DIFFUSION OF INNOVATION AND TECHNOLOGY FOR NATIONAL DEVELOPMENT: SCHOOL OF INNOVATION

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Abstract

India's future rests on its ability to harness the creative potential of its large young population. In order to foster innovation and creativity, problem and project-based learning (PBL) play an important role. These help to link education to relevant in real-life experience and this connection is crucial for engaging the young minds and increasing their motivation levels. Undertaking innovative experiments, projects and problem solving exercises in multi-disciplinary set up brings joy to learning. The enjoyment factor involved in such engagement enhances young people's motivation and interest levels, thereby opens doors for flow and creativity. Thus, provision of innovation spaces in schools and colleges, museums and science centers or institutions of non-formal learning, where such activities can be undertaken is recognized to play an important role in fostering creativity and inspiring innovation by young students. This will ultimately lead to developed culture of innovation in the country.

Keywords

Entrepreneurship and Innovation, Creativity, Motivation, Design studio, Kabhad se Jugad

1. Introduction to School of Innovation

Innovation 'Hubs' and 'schools' would help to engage youth in innovative and creative activities. These would serve as springboards for new ideas and innovation and thus helping the society and economy to face future challenges and meet rising aspirations of the growing population. Specifically, embedding such creative pedagogies in science education through Innovation 'Hubs' and 'Clubs', would have potential to retain talent in modern science.

1.1 Concept

Following are the methodologies to enhance the impact of Innovation Hubs in the country:

1.1.1 Interactivity: Leverage locally available resources to showcase science through hands-on and discovery approach to supplement school science education. Science, Technology, Engineering & Mathematics (STEM) is to be presented as a process rather than a product.

1.1.2 Outreach: Examples of innovative ways of taking science to remote areas using buses, the science train and others exist. Yet, there needs to a renewed focus on interacting with the local communities better and drawing them to leverage the facilities at the Innovation hubs. The hands-on workshops, Science Fair, Science Carnivals, Maker's Fair, and Innovation Fairs are good examples of engaging public in the process.

1.1.3 Innovation: Innovation school will focus on showcasing innovations on a regular basis. Resource Centre section will house successful application of scientific discoveries (for e.g. the story of Archimedes resolving the issue of the Votive crown), effectively relayed stories of stalwarts and innovators among others to portray application and benefits derived from science in day-to-day life. Facility shall promote independent thinking, problem solving ability, nurturing creativity and generation of innovative ideas.

1.2 Facilities:

The Innovation school will have following facilities for students/mentors:

- *Hall of Fame*

- *Innovation Resource Centre*

- *Idea Lab*

- *Design Studio*

- *Tod Fod Jod/Break & Make Corner*

- *Kabhad se Jugad (Making useful things from scraps) Corner*

- *Idea Box*

The School of Innovation, Nakari, North Lakhimpur, Assam is a unique & innovative type of educational system, which seeks to create an individualized learning environment. This, in turn will not only stimulate an extraordinary success rate of a student, but will also promote positive growth for a satisfied life of the student. School of Innovation will be co-located in the existing Science Centers, museums, non-formal as well as formal educational institutes that promotes creativity and inspires innovations. It was launched on 7th May, 2017 by Mr. IMRAN HUSSAIN (Founder, SI) from College of Fisheries, Assam Agricultural University, Raha & Mr. Udit Phukan (President of SI). The School of Innovation is quested to engage youth in innovative and multidisciplinary activities. It has its own curriculum which has been designed in a stress and burden free manner (Total no. of academic classes in 1 year = 40 classes, 3 hours every Sunday of each week, from 10.00 to 13.00) to develop skills ranging from basic to high level of learning for that particular field in which the student is interested or enrolled in. School of Innovation strives to have caregivers, teachers and community members actively involved in student's academic endeavors through the use of personalize learning.

2. Practical issues as facilities for Innovative Schooling system

2.1 Versatility: In SI, a student gets the chance to choose a particular field of study and to persuade further in that particular field. Similarly, a teacher gets the chance to act selflessly for the betterment of the society. One can teach the field in which she/he has excelled. So, this is a novel platform allowing everyone to show their creativity and to do something good for a developed society.

2.2 Career Counseling –It's a platform to promote excellence in the field of counselling in a new and innovative method that provides training, group discussion, consultation and support for the knowledge, skill and attitude necessary to advocate a youth. SI's mission is to help new upcoming youth to focus on academic, career & social/ emotional development.

2.3 Design Studio - It's a drawing office, a workplace for designers, innovators, students and teachers engaged in developing new products. Facilities in a design studio include cloths, furniture art equipment's, different scientific apparatuses best suited for design work. This will

also include work benches, small machines, computer equipment's, paint shops and large presentation boards and screens.

2.4 New Innovation- For student's interested in making new models in various fields, technical help will be provided. Also, patent related technical help will be provided.

2.5 Ncsc, Aryabhatta & Other Scientific Programmes – For young and ignited minds SI will provide technical help and guide to participate in NCSC, ARYABHATTA and other science related programs along with moral support which will in turn boost their confidence.

2.6 For *Underprivileged* children, motivational help along with educational help will be provided which will help them to fight their battles against poverty and will be able to have a bright future ahead.

2.7 Kabad Se Jugad-

Making useful things from scraps (Problem based learning). Students will be taught to use waste materials for various uses. To create a sustainable eco-friendly environment is also SI's one of the major aims.

2.7.1 Innovation process

Innovation process is more than a good idea. Source of ideas is important and creative thinking may play a role in its development but the idea that comes from ideation is different from the idea resulting from extended thought, research, and work experience. More importantly, future entrepreneurs spend a good idea in various stages of development. Hence, innovation is combination of insights of a good idea and assist in the implementation of the idea. Essentially the concept of innovation is from management perspective, begins from thought and ends with the release of new product or service businesses. In the process, the person is authorized to release and to imagine different ways to spin the idea and then it becomes a practical, useful and appropriate concept (creativity), in following he converts applied ideas to goods, services and at last by commercial distribution of goods and services produced, innovative process ends. Usually innovation takes place in successive steps. The innovation process successfully implemented, it would need to ensure that this process occurs in the organization process, respectively.

2.7.2 The difference between creativity and innovation

Considering the complexity of the concept of creativity, it is necessary to distinguish the concept of innovation and creativity. Kuntz (1988) said, innovation is application of new ideas

from cited creativity and believes that innovation can be a new product, new service or a new way of doing something, but creativity is ability of creating new ideas and innovative thought. Albrecht (1987) told about Creativity and Innovation and distinguished them such that creativity is an intellectual activity to create new idea, and innovation is converting creativity to action or result (profit). He knows innovation as process steps required to conclude a new mastermind. From this point, the creative person can be non-innovative and have new ideas, but cannot supply or sell them. So often creative person is innovator, but all creative people are not necessarily innovative.

2.7.3 Entrepreneurship

The term entrepreneurship for the first time was defined by **Kantylyvn**. Entrepreneurship was from the beginning in all facets of human life and the basis of human development and progress and is a process that occurs in many different environments and sets, and occurs in the economy through innovation and people who react to economic opportunities and creates value for society and the individual. It is valuable insight into the entrepreneurial creation of any process to achieve and pursue opportunities without regard to the resources available. It is quality that enables people to begin a new activity or the ability to develop and present innovative activities. Entrepreneurship is the process of creative destruction that is essential to the sustainability of economic development.

2.7.4 The relationship between entrepreneurship and innovation

Conceptual and theoretical relationship between entrepreneurship and innovation for years has been investigated in the literature. Economic principles of innovation attract increasing attention focused in recent years. The basic theories concerning the economic principles of innovation and entrepreneurship for the three models are:

- Entrepreneur pattern,
- The pattern of economic principles
- Technology and strategic pattern.

Entrepreneur pattern goes back to the 1930s, for the first time, Schumpeter (1934) tried to find a relationship between entrepreneurs and innovators and entrepreneurs as innovators raised. He plays a large role in the economic development of innovation because entrepreneurs are generating innovations. The concept of the entrepreneur as an innovator, entrepreneur, will

form the foundation model in which the role of the entrepreneur in the innovation process is highlighted. Overall, based on this model, innovation is a creative and entrepreneurial action.

2.7.5 Drivers of Innovation

The primary drivers of innovation include:

- Financial pressures to decrease costs, increase efficiency, do more with less,

- Increased competition,

- Shorter product life cycles,

- Value migration,

- Stricter regulations,

- Industry and community needs for sustainable development,

- Increased demand for accountability,

- Community and social expectations and pressures (giving back to the community, doing good, etc.),

- Demographic, social, and market changes,

- Rising customer expectations regarding service and quality,

- Greater availability of potentially useful new technologies coupled with the need to keep up or exceed the competition in applying these new technologies,

- The changing economy.

3. Defining Research and Development (R&D)

(Based on OECD's "Frascati Manual", 2002 edition)

In accordance with the approach advocated by the Frascati Manual, this study defines R&D as "creative work undertaken on a systematic basis in order to increase the stock of knowledge, including knowledge of man, culture and society, and the use of this stock of knowledge to devise new applications".

The term "research and experimental development" is used as synonymous to the term "research and development" and both are abbreviated by the expression "R&D". The term R&D covers three activities: basic research, applied research and experimental development:

Basic research is experimental or theoretical work undertaken primarily to acquire new knowledge of the underlying foundation of phenomena and observable facts, without any particular application or use in view.

Applied research is also original investigation undertaken in order to acquire new knowledge. It is, however, directed primarily towards a specific practical aim or objective. Experimental development is systematic work, drawing on existing knowledge gained from research and/or practical experience, which is directed to producing new materials, products or devices, to installing new processes, systems and services, or to improving substantially those already produced or installed. R&D covers both formal R&D in R&D units and informal or occasional R&D in other units.

3.1 The boundaries of R&D: Clarification of specific cases

(Based on OECD's "Frascati Manual")

The basic criterion for distinguishing R&D from related activities is the presence in R&D of an appreciable element of novelty and the resolution of scientific and/or technological uncertainty.

A prototype is an original model constructed to include all the technical characteristics and performances of the new product. The design, construction and testing of prototypes normally falls within the scope of R&D.

The construction and operation of a pilot plant is a part of R&D as long as the principal purposes are to obtain experience and to compile engineering and other data.

Those elements of industrial design work, which include plans and drawings aimed at defining procedures, technical specifications and operational features necessary to the conception, development and manufacturing of new products and processes.

Clinical trials are divided into four standard phases, three of which take place before permission to manufacture is accorded. By convention, clinical trial phases 1, 2 and 3 can be treated as R&D. Phase 4 clinical trials, which continue testing the drug or treatment after approval and manufacture, are treated as R&D only if they bring about a further scientific or technological advancementdestr.

4. Creativity and Innovation in Education

Psychometric approaches have highlighted that, creativity is often seen as a talent, or as a characteristic of eminent people, and distinctive personality traits have been identified to exemplify a creative mind. At the same time, a number of studies recognize that creativity can be enhanced and cultivated. Craft (in Craft, Jeffrey, & Leibling, 2001) distinguished two different trends in research on creativity and developed the concepts of "big C" and "little c creativity". The first (big C creativity or BCC) refers to the creativity of the genius, seen in people such as Mozart, Picasso, and Einstein. Their creative achievements are exemplary and comprise novelty and excellence in their domain, as well as social recognition and valuation. Little c creativity (LCC), on the other hand, is not for the gifted and talented and does not apply to creative and innovative outbursts that have a strong impact on society. LCC could be seen as behaviour and mental attitude, or as the ability to find new and effective solutions to everyday problems. LCC is not for an extraordinary few. A similar distinction can be found in Shneiderman (2000), who differentiates between revolutionary creativity, imputable to Nobel laureates and geniuses, and evolutionary acts of creativity, which can include doctors making a diagnosis or an editor drafting a magazine.

LCC seems particularly suitable for the educational sector, where a priority is to encourage all students and pupils, who have not yet reached their intellectual peak, to achieve their full potential. This chapter will therefore endorse an inclusive or democratic perspective of creativity, which sees all people as capable of creativity from early childhood onward (Craft, 2005). According to this idea, creative potential can be found in every child (Runco, 2003); it can be encouraged or inhibited (Sharp, 2004); and its development depends on the kind of training people receive (Esquivel, 1995).

Given the benefits of creativity to society and individuals, one would expect to see a celebration of creativity in education (Beghetto, 2005). However, though, there has been a growing interest in the relevance of creativity for teaching and learning since the 1990's (Craft, 2005), it seems that attempts to bring this issue to center stage have been overshadowed by other efforts, and demands on teachers' and students' schedules (Beghetto, 2005).

This study will argue that creativity and innovation in education are not just an opportunity, but a necessity. First, several emerging trends entail an alteration in the way young people learn and understand (Redecker, 2008). Teachers have to attract students' interest and attention in a new way, and as a result the development of creative approaches is called for

(Simplicio, 2000). Secondly, the current and forthcoming cohorts of learners are growing up surrounded by video-games, mobile phones, and other digital media. This overwhelming spread of technologies brings a new understanding of communication, information retrieval and meaning-making. The gap between the school and home digital environment is thus affecting learners' expectations (Pedró, 2006), building up a perception of the current educational framework and format's inadequacy (Selinger, Stewart-Weeks, Wynn, & Cevenini, 2008). Third, creativity has been seen as a form of knowledge creation (Craft, 2005). For all these reasons, it seems clear that creativity and innovation are unavoidable conditions for the present and future of education.

Nevertheless, it must be noted that, in the educational sector, creativity and innovation lose some of their areas of overlapping as discussed at the beginning of Chapter 2. This is mainly due to the current role of the learner in formal education. Learners are perceived as the end recipient of methods, pedagogies and knowledge. Although they are the major stakeholders in education, their current power to actively contribute to institutional change is limited. Innovation, as stated previously, is the "implementation" (OECD, 2005) or the "intentional introduction and application" (West & Richards, 1999) of a novelty which aims to ameliorate a particular situation. Teaching can be seen as the implementation of methods and pedagogies, and of curricula and contents. Any kind of teaching which addresses creativity and applies it to methods and contents can be seen as innovative teaching. At the same time, the cognitive approach to creativity emphasises its connection to knowledge and thinking skills, bridging the creativity process with learning. For these reasons, this work addresses "creative learning" and "innovative teaching". The first term refers to the possibility for learners to develop their creative skills and to learn in a new, creative way. The second term includes both the process of teaching for creativity and the application of innovation to teaching practices.

This chapter will first focus on creativity as a skill to be developed, adapting the meaning of creativity to the educational framework, identifying the components of creativity in the school setting and exploring the link between creativity and learning. It will then approach innovative teaching, and its implication for formal schooling and the curriculum. It will finally address innovation and propose a change in teaching practice.

What is creativity in education? In education, the term creativity is often used but seldom defined. As Beghetto (2005) points out, teachers might ask students to use their

creativity in the design of a project, or might refer to a student's response as creative, without explaining what they mean. A lack of definition of this concept might result in erroneous assumptions (Beghetto, 2005), leading teachers and students to identify creativity only with talent, the arts and personal characteristics.

The trans disciplinary theories on creativity do not help to frame the issue, as they often focus on outstanding performances (Runco, 2003), thus reinforcing the link between natural ability and creative achievements. Research has demonstrated that creative eminent people have in common several personality traits (Simonton, 1990); however this does not mean that creativity is limited to natural ability or talent. On the contrary, creative traits should be identified and studied in order to be able to duplicate and teach them (Simplicio, 2000).

The first step towards creative learning and innovative teaching requires an understanding of the meaning of creativity for education and its implication. This entails a threefold procedure: 1) a de-construction of several current myths about creativity which are leading to a shared misunderstanding of the issue (Sharp, 2004); 2) a discussion and framing of the implications of "newness and value" in the educational context (Craft, 2005); and 3) an emphasis on the process instead of the product (Runco, 2003).

Implicit theories or myths about creativity As Runco (1999) suggests, teachers, parents, children and other educational actors hold a tacit knowledge about creativity manifested in opinions and expectations, which are in sharp contrast with what the research is showing – and which can have detrimental effects on any attempts to foster creativity in schools. This tacit and shared knowledge builds up a series of "implicit theories", which account for how ordinary people think about creativity. These theories differ from the ones held and scientifically tested by researchers, which Runco calls Creative learning could be the first step for innovative learning.

4.1 Enabling innovative teaching and creative learning

The previous discussion regarding the framing of creativity and innovation in the broader research and in the educational sector have outlined a variety of perspectives and understandings of these two concepts. There is also a profusion of implicit theories on creativity, which allow people to judge what is creative and innovative without being able to explain or define what creativity and innovation are (Runco, 1999). Both aspects – research and

connotations – contribute to the vagueness and elusiveness of the terms, complicating the tasks of looking for creativity and innovation in practice.

At the same time, there is a gap between policies and practices. A support mechanism is needed to facilitate the implementation of policies. This also applies to the discourse of creativity and innovation in education. If we promote creativity and innovation in our educational policies, this does not guarantee that schools will show creativity and innovation in their day to day practices.

As many researchers found, one of the barriers to creativity and innovation in schools consists of teachers' overloaded schedules. The demand for creative learning and innovative teaching from policy-makers has to be matched with a support mechanism, i.e. with policies and tools that help all educational actors to pursue creative and innovative paths. Besides, policies for creativity and innovation in education need to be in line with other policies and with what is demanded from teachers and students, as contradictory messages will increase uncertainty and further impede the adoption of necessary measures for a creative learning environment. The promotion of creativity and innovation needs to be articulate and coherent, as the issue is complex and multi-faceted. Moreover, policies need to be mirrored by practices, for instance by establishing a nurturing school culture or by finding support in the availability of certain tools, in order to be applied in an effective way and to have a positive impact.

It becomes evident therefore that looking for manifestations of creativity and innovation is challenging for several reasons:

- Creativity and innovation are processes which do not always result in tangible outcomes and as a result it can be difficult to find evidence of them;
- Creativity and innovation are exposed to subjectivity, arbitrariness and interpretation; thus making it challenging to compare data;
- Policies are not necessarily mirrored in practice: encouraging creativity and innovation in policies is not enough, as there is a need for a support mechanism.

The fostering of creativity and innovation does not uniquely rely on the intention of educators and pupils, as there are several conditions to be met before a creative and innovative environment can be promoted. In this sense, policies and common practices may provide the circumstances for creative learning and innovative teaching or, on the contrary, obstruct them. It

is therefore interesting and necessary to examine which conditions can trigger creative learning and innovative teaching in order to support and allow them to spread.

5. Conclusion

These 'Hubs' and 'school' would add innovation, creativity, and enjoyment factors in learning. These would serve as springboards for new ideas and innovation helping the society, as in school of innovation and economy to face future challenges and meet rising aspirations of the growing population. Normally the Innovation hub will target school/college going students in following manner:

- Participate in activities after school, weekends or on holidays.

- Keep the spark of creativity, innovation and design alive and thriving in students / Inventors & researchers.

- Makers Fairs to collectively work on innovative ideas.

- School of Innovation would provide technical support to schools and colleges interested in setting up "Innovation Clubs" on their premises and through them promote a culture of innovation in the schools and colleges.

- Design Studio, In such design studio, young people could be encouraged to conceive new designs and fabricate new items, products, craft and so forth.

- Geographic regions, this would ensure formal and informal knowledge exchange among communities of students, with Hubs acting as nerve centers.

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