MATHEMATICS TEACHING-RESEARCH JOURNAL ONLINE
VOL 5, N 2
May 2012

ENGAGEMENT IN CREATIVE THINKING

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ABSTRACT

Teaching-Research TR-NYC model, envisioned by teacher-researcher, B. Czarnocha, at Hostos Community College, is the methodology that allows the community college professor to see her/his classroom as equivalent to the laboratory of the scientist at the Institute of Advanced Study, Princeton University, in that, "the complexity and difficulty of the issue in the Bronx classroom is comparable with problems they solve there, but instead of clinical laboratory I can study it en vivo.". The thinking potential that a basic mathematics adult classroom holds, is thinking technology in creative interaction with mathematics along the three 'divides': cognitive, affective and metacognitive, and which in an integrated creative problem solving environment have the power to transform resistance to creative positive enjoyment and mastery of mathematics, bringing about change of habit to originality (Koestler, 1964). Structure of the creative learning environment has been described in (Barbatis, et. al., to appear Dec. 2012; Prabhu, et. al, 2012; submission to TODOS, 2012).

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INTRODUCTION

Student success in classes of calculus at the two community colleges of the Bronx (NSF-ROLE #0126141, 2002-2006), prompted the teaching-research question, what is the difficulty with success in remedial mathematics courses? In the iterative teaching-research experiments over the period 2007-2012, we have been able to find a route to partner with students at various levels to create the skeletal prototype of Students as Partners in Learning. Partnership, as in co-authoring this article, or as cognitive apprenticeship in the Arithmetic class, or co-teaching a class with either students or administrators and librarians, the multi-faceted possibilities make it difficult for students to disregard partnership easily. Partnership grows as students change their initial didactic contract and the Community of Practice, determines its practice for the semester.

Students as Partners in Learning was initiated actively in Fall 2010, as a response to the extent of absence of interest in learning evidenced in classes of Developmental Mathematics (and as follow-up preparation for the Bronx Community College participation in USAID funded Partnership of Skills Development at the FET colleges in South Africa). In this article, we report on the active involvement of two of the co-authors in their lead toward partnership through the common work of all, Creativity.

Aisha Sidibe is a former student of Vrunda Prabhu (Statistics, Spring 2010). Aisha and Alcy Leyva are co-founders of the Creative Writing Club on the Bronx Community College campus. They lead regular Creative Writing workshops that include poetry, flash fiction and other types of writing. Their enthusiasm in teaching is contagious. They are the new addition to the Teaching Research Team in Spring 2012. While creativity has perhaps always been in the background of the work of the team through James Watson's embedding of GIS based projects, creation of posters using the maps of Bronx County, etc., into projects for the classes, creativity emerged as an obvious practice when Vrunda

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Prabhu and Peter Barbatis team taught in Spring 2011. Since end of Spring 2011, creativity found a theoretical support and assistance to development of instructional materials through Arthur Koestler's *The Act of Creation*. By the active involvement of students, Aisha and Alcy, creativity became a common denominator, and an explicit starting point for the elimination of the fear of mathematics and its transformation to the enjoyment of mathematics and consequent better performance.

THE ACT OF CREATION - KOESTLER

What is creative thinking? Creativity, or the creative process, according to (Hadamard, 1954) consists of 4 steps:

1. Insight
2. Incubation
3. Illumination
4. Verification

The above is useful as an insight into the creative process after it has already occurred. However, the teacher-researcher needs active ways to bring about the creative process in the mathematics classroom. Arthur Koestler details the process of creative thinking in his work, *The Act of Creation*. He strips creative thinking to its bare components and provides the teacher-researcher an inroad into the design of materials that actively embed creative thinking into the regular syllabus, and into the teaching and learning activities of the daily mathematics classroom.

For Koestler "problem-solving is bridging a gap between the initial situation and the target" (Koestler, p.649). In its most general sense, the problem we as mathematics teacher-researchers have set up for ourselves to solve is the absence of learner interest in mathematics. An absence perhaps initiated and definitely exacerbated by prior exposure and repeated sense of failure. In this sense, the problems we must solve (in the span of

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one semester) is how to get students to take interest in their own learning; and how to get students to convert the trend of failure and a "cannot do" attitude, into a trend of mastery and a "can do" attitude.

Koestler's approach in *The Act of Creation* is one through which learners make "the creative leap of insight" or "bisociation", and so transform habit into originality. Bisociation is defined[1] as "the creative leap which connects previously unconnected frames of reference and makes us experience reality on several planes at once". Given that bisociation can transform habit to originality, the question is, how instruction can prepare the environment through which learners make this transformation? In particular, what are the routes suggested by Koestler that can be adapted to our specific situation?

The first such is the Triptych[2]. The triptych consists of "three panels..indicating three domains of creativity which shade into each other without sharp boundaries: Humor, Discovery and Art….Each horizontal line across the triptych stands for a pattern of creative activity which is represented on all three panels; for instance:

Comic comparison ←→ objective analogy ←→ poetic image

The first is intended to make us laugh; the second to make us understand; the third to make us marvel. The logical pattern of the creative process is the same in all three cases; it consists in the

[1] Note the similarity of this definition with the quote of Einstein used on some of our syllabi: What precisely is thinking? When at the reception of sense impressions, a memory picture emerges, this is not yet thinking, and when such pictures form series, each member of which calls for another, this too is not yet thinking. When however, a certain picture turns up in many of such series then – precisely through such a return – it becomes an ordering element for such series, in that it connects series, which in themselves are unconnected, such an element becomes an instrument, a concept. A. Einstein, Autobiographical Notes, p.7).

[2] Koestler's triptych is appended at the end of this article. The triptych used in the Statistics class was created by students of the class with the central column of concepts, and two complete rows provided by the instructor. The triptych used in the Algebra class constituted an even smaller conceptual layout, rather students were asked to generate the concepts of the course that could make up the central column.

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discovery of hidden similarities. But the emotional climate is different in the three panels……..The panels on the diagram meet in curves to indicate there are no clear dividing lines between them."

The creative process to be initiated in our classes of remedial/developmental mathematics urgently needs to address the emotional climate of learners. The emotional climate has to be transformed to one in which engagement of learning is possible, and here is where the first column of the triptych comes into play – Humor. Having found humor and the bearings of the concept in question, the connections within it have to be explored further to "discover" the concept and its subconcepts in detail, and finally to take the discovery to a form that discovery is sublimated to Art. (Koestler, p.27) "The point of [this game] (i.e. move along the sloping curves of the triptych) is to show that regardless of what scale of values you choose to apply, you will move across a continuum without sharp breaks….boundaries…are equally fluid.." Thus, changing the emotional climate as our team-taught classroom instruction (between mathematics instructor and counselor), the remedial Arithmetic classroom could engage learners in topics of Arithmetic through second semester of Algebra (Spring 2011), and utilizing the triptych as a student tool (Spring 2012), the classes of Algebra could communicate the specific nature of the Arithmetic learning difficulties they face, while a well-motivated Statistics class could create deep connections between concepts of the course.

His (Koestler's) explanation of why the triptych works is also useful to note: (p.35)"…perceiving of a situation or idea, L, in two self-consistent but habitually incompatible frames of reference M_1 and M_2. The event L, in which the two intersect, is made to vibrate simultaneously on two different wavelengths as it were. While this unusual situation lasts, L is not merely linked to one associative context, but bisociated with two."
(p.35)"I have coined the term 'bisociation' in order to make a distinction between the routine skills of thinking on a single 'plane', as it were, and the creative act, which, always operates on more than one plane. The former may be called single-minded, the latter a double minded transitory state of unstable equilibrium where the balance of both emotion and thought is disturbed".

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For Koestler, 'matrix' " denotes any ability, habit or skill, any pattern of ordered behavior governed by a 'code' of fixed rules", and code and matrix are elaborated (using context of playing chess),

(p.42) "Matrix is the pattern before you, representing the ensemble of permissible moves. The code which governs the matrix… is the fixed, invariable factor in a skill or habit; the matrix, its variable aspect. The two words do not refer to different entities, they refer to different aspects of the same activity".

The importance of integrating instruction across affective and cognitive domains, apparent in our classroom situation is also addressed:

(p.58)"There is probably no formal thinking without some affective colouring…emotion deserted by thought which is discharged in laughter. For emotion, owing to its greater mass momentum is unable to follow the sudden switch of ideas to a different type of logic or a new rule of the game…"

(p. 638) The problem in problem solving consists firstly in discovering which routine is appropriate to the problem – what type of game is to be played; and secondly, how to play it – i.e., which strategy to follow, which members of the flexible matrix are to be brought into play according to the lie of the land". Further, addressing the need to transform habit of using the same procedures to learning of mathematics that have not worked before, Koestler offers the following: (p.639) "Habit is heir to originality; without the hierarchies of organized habits life would be chaos; creativity means breaking up habits and joining the fragments into a new synthesis".

Finally, the understanding which we hope our instruction will result in is also addressed, and distinguished into (a) the progression of understanding and (b) the exercise of understanding:

(p.619)"…distinguish between progress in understanding – the acquisition of new insights, and the exercise of understanding at any given stage of development. Progress in understanding is achieved by the formulation of new codes through the modification

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and integration of existing codes by methods of empirical induction, abstraction and discrimination, bisociation. The exercise or application of understanding – the explanation of particular events – then becomes an act of subsuming the particular event under the codes formed by past experience. To say that we have understood a phenomenon means that we have recognized one or more of its relevant relational features as particular instances of more general or familiar relations, which have been previously abstracted and encoded".

Creativity has been the critical pedagogy of the classroom, transforming the habit of dislike toward mathematics to one where engagement and performance to the extent permitted by individual fulfillment of the didactic contract (handshake toward one's own excellence). Thus, creative problem solving has been the medium of maximizing educative potential. How does it work when the teaching-research team constitutes students as partners in the learning process?

AISHA AND ALCY – STUDENT LEADERS

Aisha and Alcy's workshops in each of the 3 classes taught by Vrunda Prabhu in Spring 2012, provide the perspective. The style of engagement of the student-partners is that of co-generative dialog (Tobin, 2005). The general format of their 2-hour workshops can be summarized through the following list:

- Introductions
- What is a "Creative"
- Exploratory fiction (Alcy)
- -where is it found?
- -how does it relate to the learning model set within a class?
- -what kind of student does it create?
- Poetry (Aisha)
- -what is poetry?
- -what can we learn from it?
- -writing prompt
- -What have we learned from our experiences?

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- -The classroom as a learning being (shapes forming shapes)
- -student centered learning pedagogy
- -The New World: exploring the new dynamic of students as facilitators to the learning atmosphere
- Closing statements

The idea for using the triptychs as classroom tools (for deeper learning, for students' making their thinking transparent to the instructor, etc) was also prompted by the intervention of the student partners. At the first workshop conducted by the student partners, Aisha noted the triptych to have word associations, while in the second workshop, Alcy spontaneously used the list of words from the chapter on Correlation and Regression that happened to be on the blackboard to create an interactive discussion with the class. This discussion was used by the instructor several times over the course of the semester to create similar discussions with the class.

The 3 classes of the semester had very different dynamics. The Arithmetic and Statistics class were more motivated and interested while the Algebra class which met 6-8 in the evenings, was much less so. The dynamics created by the student-partners resulted in several poems written by the 2 active classes. At the time after the midterm, in the second iteration of the teaching-research cycle for all three classes, the two motivated classes agreed to have their poems and fiction as personal journal prompts for the class that needed motivation. The workshops by the student partners sparked the classes into exercising their own creativity in the writing of poems and helping other students toward success, while the triptychs in all three classes allowed for a greater interaction into the thinking process than the teacher researcher had been able to motivate in previous semesters,

IMPLICATIONS AND NEXT STEPS

A phase of the development cycle of Students as Partners in Learning prototype was targeted toward the Bronx CC-FET, South Africa partnership of Developing Skills. BCC personnel served a consulting role utilizing the successful American community college

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model for the FET colleges in South Africa. The integrative approach presented in our approach is in accordance with the Learning Paradigm College Model, TR-NYC offers the possibility of realizing Learning Paradigm College from foundation, upward in the mathematics classrooms of practicing teacher-researchers. Scalability and replicability are both possible through the TR-NYC approach.

The teaching-research approach embeds successful practices and materials into the regular environment for the succeeding semester. Writing is an essential aspect in the goal of improvement of learning (Czarnocha, 2006) given the existing need for rapid end of fear of mathematics, and transformation to creativity, with active student involvement. The mathematics instructor, Vrunda Prabhu, will teach Statistics as a writing-intensive and hybrid (partially online) course in Fall 2012. The syllabus for the Writing Intensive Statistics course offers the analog of Service Learning for the remedial/developmental courses of Arithmetic and Algebra for Fall 2012, i.e., students participate in the Creative Learning environment in order to serve their own mathematical creativity. They write letters to a fictitious high school student Jonathan, on a weekly basis, as a way to keep their work aligned with syllabus expectations.

(B. Sriraman, 2009) asks the following questions:

- Does the study of mathematical creativity have implications for the classroom?
- What are the characteristics of the creative process in mathematics?

We clearly answer the first affirmatively. To outline the characteristics of the creative process in mathematics useful to our approach, we refer to characterization of Grothendieck's work: "the slow broad approach, the search for the essence, the embrace without reticence of a problem as its own solution".

Creative thinking, is the connection of the moments of understanding occurring in the classroom discourse as the topics of the syllabus are discussed and its ownership by learners to question and involve themselves in, voluntarily to their own satisfaction, and to the expectation of the college. The Creative Learning Environment resulting from this

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approach is the one well-aligned with the Learning Paradigm College. So, teaching-research in its quest of improvement of learning is able to achieve its goal somewhat satisfactorily.

THE TEACHIN-RESEARCH TEAM:

Aisha Sidibe

From poetry, to fiction to memoir, Aisha has felt comfortable in cross genre writing. As a student at Bronx Community College, she worked hard on exploring her writing and to influence others to do so as well. She was not only the President of the Creative Writing Club, but also served as the Poetry Editor of the Thesis Literary Magazine and provided workshops for students in both memoir and poetry. Her work has seen several publications and she has spoken at writing panels in Harlem and on the BCC campus. After graduating BCC in 2012 as an honors student and member of Phi Theta Kappa Honors Society, Aisha is currently continuing her education as a student at Hunter College, studying English with a minor in Sociology. She will continue her research on the intercultural relationship between African Americans and West Africans in New York.

Alcy Leyva

Alcy Leyva is a Bronx-born writer who is into elements of fantasy and dark humor, but tends to roam around tirelessly for the next great project. He was the fiction editor for the Bronx Community College Thesis Literary Magazine and has had his musings printed in U4U magazine and Thesis. He has also developed a student film for the BCC 19th Annual Film Festival for which he won four awards, including 2nd place. Alcy has also led his own workshops in flash fiction and writing for films. He is currently enrolled in Hunter College, studying English with a focus on Creative Writing.

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Peter Reyes Barbatis

Peter Reyes Barbatis has been an educator for more than 20 years. Having served as a student affairs practitioner in Florida, California, and Texas, he has been Vice President for Student Affairs at Bronx Community College until June 1, 2012. He has been responsible for the student support services that promote access, engagement, and retention. He has taught developmental mathematics and student success skills. He has a doctorate in Higher Education Leadership from Florida International University. His dissertation entitled, Perceptions of Underprepared College Students Regarding their Academic Achievement was selected as the 2009 Dissertation of the Year by the National Council on Student Development. He has a new position as Vice President of Student Affairs at Palm Beach State Community College.

James Watson

James Watson is an Assistant Professor and System's librarian. He possesses Master degrees in both Information Science and Interactive telecommunications. His primary research interests are student self-efficacy and self-regulated learning strategies. His other interests include using Geographic Information Systems to map spatial data; developing self-contained learning modules; and integrating mobile technology into instruction.

Vrunda Prabhu

Vrunda Prabhu received her Ph.D. in Point Set Topology in 1993. For 10 years she taught at a liberal arts college in Midwestern United States and for the past decade at Bronx Community College of the City University of New York. She is a practicing teacher researcher for the past 15 years of her academic career. As a mathematics teacher researcher, she has had the privilege of learning from sharp student minds. Her teaching-research results and discoveries now find connections in the fields of foundations of mathematics, and mathematics education.

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Triptych from Arthur Koestler, *The Act of Creation*

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