Teaching Science Education with special reference to Morals, Values, Ethics, And Character Education.

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ABSTRACT

This paper 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 were discussed. 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

This paper 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. 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, values, and ethics are strongly attached to society, spirituality and culture (United Nations Educational Scientific and Cultural Organization,1991). Ethics has three meanings which include;

1   Ethics is often taken as a synonym for morality, the universal values and standards of conduct that every rational person wants every other to follow.

2   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.

3   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).

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). 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. 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).

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 fulfillment (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.

However 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' demonization 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. (Mohammad 2016).

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).

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, 1999; 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 he development of school culture responsive to character development than individual character education (Goldsmith-Conley, 1999).

Teaching Morals/Ethics and implementing Character Education in the Sciences and its impediments.

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 nonmoral 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 modeling can be an effective contributor to students' moral and character development. Sanderse (2012) stated that role modeling 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 modeling is to contribute to children's moral education, teachers need to understand why the modeled traits are morally significant and how students can acquire these qualities (Sanderse, 2012)

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 judgment capability; thus students become more virtuous, and can make the right choice and take right action (Reiss, 1999). This is an indication that rigorous synthesis of various philosophies, methods and goals of moral and character education based on solid empirical and theoretical research 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. (Althof & Berkowitz, 2006)

Development of Science Curriculum using Values, Morals/Ethics, and Character Education.

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.

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 fo fostering a developed mind through amended or reformed thinking.

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 judgment 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.

Encouraging 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 and methods are suggested as they may Profoundly impact on fostering values, moralities and ethics, and students' character development of which teachers and students can find useful for translating into real life situations. Some pertinent examples are also provided.

Professional Development Program through Teacher Training

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' 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 (BulloughJr, 2011).

Discussions and Role-Play

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 dilemma 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). Standpoint or be convinced in eliminating any ethical ambiguities that may exist in their minds.

Decision Making

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). 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.

Debate and Discussion through Students' Engagement

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.

Adopting Professional Values through Work Placement

Employers 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 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. (Zegwaard & Campbell, 2011). Summarily 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). In all, these presented teaching techniques, methods and important issues will enhance student motivation and engagement hence producing better informed future citizens.

CONCLUSION

In spite of various obstacles in teaching morals/ethics and implementing character education in the Sciences, 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' judgment, 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 fulfillment 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. This paper is aimed at 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. Some teaching approaches were suggested to enhance students' motivation and engagement, and foster human values and connectedness with personal and societal issues.

This paper also 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 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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