**Educating Self-Regulation for Sustainable Development in 21st Century**

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**ABSTRACT**

The twenty-first century young generation is growing up in a society of scientific and technological advances. At the same time it is not only facing the multitude of challenges but also living under the dubious shadow of uncertain future and fragile ecosystem. Environmental concerns, the exploitation of natural resources and degraded ecosystem in the world oblige the responsible behaviour of all citizens. The conditions demands individual efforts, attention and action. In such a condition, education plays a key role shaping the attitude and behaviour of students in the school. The primary aim of education is to prepare the young generations for the future as responsible citizens. Their upbringing in a certain environment since a young shapes their attitude and behaviour. Habits and attitudes do not follow in one day but a continuous process of self-assessment, self-improvement and decision-making. Students need to be taught to reform their habits and behaviour for a concerned attitude towards environment. Self-regulation is the ability to monitor and control one’s own behaviour, emotions, or thoughts, altering them in accordance with the demands of the situation. The paper presents the five models of self-regulation by Boekaerts, Borkowski, Pintrich, Winne and Zimmerman. While teaching environmental sciences and other subjects, strategies of self-regulation can help students to reflect upon socio-scientific issues of ecosystem.

**Introduction**

“No generation has a freehold on this earth. All we have is a life tenancy — with a full repairing lease”, Margaret Thatcher’s felicitous words reminds to be watchful of the actions towards nature. Inventions, explorations and discoveries have been an inseparable part of human living. Civilizations have developed and flourished due to preservation and conservation of knowledge and skills throughout the centuries. Generations have come and gone by leaving behind the ecological footprints. Living in the twenty-first century provides an enormous account of past to the present that gives a magnificent history to live by and learn. According to Footprint Network Organization, The average Ecological Footprint per person worldwide is 2.6 global hectares (6.5 global acres), while the average bio-capacity available per person is 1.8 global hectares (4.5 global acres). But some countries' level of ecological demand per person is much higher than world average, and some is much lower. China's share of ecological footprint, which is measured to be a massive 19 %, followed by USA's 13.7 % and India at 7.1 %, The Living Planet Report 2014 said. The top five countries, which include Brazil and Russia, make up about half the global total. On the other hand, instead of understanding environmental problems and concerns in isolation, Brundtland and the members of the World Commission on Environment and Development (WCED) related these issues and concerns to developmental policy to unravel the complex causes and identify possible measures against environmental degradation (Redclift, 1987). In the final statement of the Brundtland report ‘*Our common future’,* the term *sustainable development* was coined. This term not only involves sustainable management of resources, economic growth and environmental protection but also social justice within and between generations (WCED, 1987).

Education has an age-old role and its impact on the conduct of human behaviour. It has provided necessary control, knowledge, skills and training to prepare the generation for a living. The generations of tomorrow are trained in the present in the schools with the experiences of past. In order to procure sustainable development, education has been the key to train nimble minds for proper behaviour and conduct towards nature. It demands of the young generation to reflect at the present conditions critically and behave accordingly.

**Socio-scientific Issue**

As contrasting to entirely scientific topics, socio-scientific issues involve both considerations of scientific content and societal implications. Sadler refers to socio-scientific issues as “complex, open-ended, and often contentious problems, with no definitive answers” (Sadler, 2004, p. 514). Their resolution requires interdisciplinary approaches because socio-scientific issues involve evidence from many areas of research (Fensham, 1988; Kolstø, 2001; McConnell, 1982; Solomon & Aikenhead, 1994). Due to this, uncertain consequences and the contrary perspectives of a multitude of stakeholders, many alternative solutions to resolve socio-scientific issues exist. Science and environmental education should generate curiosity and concern among students to form a reflected view on such issues, and support them to participate in discussions and debates. Researches have been conducted to unravel how students essentially deal with socio-scientific issues and which methods are appropriate and suitable to foster the abilities of students to deal with with these complex tasks most effectively. Including socio-scientific issues into science and environmental education requires meaningful real-world contexts and exposure for the reality check that allow for an analysis, synthesis and reflection on these complex issues to promote the genuine concern and care among students. Self-regulation is one of the solutions that education has to offer to address this need to generate care and concern among learners.

**Concept of Self-regulation**

Self-regulation is a significant personality process through which people can seek to make use of control over their thoughts, their feelings, their impulses, and their task performances. Self-regulation refers to “...the self-generated thoughts, feelings and actions that are planned and cyclically adapted to attain personal goals” (Zimmerman, 1992). It can also be said that *self-regulation* is a self-directive process of transformation in which students change their mental ability to acquire academic skills (Zimmerman, 1992). *Meta-cognitively,* self-regulated students are students who plan, set goals, organize, self-monitor and self-evaluate their learning at different points in the process of the acquisition of knowledge and skills that lead to habit-formation. *Motivationally*, self-regulated students report high self-efficacy, self-attribution and intrinsic interest, while *behaviourally* they select structure and create an environment which contributes to optimise learning and habit-formation (Zimmerman, 1992). Self-regulated students are independent students.

**Education for Self-regulation**

The ever-growing technological and scientific advances that have occurred since the industrial revolution have led to economic growth and development in the world. However, the production of required amount of goods for an exploding world population has without doubt reduced the quantity of available natural resources and has affected the eco-balance. The scarcity of natural resources and the limitations of productions were identified long back. Today, apparently the issue of concern is environmental degradation through deforestation, acid rain, ecological and digital footprints and many other causes. To ensure sustainable development, the education of the world’s citizens is a crucial prerequisite. At the United Nations (UN) conference in Johannesburg in 2002, all the countries agreed on implementing education for sustainable development in their educational systems.

The importance of education for sustainable development has been widely recognized. Education for Sustainable Development (ESD) /Environmental education for sustainable development (EESD) is a concept encompassing a vision of education that seeks to empower people of all ages to assume responsibility for creating a sustainable future. Environmental education for sustainability acknowledges what has always been true, that how people understand, perceive and interact with their environment cannot be separated from the society and the traditions and the culture they live in. Learning through life-experiences has the dimensions of process and outcome to apply critical thinking, and develop skills in inquiry that have regulation of habits beyond the classroom. Self-regulation insists on the meta-cognition, habit-formation and attitude development that foster the prospects for significant change in behaviour.

Constructivist theory frames learning as an active, continuous process whereby learners take information from the environment and construct personal interpretations and meaning based on prior knowledge and experience (Driver and Bell., 1986, Roth, 1990). Moreover, learners construct knowledge by physically and mentally acting on objects or phenomena in the environment (Piaget, 1970) and through social interactions with members of the community (Vygotsky, 1986). In the last few years, the new meta-knowledge of teaching and learning, new concepts of learning environments and new knowledge of the diversity of the learners and their ability to control and plan their own learning have presented many concepts to seek novel practices at schools.

**Models of Self-regulated Learning**

Regulation of one's own cognitive processes, control of behavioural processes, motivation have attracted increasing numbers of researchers in psychology as well as educators, as evidenced by the different models of self-regulation that have been developed over the past two decades. This section of the concept paper presents and compares the latest models of self-regulated learning (SRL) by Boekaerts, Borkowski, Pintrich, Winne and Zimmerman.

**(I) Boekaerts’ Model of Adaptable Learning -** Boekaerts (1992, 1995, 1996a, 1996b) developed a model of adaptable learning in the classroom, affording appraisal a central role in the SRL process. Three kinds of information were assumed to influence the appraisals via a dynamic internal working model, namely perception of the learning situation, domain-specific meta-cognitive knowledge and the self-system, together with the associated motivational factors. Appraisals were considered to be the unique and they were assumed to direct students’ behaviour in the class-room.

**(II) Borkowski’s Process-oriented Model of Meta-cognition-** Borkowski et al. (Borkowski, & Muthukrishna, N. 2000) defined the characteristics of a good strategy user or information processor. According to this definition, successful integration of cognitive, motivational, personal and situational components underlies good information processing. The development of self-regulation begins when children are taught the use of a learning strategy. They progressively gain knowledge about the attributes of that particular strategy. With time, children learn to know other learning strategies. Applying them in diverse contexts contributes to enlarge and enrich the specific strategy knowledge available to them. Self-regulation emerges when children become able to choose appropriate strategies and monitor their performance. As strategic and self-regulatory or executive processes become well established, children learn to recognise the utility of behaving strategically. Self-efficacy perceptions and attributional beliefs also develop, thus linking strategy use to personal and motivational states with feedbacks. This feedback is assumed to have an important role in shaping personal–motivational states which in turn energise the executive processes necessary for future strategy selection (Borkowski, 1996).

**(III) Pintrich’s General Framework for SRL-** Pintrich (2000) developed a general framework for SRL. According to the framework SRL is composed of four phases, namely forethought, monitoring, control and reflection phases. For each phase, self-regulatory activities are listed in four separate areas, including cognitive, motivational and affective, behavioural and contextual areas.

**(IV) Winne’s Four-stage Model of Self-regulated Learning -** According to Winne & Hadwin (1998) SRL has some of the properties of both an aptitude and an event. According to this model (Winne & Hadwin, 1998) SRL includes four distinct stages. The first stage of the model, task definition, is characterised by the perceptions that students generate about the task. Stage two is devoted to goal setting and planning and third stage is that of enacting tactics and strategies planned in stage two. The fourth and last stage, meta-cognitively adapting studying techniques with an eye to future needs, refers to a process by which students critically examine the things they came up with in the preceding stages, in the light of their meta-level knowledge.

**(V) Zimmerman’s Social Cognitive Model of Self-regulation -** Zimmerman’s (1989, 1990a,b, 1998, 2000a) social cognitive model of self-regulation is based, as its name indicates, on Bandura’s (1986) social cognitive theory. According to Zimmerman (2000a) self-regulation is cyclical in nature. According to this model self-regulation involves three classes of determinants. In this triadic reciprocal determinism, covert personal (i.e. self), behavioural and environmental events are viewed as separable, but at the same time interdependent, factors influencing individuals’ functioning. Covert self-regulation involves monitoring and adjusting cognitive and affective states. Behavioural self-regulation consists of self-observing and strategically adjusting performance processes. Finally, environmental self-regulation includes observing and adjusting environmental conditions or outcomes (Zimmerman, 1990a, 1998).

**Self-regulation and Sustainable development**

During the first year of the United Nations Decade of Education for Sustainable Development (UNDESD 2005–2014) ‘Educating for a Sustainable Future’ was released. ESD entails a shift from viewing education as a mere delivery mechanism, to the recognition that everyone is a learner as well as teacher. ESD must happen in villages and cities, schools and universities, corporate offices and assembly lines, and in the offices of ministers and civil servants, in other word everywhere. There must be a joint struggle with how to live and work in a better way that protects the environment, advances social balance, and promotes economic fairness for present and future generations. One must learn how to resolve conflicts, create a caring society, and live in peace through self-regulation and control. ESD must start with examining our own lifestyles and our willingness to model and advance sustainability in our communities through educating minds with motivation. We need to pledge to share our diverse experiences and collective knowledge to refine the vision of sustainability while continually expanding its practice where attitude and motivation play a crucial role.

**Conclusion**

There is a lack of knowledge about active learning methods and strategies and a lack of meta-cognitive knowledge at all levels of the educational system in India. Students in schools do not have enough meta-knowledge of learning. Self-regulation does not mean leaving students alone on its own, but developing and harnessing their capacities and empowering them for a life-time. Monique Boekaerts (1997), as a researcher of self -regulated learning, describes a recent situation in schools and societies in the following way: most classrooms are still populated with students who are not self-regulating their learning, and that most teachers are not yet equipped to turn students into self-regulated learners. In most cases, teachers are still steering and guiding the learning process, a situation which does not invite students to use or develop their cognitive or motivational self-regulatory skills. Usually, students are expected to reproduce and apply the new information that the teacher has presented or made available (Boekaerts, 1997). In modern learning psychology many concepts, such as authentic learning, self-directed learning, self-regulated learning, independent learning, autonomous learning, problem solving and active learning, serve the same purpose, even though they originate from somewhat different theoretical frameworks. The aim of these framework is a learner‘s active impact on learning and a learner‘s involvement in the learning process and formation of habits and control of behaviour. According to self-regulation concept, the quality of learning also depends on learners’ abilities to steer their own learning orientation, to develop inquiring skills and to learn to reflect on and control their own learning processes with meta-cognitive skills. The teachers and educators need much encouragement to keep the ideal of the importance of self-regulation for sustainable development.

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