the professional training in character education little information is provided for future teachers (Berkowitz, 1999).

Modern educators are also defining character education differently. Anderson (2000) stated that character is defined as moral excellence and firmness where integrity refers to a firm adherence to a code of moral values (Anderson, 2000). Good character consists of the virtues where virtues are objectively good human qualities such as, wisdom, honesty, kindness, and self-discipline. Virtues provide a standard for defining good character. Thus the more virtues we possess, the stronger our character (Lickona, 1999). Goldsmith-Conley (1999) emphasized the development of school culture responsive to character development than individual character education (Goldsmith-Conley, 1999).

### **Obstacles in Teaching Morals/Ethics and Implementing Character Education in the Sciences**

A myriad range of obstacles are found in teaching morals/ethics and implementing character education in the sciences. Character education focuses on moral concepts, manners and civility, and shapes students' personality, values, attitudes and habits in their development (Althof & Berkowitz, 2006). Since character education takes a broad approach, it often blurs the line between moral concepts and other non-moral related concepts. Disagreement is also found within character education on the place of morality (Althof & Berkowitz, 2006). The most serious obstacles confronting character education are: (a) clarifying what character and character education are, (b) identifying which forms of character education are effective and for what outcomes, and (c) developing focal expertise in teacher training institutions (Berkowitz, 1999).

Six major obstacles have been identified in the pre-service teacher training in character education. The obstacles are: disagreement on what character is; and what constitutes character education; perceptions of limited space in pre-service curricula for character education training; limited scientific data about which character education elements are effective and for what outcomes; where the expertise and resources are; and, mixed or contradictory feelings about the appropriateness of educating for character (Berkowitz, 1999).

The secular ideology is becoming predominant in modern societies, and questions are being raised from individuals, groups, and institutions about the legitimacy of the educational institutions to engage in character education (Berkowitz, 1999). In the past when society was influenced by religion, such opposition in teaching morals and character education was not encountered. Families, societies and religious institutions had the authority to teach character (Berkowitz, 1999) and morals, and religion was the only potential source of morality, values and ethics. However, the majority of contemporary surveys show that society prefers the schools to actively participate to build character of the youth contrary to the opposition found in teaching character education (Berkowitz, 1999). Because in democratic societies the school's role is to develop moral citizens, and focus on moral and character development, teaching of civics and development of citizenship skills and dispositions (Althof & Berkowitz, 2006).

The application of role model has profound impact in teaching morality and implementing character education. Although teachers are considered to be the role models in character education, however, many teachers find it ambiguous in understanding as to how modelling can be an effective contributor to students' moral and character development. Sanderse (2012) stated that role modelling is rarely used as an explicit teaching method and only a very small percentage of students recognize their teachers as role models. Thus if role modelling is to contribute to children's moral education, teachers need to understand why the modelled traits are morally significant and how students can acquire these qualities (Sanderse, 2012).



In the Islamic educational point of view, moral and character education is more important than any secular education. And in Islamic character education, teachers are always considered as students' role models, and students show their utmost respect to teachers as to their fathers. According to Islam, teaching morality is itself a moral duty (Halstead, 2007) as is character education which is a form of moral education. The most influential Islamic scholar Al-Ghazali (1058–1111 CE) mainly focused on the education of character and virtues. Al-Ghazali's view of moral education was based on the mutual activity of educator and learner, and moral education becomes effective when students take their lessons to heart and put them into practice in their own lives. Teachers are considered as both moral exemplars and moral guides to their students. Al-Ghazali defined morality as a stable state of the soul which drives a person to attain good habits and perform good works that benefit both the person and society (Alavi, 2007).

Two major arguments exist against teaching of ethics in science. One is concerned with the nature of science, and the other, the consequences of teaching ethics in science. One argument portrays that as science is concerned with matters of fact, there should not be any ethics teaching in science. The argument against teaching of ethics in science originates from a consideration of the nature of science that has its roots in epistemological distinctions between forms of knowledge. Thus, because of two arguments, science and ethics occupy separate spheres of knowledge. Despite the arguments against teaching of ethics in the sciences, a greater proportion of science educators support teaching of ethics in science. Such support perhaps entails that teaching ethics in science improves students' ethical sensitivity, enables increased ethical knowledge, and improves ethical judgement capability; thus students become more virtuous, and can make the right choice and take right action (Reiss, 1999).

### **Brief Summary**

Thus rigorous synthesis of various philosophies, methods and goals of moral and character education based on solid empirical and theoretical research (Althof & Berkowitz, 2006) can enable us to conceptualize and articulate a solid theoretical framework that guides to optimally designing school programs to effectively foster morals, values, ethics and character education, and ultimately benefit society.

### **Discourses of Values, Morals/Ethics, and Character Education Through Science Curriculum Development**

In the 21st century it is not surprising that many young students will face the ethical issues raised by science that are too often lacking in their science education (Reiss, 1999). Values, morality and ethics are part of our life and these cannot be separated from society (Corrigan, Dillon & Gunstone, 2007; Kang & Glassman, 2010). Morals, ethics and values are different branches of knowledge that have different theories and philosophies. Science teachers are generally educated in science, and not in moral or ethical philosophy. It is therefore unrealistic and unfair to expect them to teach ethics (Reiss, 1999) and morals as separate but essential elements of science teaching. Again, teaching is fundamentally a moral enterprise (Bullough Jr, 2011). Thus teachers have the responsibility to engage in moral activities through their teaching profession. In science education, morals, values, ethics and character education cannot be taught as a separate curriculum. But all these essential elements should be entwined in all science curricula, and ranges of different but appropriate teaching techniques are required to apply in teaching them (Anderson, 2000; Berkowitz, 1999; Unesco, 1991). And students are required to look both at the consequences of any proposed course of action and at relevant intrinsic considerations before reaching any moral/ethical conclusion (Reiss, 1999). Such integrated science curricula can help students achieve a clear understanding of the moral and ethical ramifications of science.

Despite the myriad range of obstacles and opposition in teaching morals/ethics and implementing character education in the sciences, however, a majority of teachers and educators strongly support inclusion of these aspects in the science curriculum (Althof & Berkowitz, 2006; Anderson, 2000; Berkowitz, 1999; Corrigan et al., 2007; Goldsmith-Conley, 1999; Kang & Glassman, 2010; Lickona, 1999; Reiss, 1999; Rolston, 1988; Rosnow, 1990; Sanderse, 2012; Tan, 1997 Yap, 2014). A recent survey-based study (Sewell, 2003)

examined teachers' attitudes toward character education and the inclusion of character education in the family and consumer sciences education curriculum. It revealed that the teachers strongly agreed that character education can be (Strongly Agree & Agree = 98.9%) and should be (Strongly Agree & Agree = 87.1%) integrated in the family and consumer sciences curriculum. Teachers' responses to the survey indicated that they had extensive knowledge of the character traits (Strongly Agree & Agree = 95.4%) and how to teach (Strongly Agree & Agree = 88.2%) character traits. This study reflects not only the teachers' agreement but also their enthusiasm to teach character education in the corresponding curriculum, which similarly applies to science curricula as well.

A fundamental feature of science, as conceived by most scientists, is that it deals with facts, not values. Further, science is objective, while values are not (Allchin, 1998). Hurd (1998, 2000) argued that successful science curriculum reforms should focus on the shift from traditional discipline-based courses to rigorous science education that reflects on fundamental necessities of science education. Science educators suggest shifting from a content-driven science approach to more on the process of science embedded in and inherently associated with its conceptual content. Thus it requires emphasizing the relationship between the values inherent in society and the values embedded in science (Corrigan et al., 2007). It was suggested (Unesco, 1991) that the process of science curriculum development should focus on an effective value-oriented science curriculum while emphasizing the interdependency of science and technology, and their benefits to society.

The re-emergence of values in science education requires the consideration of different national and cultural contexts, understanding of the interactions between values and science in those contexts, and their impacts on the society or culture. Beyond the scope of focusing only on values centrally associated with science and teaching, it requires more attention to other generic values (e.g., cooperation and teamwork). Corrigan et al. (2007) described that one dimension of values and science curriculum that has remained remarkably constant across many countries and cultural contexts is the nature of values associated with laboratory work and science itself, and the ways these values are central to the curriculum. Allchin (1998) explained how the interactions take place between values and science. First, there are epistemic values, which guide scientific research itself. Second, scientific enterprise is always embedded in particular culture, and values enter science through individual practitioners, whether consciously or not. Finally, values emerge from science, both as a product and process, and may be redistributed broadly in the culture or society (Allchin, 1998).

Most students lack familiarity with ethics as a discipline, and are unable to articulate their position or participate in a reasoned discussion about the ethical issues in science which necessitates incorporation of ethics into science teaching. Three components were suggested as keys to promoting effective discussions related to ethics and science (Chowning, 2005): content and lesson strategies, a decision-making model, and a familiarity with ethical perspectives. The strategies based on these three components may allow teachers to confidently address ethical issues in science. In this way teachers can help students develop understanding of science as a social enterprise, and students can develop their skills to apply in the science classroom. Other researchers (Frank et al., 2011) put forward their rationale to address ethics within university curricula since multicultural societies are developing all around the world without shared moral values. Thus in the university curricula an introduced course in ethics should convey knowledge and encourage a culture for fostering a developed mind through amended or reformed thinking.

There is no agreement on the frontiers in morals or science. In the past centuries, moral conclusions of humans are found to be more stable than scientific conclusions. This is because moral responsibility demands a level of agency, and people are responsible for their values as they are not for science. This comment (Rolston, 1988) was supported by an important study (Bell & Lederman, 2003) conducted on a range of professors of geographically diverse universities who had varied ranges of expertise, and displayed their reasoning differently on the understanding about the nature of science. It was revealed that the personal values of all academics were the principal influence on their decision-making processes. Other factors included morality or ethics, and social issues.

It is obvious that certain types of curricula may not engage students in moral considerations where they can express moral positions on a particular topic/issue related to science. In this regard the United Nations Educational Scientific and Cultural Organization (1991) had put forward the rationale for the presence of moral and ethical education in the science curriculum that may contribute to students'

development to become self-dependent individuals, who will be capable of recognizing, accepting and internalizing their roles as responsible decision-makers. Students will be able to reflect on their own moral positions that help to handle various moral and ethical issues in society. This rationale was authenticated by Hurd (2000) who also provided a similar outline for an effective science curriculum under present circumstances. Thus an effective curriculum can be designed to engage students, improve their decision making and judgement forming abilities; and help them to choose the right actions that involve elements of risk, uncertainty, values and ethics. Therefore the new curriculum standards can principally focus on the utilization of knowledge in science and technology, and enhance students' adaptive needs. Thus the arguments (Hurd, 1998, 2000) presented for a reformed science curriculum support the rationale provided by the Unesco (1991). Such agreement stresses on the compelling reason and strong needs for emphasizing morals, values, ethics and character education through science curriculum development and implementation.

### **Fostering Morals, Values, Ethics and Character Education Through Teaching Practices in Sciences**

Values and ethics should not be taught directly to students (United Nations Educational Scientific and Cultural Organization, 1991) as some students may be sensitive and react in different ways. However, the proper nurturing of intellectual honesty in students' minds will help to enrich their faculty of knowledge, morality, values and ethics. This view aligns with the guidelines provided by National Science Education Standards (National Research Council, 1996). Morals and values can be fostered (Unesco, 1991) through a myriad range of teaching techniques such as role-play, drama, simulation, educational games, debates, discussions, projects, group work, educational visits, interviews, brainstorming; and utilizing the resource materials using poems, stories, songs, photographs, posters, and slogans. Other teaching techniques involve project assessments, group work evaluation, observation techniques, interviews, pre-test, post-test, anecdotal records, and audio-visual evaluations (Churchill et al., 2013). These techniques effectively help teachers to evaluate the students on critical engagements with important issues while considering the morals, values and ethics of science and other life-worlds. The purposes of science lessons can be realized through the pursuit of examination processes (e.g., decision-making and evaluation of evidence) rather than only considering content knowledge (Ratcliffe, 2007). Teaching may particularly focus on the articulation of limited domain of scientific values, and how they can be integrated or linked to other values (Allchin, 1999) existing in the societal domain.

The following important teaching techniques, methods and issues are suggested as they may profoundly impact on fostering values, moralities and ethics, and students' character development. The suggested teaching techniques, methods and issues are based on research outcomes reported elsewhere, and have practical implications where teachers and students can find them useful for translating into real-life situations. Some pertinent examples are also provided. The following suggestions provided may help to develop a student-centered and inquiry-based learning in classroom practice:

### **Teacher Training Through Professional Development Program**

It is important that teachers understand the importance of fostering morals, values and ethics to students. This is because values, ethics, practices and perspectives of sciences are part of science education (Jegede, 1997). Values and beliefs both have a cognitive dimension, and values and attitudes are developed within an affective domain. The notion of values is that they play a large role in how our attitudes and beliefs are formed (Corrigan et al., 2010). Teacher training programs may address how teachers can handle morals, values and ethics related issues, and articulate different pedagogical approaches and techniques to address them. Teacher training may address how to handle effectively when students' morals, values and ethics clash with those of other students and those of the teacher and of Western science. Teachers should be careful when a debatable discussion develops in a classroom where many students may hold different morals, values and ethics against that sensitive issue. A sensitive teacher who acts as a good facilitator can handle the situation of differing morals, values and ethics among students; and will try to prevent the students from adopting certain morals, values and ethics. Students' scientific preconceptions which they bring to the classroom can be perfectly logical, and therefore, any effort to modify the preconception will be ineffective



(Jegede & Aikenhead, 1999). Effective teaching should use science activities that do not conflict with students' beliefs, or emphasize activities that attend to those beliefs but provide bridges between them and scientific content.

Teachers' professional development programs may utilize case methods to promote ethical and moral development among teachers. Teachers need to be taught how to facilitate a case analysis, improve their moral vocabulary, and critically reflect on various matters related to moral and ethical issues (Bullough Jr, 2011).

### **Role-Play and Discussions**

Based on classroom exercise role-plays and discussions can be effective to sharpen critical thinking and develop an appreciation of ethical aptitudes (Rosnow, 1990). Role-plays based on dual-use of dilemmas motivate students' active engagement with ethical issues, and work as a catalyst for developing critical, analytical, argumentative and verbal skills. This activity should be done in an enjoyable and non-threatening way (Johnson, 2010). Various situations involving ethical dilemmas can be given to students for discussion. Teachers can participate in discussions and constantly monitor students' reactions whether positive or negative, and students' judgements. A set of examples of situations with ethical dilemmas are reported (Rosnow, 1990) that can be useful to teachers or they can find them from any valid sources. At the end of discussions, students should be able to understand their own ethical assumptions, and compare them with the acceptable norm. Importantly, students will be able to understand any bias that can distort the ethical standpoint or be convinced in eliminating any ethical ambiguities that may exist in their minds.

### **Decision Making**

Teachers may consider prior understanding about reasoning and human beliefs to improve decision-making abilities. Peirce (1877) described that the entity of reasoning is to find out, from the consideration of what we already know, and something else which we do not know. This is because the question of its validity is purely one of fact and not of thinking. Reasoning is good if it be a true conclusion from true premises, and not otherwise. Both effective reasoning and ineffective reasoning are possible, and such fact of reasoning is the foundation of the practical side of logic (Peirce, 1877). Teachers can play a vital role in encouraging students' personal decision-making which involves how to listen respectfully to the positions of others, overcome prejudices, and communicate opinions reasonably on matters that differ from their sentiments or views (Chowning, 2005). Decision making necessarily surrounds a wide scope of other types of knowledge which always include values and personal knowledge, environment, technology, ethics, civics, politics, laws, economics, public policy and ecology (Jime'nez-Aleixandre, 2002). When students partake in the decision-making process, they give priority to values over scientific evidence since values are more important in culture and hence influence their decision-making process on most socio-scientific issues involving them (Aikenhead, 2005). This finding (2005) is aligned with what Peirce (1877) described about belief and doubt. Students give priority to values over scientific evidence because values are embedded in the students' culture, and they find doubts in scientific evidence. In such case students want to remove the doubts to attain a calm and relaxed state of mind that influence their decision making process. In decision making, students may learn and understand what constitutes the data that provide information, and how it can be utilized in the process of decision making. The significance of decision-making practices can be well understood from the research outcomes (Sadler, Chambers, & Zeidler, 2004) which were based on students' responses. Students were provided contradictory reports about the status of global warming, and were asked to read the reports and answer the questions set by the researchers. Sadler et al. (2004) found that nearly half (47%) of the students lacked adequate conceptions of scientific data (data confusion and data recognition) presented to them. Some students were able to recognize data without the ability to describe its significance, whereas others could not even distinguish among data, unfounded opinions and predictions. These observations also demonstrated that moral development is an important factor when decision-making strategies are assessed.

### **Historical Case Studies**

Students generally respond very well to case studies (Kovac, 1996). Research shows that scientific values can be introduced through historical case studies as a valuable tool for teaching (Allchin, 1999).

However, the challenging task is how to identify the facts of a case, recognize the underlying ethical dilemmas, and understand different perspectives involved (Chowning, 2005). A recommended approach (Allchin, 1999) to teach scientific ethics is through a case method in which students are introduced to ethical questions surrounding any realistic situation. In this context, teachers need to understand the multi-faceted relationship between science and values, and appreciate the nature of science through reflexive exercises and case studies. It is important to gain a historical view of science. The disasters that occurred in Seveso and Bhopal may be up for discussion to link sciences and humanities; and instigate a fruitful dialog between the faculty and the students (Frank et al., 2011), and thus can fulfil the requirements for a successful case study implementation. A range of researches (Zeidler, Sadler, Simmons & Howes, 2005) supported the efficacy of using controversial socioscientific case studies to foster critical thinking, and moral/ethical development. Each socio-scientific issue can provide an environment for engaging students in debate and reflection that positively impact on their cognitive and moral development. In addressing both sociological and psychological ramifications of curriculum and classroom practices, the case-based socio-scientific issues may be applied as a pedagogical strategy.

### **Engagement Through Students' Debate and Discussions**

The understanding of science, values and objectivity supports the validity for discussing values in a science classroom, which lead to scientific inquiry. Cultural differences may imply ethical disagreements, and especially in pluralistic societies on a global scale. Students should be inspired to learn and practice science for negotiating within and without familiar settings and situations (Zeidler et al., 2005). A research study (Leeuwen, 2007) revealed that students' cultural diversity does not influence the way ethics are taught. But different cultural backgrounds may cause some confusion when the criteria of academic honesty, collusion and plagiarism are considered. Teachers may carefully choose the issues that stimulate debate and discussion. As an example, students may be asked to debate and discuss a current issue (e.g., addressing a scientific approach to solve the current global warming issue). This will allow students to explore the implicated components related to this issue, such as cost effectiveness of eliminating greenhouse gas emissions, and the social and ethical responsibilities of industrialized nations (Allchin, 1999) who are mostly responsible for causing the problem. It is important to ensure that when students are involved in their own evaluation of an ethical-dilemma related to science, they have solid understanding of the science behind the issue (Chowning, 2005). Teachers should be well aware of current scientific knowledge and emerging technologies which may further introduce new ethical and social dilemmas based on pre-existing values (Allchin, 1999). A daunting feature of a biomedical research was revealed from a Hastings Center Report publication (King, 1992) on the Tuskegee syphilis study and its legacy. The study was held from 1932-1972, where 412 poor African-American men were deliberately left untreated so that researchers could determine the natural history of syphilis although penicillin was available at that time as an effective drug against syphilis. These types of real issues can be raised for students' debate and discussion. Different contextual issues involved in science research can also be brought forward to benefit both teachers and students.

### **Adopting Professional Values Through Work Placement**

The prevailing general education curricula, particularly in the sciences, which are organized along the traditional disciplinary lines, are constantly failing. This is because of their inability in fostering understanding of the current practices and culture of science and technology, and overlooking the necessity to integrate science and technology with relevant aspects of life (e.g., civic, work, personal, social and economy) (Hurd, 2000). Thus it is evident that current school or university general education cannot provide adequate support to enable students entering the workforce, which requires prior preparation. Employers also expect some skills and experiences from the new graduates that can fit their requirements, and expect them to adapt quickly to the workplace. A co-operative education idea (Zegwaard & Campbell, 2011) may offer an unparalleled learning atmosphere for grasping professional values and ethics. It can help develop moral reasoning, professional identity and integrity. Hence by engaging in work placement programs, students can benefit when they adhere to and reflect on the workplace value systems and the ethical nature of work practices.

### Focus on Character Education

In the past, when religions had great influence on society, the importance of character education was realized. Over the period when science and technology started to flourish, the socio-economic and political landscape of society had started to change enormously with growing needs and expectations, and the importance of character education started to deteriorate. Thus it is important that educators emphasize character education to develop virtues, quality attributes, personality and leadership in students. Character education is mainly required in the early school years when young students are at the stages of developing their own world views.

The great philosopher, Aristotle, offered an account of human moral or virtuous character in terms of its natural purpose, function and utility (Carr, 2014). Aristotle regarded moral exemplification as important for virtuous and admirable character education. Practical wisdom or *phronesis* is central to the development of Aristotelian virtue which is about intrinsic human values. The main goal of *phronesis* is the virtuous ordering of appetites, desires, emotions and feelings for building an admirable character (Arthur & Carr, 2013). Aristotelian character education may be successfully applied in current situations by identifying the main processes that Aristotle considered necessary for development of virtue such as emphasizing the practical nature of virtues and for early training in habits of honesty, self-restraint, and courage. Teachers can guide and instruct properly so that young people acquire good habits of honesty, courage and fairness from parents, guardians or teachers who themselves should display such virtues. And teachers can explore the scope of formal educational opportunities to inform and exercise the reflection, slow and careful consideration, and evaluation of the Aristotelian *phronesis* required for building a superb character (Arthur & Carr, 2013).

### Brief Summary

Many educators acknowledge the necessity for aligning science curriculum design with cognitive and affective goals. Students want to see real-life science applications and practical implications such as experience in industrial settings and dealing with various problem-solving issues that can interest them in the sciences. Students can perceive their science knowledge as useful and relevant when they consider scientific topics such as medical, health, environment, energy, materials science and industry-based matters (Chowdhury, 2014) and value-oriented and ethical issues related to science are presented to them in a plausible and intelligible way. There is strong evidence that students like ethical issues to be more widely addressed in science education than is often the case (Reiss, 1999). Hence the presented teaching techniques, methods and important issues may significantly impact on students' critical thinking, values, morality, ethics, and character development. And at the same time addressing ethical issues will provide the opportunity to learn applied science and associated business consequences; help students build solid foundations in science and enable further acquisition of scientific knowledge that considers culture and context in making decisions, and relate their knowledge to other knowledge. Students gain the capability to apply their scientific knowledge in understanding and controlling environments. They are able to reflect on science, technology, and decisions, various limitations of science, differences between science and technology, and how science and technology considerations differ from personal and political values (Roberts, 1982). Overall, these presented teaching techniques, methods and important issues will enhance student motivation and engagement hence producing better informed future citizens.

### CONCLUSION

Despite various obstacles in teaching morals/ethics and implementing character education in the sciences, the majority of science educators, teachers and society at large strongly support the presence of morals, values, ethics and character education in the science curriculum which may provide a motivational context for learning science, and understanding the socialization and humanization aspects of science and technology. Students can develop higher awareness of social implications of their science studies, become self-dependent individuals, and be able to recognize, accept and internalize their roles in decision-making. Such teaching will enhance students' judgement, critical thinking abilities and motivation besides encouraging engagement in the sciences. Students can handle various moral and ethical issues in society, take responsibility, and build a good character.

Rapid science and technological advancements, globalization and emerging complexities in societal structure are influencing and changing the social dynamics with respect to economics, politics and environment, and the way science is organized and operated. Such changing circumstances pose challenges to future science educators as to how morality, values, ethics and character education can be presented through curriculum development and implementations. The current science education is lacking in providing adequate inner orientation and bases for students' unfolding and fulfilment of inner moral values and ideals which are essential for their development. Thus it necessitates emphasis on morals, values and ethics that can be reflected through an improved science education curriculum. Recent calls from science educators and researchers for the re-emergence of values in science education (Corrigan et al., 2007) attest to the validity of this statement.

This article presented rigorous syntheses and analyses of the philosophical and pedagogical questions related to morals, ethics and character education with a view to conceptualizing and articulating a solid theoretical framework to develop appropriate school programs and teaching instructions. The comparative study between the philosophical and theoretical basis of modern Western moral education and the Islamic moral values and education may contribute to the future moral educational framework.

A student-centered and inquiry-based teaching approach is suggested to enhance students' motivation and engagement, and foster human values and connectedness with personal and societal issues. Research has proven science teaching and learning practices may be applied while fostering morals, values and ethics. This article presented some important teaching techniques, methods and issues with examples based on research, and suggested views which may impact on fostering values, morality and ethics in students' minds, and enhance student motivation and engagement.

While it is important to implement the teaching techniques and methods discussed, it is also necessary that teachers are well aware of and regularly informed about new emerging issues, instructional methods and techniques from upcoming research. This may help teachers to develop conceptual tools in the context of teaching morals, values, ethics and character education in the sciences.

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