Creativity and Technology Education

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Abstract:

A creativity focus augments the content standards thrust by causing us to be preoccupied not just with student learning of technological concepts and processes, but with what children can learn about themselves by engaging technology. Creative people are governed by internal factors, especially personality. They invariably are creative within particular domains, such as art, music or electronics. But across domains, creative people share as common cognitive characteristics such as ability to: think metaphorically, flexibly; recognize good problems in their fields and willingness to take intellectual risks. This article unfolds what creativity is with particular reference to technology education. It also sought to stimulate a conversation about inculcation of creativity as an important goal of technology education, and as a concomitant of the goals of the standards for technology literacy. The author recommended that the concept of creativity be included in the curriculum of young technology learners so as to provide them opportunity for problem finding, as a precursor to problem solving.

Keywords: Creativity, Technology Education, Pedagogy, Curriculum, Teaching, Professional development.

Introduction

Creativity is not easily defined, because of its unseen character. As Boden (1994) points out, inventors often do not know the source of their insight. Still, it is possible to discern the creative from the ordinary. Bailin (1994) notes that while there has not been universal agreement on what constitutes creativity, there are shared beliefs about the nature as follows: (a) that creativity is concerned with originality – with a break from the usual, (b) that the value of creativity products cannot be objectively ascertained since there are no standards by which new creations can b-e assessed, (c) that beyond products, creativity can be manifested in new and novel ways of thinking that break with previously established norms (d) that existing conceptual frameworks and knowledge schemes impose restraints on creative insight, and (e) that creativity is a transcendent, irreducible quality.

An enduring definition provided by Bruner (1992), is that creativity is an act that produces "effective surprise". Bruner explained that the surprise associated creative accomplishment often has the quality of obviousness after the fact. The creative product or process makes perfect sense-once it is revealed. For the creative person, surprise, according to Bruner, is the privilege only of prepared minds-minds with structured expectancies and interests. Bruner identified three kinds of surprise, predictive (such as theory formulation or re-formation), formal (as in a musical composition where there is an elegant reordering of elements), and metaphorical (as in the idea of systems), where the creativity comes from recognizing commonality across disparate element.

Tardif and Sternberg (1988) suggested that it could be fruitful to dissect creativity into processes, persons and products. Much of the research on creativity therefore is framed along these lines. Creative processes take time, and include search through a problem space. They may involve transformations of external work, internal representations through analogies and metaphors.

Schooling and Creativity

Schooling is an important aspect of the development of creativity in children. Support for such development can begin with a curriculum that takes student interest and individual differences, including thinking styles (Sternberg, 1990) into consideration. Especially, the curriculum must account for the multiple intelligences among students (Gardner, 1999). We can gain insight into what creativity enhancement through the school curriculum might entail by setting for the six resources identified by Lubart and Sternberg (2005) as being critical to creative performance as a framework. These "resources" are: (1) Problem definition or redefinition, (2) Knowledge, (3) Intellectual styles, (4) Creative personality, (5) Motivation to use intellectual processes and (6) Environmental context. How can these resources be engaged in the classroom?

While students with exceptional creative talent would benefit from curricula that deliberately include a creativity-oriented component, all children stand to benefit when such an approach is taken. Cropley (1997) contended that the inculcation of creativity should be a normal goal of schooling, with the aim being to help all students attain their creative potential. Children should be helped to achieve effective surprise in their work. He outlines a framework of ideas around which a creativity-focused curriculum can revolve – one that overlaps with Lubart and Sternberg's (2005) resources approach. It includes provision of content, knowledge, and encouraging risk taking, building intrinsic motivation, stimulating interest, building confidence and stimulating curiosity. As can be seen here, creativity enhancers must address factors that are internal to the student, such as personality and intellectual disposition as well as factors that are external such as curricular, social and environmental.

Domain knowledge features are a key prerequisite of creative productivity in the schemes offered by both Lubart and Sternberg (1995) and Cropley (1997). There is strong evidence in research literature indicating that a "fund" of domain knowledge is imperative for creative accomplishment (e.g Csik, 1996). Cropley (1997) contended that providing such knowledge is one important way in which schools can foster the development of creativity. Lubart and Sternberg (1995), wrote that knowledge of the state of knowledge in a domain prevents attempts to reinvent the wheel. Nickerson (1999) offered the view that the importance of domain-specific knowledge in the forging of creativity is underestimated. He agued that across a wide front of domains, including the arts, mathematics and sciences, acquisition of sound knowledge base is a precursor of exemplary creativity.

Beyond provision of domain knowledge, schools can enhance the creativity of children if classroom environments support and facilitate risk taking, problem posing, individual learning thinking styles, and intrinsic and extrinsic motivation (Jay &Perkins, 1997). Some school contents are mere supportive of creative behaviour than others, and the factors that can militate creative behaviour may be both internal and external in character (Jones 1993). For example, low self esteem could inhibit creative effort (Hennessey & Amabile, 1999). The external environment can dampen creativity if it does not reward creative behaviour, or if it deliberately suppresses it.

Creativity can be enhanced in the curriculum by providing students more opportunity for problem finding, as a precursor to problem solving. Problem finding has not been given as much prominence in technology education as problem solving. France and David (2001) showed how questions can be a part of a collaborative process in community-based problem solving. Jay and Perkins (1997) draw attention to the importance of problem-finding as a starter for creativity, contending that often in great discoveries, the most important thing is that a question is found. Envisaging, putting the productive question is often more important, often a greater achievement than solution of a set question. Problem finding refers to the way that a problem is conceived and posed, and includes the formulating of the problem statement, periodic assessment of the quality of the problem formulation and solution option, and periodic reformulation of the problem (Jay & Perkins, 1997). Reed (2004) wrote that problem construction contributes to creative problem solving, and that it is a predictor of real world creativity.

Creativity and Design

Technology education in the school curriculum should be where creativity can be fostered uniquely. Indeed the subject should be premised upon human creativity- on the ingenious ways in which from the time human beings had devised ways and means of dealing with problems that beset them in daily existence to assure their survival. Human beings had along the way systematically relied upon their creativity to overcome existential obstacles and with each advance have yielded and stored technological knowledge upon which even further advance could be made.

Every form of technological creativity before the coming of the Europeans to Africa was through the apprenticeship system. Young men were apprenticed to master craftsmen to learn skills for employment in the areas such blacksmithing, carpentry, boat building, carving, smelting, masonry and so on (Roger, 2003). As creativity in technology advanced, there was a retreat from this essentially instrumental focus towards where children were taken behind the scenes of human development and presented with hurdles that can be overcome only through their creative design. This shift of subject to an earlier place in the stage of the process of technological creation, where things were unsettled and there was no single right answer had made technology almost ideally suited to uncovering dimensions of the creative potential of children that would remain hidden in the rest of the curriculum.

Stimulating creative impulse in children through design and problem solving activities is as grand a goal of curriculum as in the achievement of particular design-based measurable outcomes. But how do we get children to improve upon the quality of their design? What makes one design solution more elegant than the other? There are no easy answers here because creativity does not quite respond to the accustomed inquiry questions that we pose in discussion of curriculum, instruction and assessment in technology education. As Brunner (1992) pointed out, creativity is a silent process which by its very nature will not be responsive to the processes ordinarily employed to determine content standards. Instead, it requires its own set of questions, including examination of its nature.

Design offers opportunities for teaching to enhance creativity. What makes design specially suited to the inculcation of creativity in children is its open-endedness. There is more than one right answer, and more than one right method of arriving at the solution. The ill-structured character of design requires that students resort to divergent thought processes and away from the formulaic. As they do so, their creative abilities are enhanced.

Despite the potential here, there are indications in literature that we still have some way to go before creativity becomes a more central feature of the teaching of design in Nigerian schools. Even in Britain, teachers were given precedence to products over process. Others observed that technology teachers were pursuing a somatic line when teaching design contrary to the natural design tendencies of children (Chidgey, 1994, Jones, 1993).

The problem for the field of technology education especially in developing countries is that the overt description of the stages of the design process, observable when engineers do their work, has become the normative design pedagogy. This stage approach according to Akinboye, (1996) runs the risk of overly simplifying what underneath is a complex process. Teaching design as a linear stage process is akin to arriving at pedagogy of art by mere narration of the observable routines of the artists. It simply means the point that design, like art, proceeds from deep recesses of the human mind. To arrive at pedagogy of design, there is need to get beneath the externals of the process. The key is to recognize design as a creative rather than a rationalistic enterprise. Roger (2003), wrote that: Technological design involves cognitive abilities such as creativity, critical thinking, and the synthesis of different ideas from a variety of sources (p.26).

Flowers (2001) suggested that humour in the design and problem solving classroom can promote divergent thinking. Warner (2003) joined Flowers in pointing out that the tone of classrooms can make a difference in the quality of the creations of children. He argued that to support creativity in technology education classroom, teachers must be more tolerant of failure. Flowers wrote that teachers of design must maintain a classroom culture that promotes successes but embraces the learning opportunities that failure presents. He drew on research suggesting that some kinds of classroom climates, such as where competition is encouraged or where rewards are offered per performance, actually dampen creativity (Hennessay & Amabile, 1999).

Beyond cognitive strategies that are known to yield novel products, are the concomitant factors that support creativity, notably the importance of domain knowledge, problem posing and problem restructuring. We have learned from literature that domain knowledge is fundamental to creative functioning

(Cropley, 1997). And yet, this is an area of the design discourse in technology education that receives almost no attention. Creativity cannot proceed in a knowledge vacuum. While there is a place for the teaching of domain-independent design, where the context is everyday functional knowledge, it is necessary that children be challenged with design problems that reside in particular content domains, such as electronics, manufacturing, or transportation. Children are more likely to arrive at creative solutions when they puzzle over such problems if they are first taught the supporting content knowledge.

Although problem posing ability is an acknowledged marker of highly creative behaviour, it remains an almost neglected aspect of the technology education discourse. A discourse steeped in treatment of problem solving is desirable. Lewis (1998) argued that using principles of constructivist learning concepts would enhance the ability of children to find good problems and sole them. There are implications here for how we arrive at design problems in our classrooms. Are those problems teacher-imposed, or do they originate from the observations of tour students?

Akin (1994) called attention to the creative potential of problem restructuring for increasing the creative potential of design. Drawing from experiences in architecture he distinguishes between anonymous and signature design, and between routine and ill-defined problems. Ill-defined problems are not bounded by available design standards. They require the traditional functionality of problem restructuring as they cannot be resolved without a framework within which problem can operate. According to Akin (1994), within problem restructuring resides great creative potential, capable of yielding signature work. This view that problem restructuring engenders creativity is consistent with the concept of productive thinking.

There is clearly a need in technology education for a more textured discourse on the teaching of creativity and design than currently exists. Problem posing, problem restructuring, and the use of humour are pedagogical devices that belong in an expanded view of how the creative aspect of design can be realized. It should be noted that creativity and design are “twin brothers’. They complement each other.

Implications of creativity for technology education

This article has attempted to offer creativity as a framework for a discourse on design and problem-solving, as a complementary conversation to that on content standards. In a way, this article constitutes a caution to the technology education community that the subject is still a work in progress, and that there are aspects of it that are not given naturally to rationalistic content derivation methods. We are at a point where the subject in the curriculum is only reflected in the lowest level of our secondary school system- the Junior Secondary School, where the name introductory technology is first heard of in the curriculum. Technology education increasingly takes its cue in science, with its exactness, but it may be that we can benefit from alliances with other subjects, such as art or music. Here students are encouraged to use knowledge not for its own sake but in support of thought leading to creative expression.

Five kinds of implications of creativity for technology education are suggested by the discussion that has ensued here, viz: (a) implications for design/problem solving pedagogy, (b) implications for assessment, (c) implications for professional developments (d) implications for curriculum theorizing, and (e) implications for research. Each is reflected upon briefly here.

Design/Problem Solving Pedagogy

Despite the centrality of design/problem solving activities of technology education, the field has not made strides in finding proven ways in which these activities can be taught. One explanation for lack of movement here is that insufficient attention has been paid to the role that creativity plays in design/problem solving. A creativity focus allows for inclusion of a wider array of auxiliary activities into the pedagogic approach – activities in realms of divergent thinking and productive thinking.

Assessment

As with pedagogy, assessment of design and problem solving activities in technology education is still a new area even in some developed countries. A reason is that the field has not worked out measures for helping teachers determine the degree of creativity inherent in students' design related work. When is the design routine, when middling, and when exemplary? This is an area of need. Technology education teachers have to be able to distinguish between gradations of creativity and to communicate their assessment to students in much the same way that teachers of art and music are able to do in their classrooms. There is a clear need here for an expanded discourse on challenges inherent in providing feedback to students when the intent is to help them improve their designs.

Professional Development

Pre-service teacher education programmes in technology education ordinarily do not include coursework on creativity. Thus, most teachers do not have preparation that is sufficient enough to allow them to inject creativity into their teaching. Teachers may introduce design/problem solving activities into their teaching, but the competence they bring to the classroom is more in the realm of the technical than the aesthetic. There is a clear need here for professional development activities aimed at helping teachers see possibilities for introducing creative elements into the curriculum and instruction.

In the literature on technology curriculum, creativity is often implicitly included, especially where the focus is on design and problem solving. But there is an absence of explicit treatment of the topic. This clearly is a shortcoming made more telling by the new focus in the standards of design. Creativity in all of its facets, and as it relates to technology, education, teaching and learning, needs to be a more deliberate focus of the technology education curriculum literature.

Research

Creativity has strong claims towards being a foundational area of research in technology education. Such research can address a host of pressing needs, including methods of assessing creative performance, auxiliary instructional activities that are good precursors of students' creative performance, professional development activities that improve teacher competence in teaching design/problem-solving, and strategies employed by students as they complete creative tasks.

Conclusion

This article sought to stimulate a conversation about inculcation of creativity as an important goal of technology education, and as a concomitant of the goals of the standards for technology literacy. The purpose was to direct the attention of the field to an area of the subject that remains under-explored. It could be argued that creativity underpins the substantial attention that has been devoted within recent times to design and problem solving. But much of this attention is implicit rather than explicit. There is need for design and problem solving in technology education to be framed not so much in terms of methodologies of engineers, but as opportunities for students to step outside of conventional reasoning processes imposed by the rest of the curriculum. Creativity has compelling claims to being the anchoring idea in such a framework.

Creativity can be enhanced in the curriculum by providing students more opportunity for problem finding, as a precursor to problem solving. Problem finding has not been given as much prominence in technology education as problem solving. France and Davies (2001), showed how questions can be a part of a collaborative process in community-based problem solving. Wertheimer, (1996) drew attention to the importance of problem –finding as a marker of creativity contending that often in great discoveries the most important thing is that a question is found. Problem finding refers to the way that a problem is conceived and posed, and includes the formulating of the problem statement, periodic assessment of the quality of the problem, formulation and solution options, and periodic reformulation of the problem. Schools must therefore provide children with the foundational knowledge supportive of creative insight. There is also clear need for professional development activities aimed at helping teachers see possibilities for introducing creative elements into the curriculum, and into instruction.

References

Akin, O. (1994). Creativity in design. Performance Improvement *Quarterly*, **7**(3) 9-21

Akinboye, J.(1966).*Workbook for Creativity Experiences.* Ibadan, Institute of Education. Ibadan, University Press.

Bailin, S. (1994). *Achieving Extraordinary Ends.* Narwood, New Jersey:
Ablex publishing Corporation.

Boden, M.A. (1994). What is Creativity? In M.A. Boden (Ed.). *Dimensions of Creativity*. Cambridge. Mass: MIT Press 7(2) 75-117

Bruner, S. (1992). The Conditions of Creativity. In H.E. Gruber. G.Terrell & M.Wertheiner (Eds.) *Contemporary Approaches to Creative Thinking.* New York: Atherton Press.

Chidgey, J.(1994). A Critique of the Design Process in F. Burns (Ed.) *Teaching Technology*. 26-35. London: Routledge.

Cropley, A.J. (1997). *Fostering Creativity in the Classroom: General Principles.* New Jersey: Hampton Press.

Cisk, M. (1996). *Society, Culture and Person: A Systems view of Creativity. The Nature of Creativity: contemporary Psychological Perspectives.* Cambridge: Cambridge University Press.

Flowers, J.(2001). The Value of Humour in Technology

Education. *The Technology Teacher*. **50**(8). 10-13.

France, B. & Davis, J. (2001).Asking the Right Questions: Identifying Issues in developing a Technological Solution. *Research in Science Education* **31**(1) 137-153

Gardner, H. (1999). *Intelligence Reframed: Multiple Intelligence for the 21st Century:* New York: Basic Books.

Hennessey, B.A. & Amabile, T.M. (1999). *The Conditions of Creativity* . New York: Cambridge, University Press.

Jay, E.S. & Perkins, D.N.(1997). Problem Finding: The Search for Mechanism In M.A. Runco (Ed.), *Creativity Research Handbook.* Cresskill. New Jersey: Hampton Press.

Jones, L. (1993). *Barriers to Creativity and their Relationship to Individual, Group and Organizational Behavior.* Norwood. New Jersey: Ablex Pub. Co.

Lewis, T. (1998). Problem Posing: Adding a Creative Element to Problem Solving. *Journal of Industrial Teacher Education.* **36**(1) 5-35.

Lubart, T.I. & Sternberg, R.J. (1995). *An Investment Approach to Creativity: theory and Data. The creative Cognition Approach*. Cambridge, M.A: The MIT Press.

Nickerson, R.S. (1999). Enhancing Creativity. In R.J.Sternberg (Ed.) *Handbook of Creativity.* Cambridge. Cambridge University Press.

Reed, P.A. (2004). A paradigm Shift: Biomimicry. *The Technology Teacher* **63**(4) 23-27.

Roger, K.J. (2003). An Overview of the Industrial Design Curriculum. *The Technology Teacher*, **60**(3) 21-23.

Sternberg, R.J. (1990). Thinking Styles: keys to Understanding Student Performance. *Phi Data Kappan.* **7**(5) 366-371

Tardif, T.Z. & Sternberg, R.J (1988). *What do we know about Creativity?* Cambridge: Cambridge University Press.

Warner, S.A. (2003). Teaching Design: taking the first steps. *The Technology Teachers*. **62**(4) 7-10.

Wertheimer, M. (1996). *Productive Thinking.* Chicago: University of Chicago Press