

# STUDENTS' SELF-ASSESSMENT OF CREATIVITY: BENEFITS AND LIMITATIONS

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*In this paper, we describe the process of students' self-assessment of their creativity and its development in the context of posing mathematical problems, presuming that such a process would support the development of their creativity. Examination of two case studies reveals that self-assessment of creativity may support its development provided that one possesses specific personal recourses; however, this process might suppress the creativity of those lacking the needed resources. Therefore, we suggest that self-assessment of creativity cannot stand on its own, and should be supplemented by teachers' feedback or other environmental 'scaffolding'.*

## INTRODUCTION

Reviewing over 90 articles with the word “creativity” in the title, Plucker, Beghetto, and Dow (2004) found that only 38% of them explicitly defined what creativity was. Clearly, a lack of agreed-upon definition of creativity makes it difficult to reach any consensus about how to assess creative expressions or creative personality, as well as make a decision about the appropriate design of learning environments intended to realize students' creative potential. Nonetheless, the extensive literature concern with creativity recognizes the importance of nurturing students' creativity and the central role of schools in this regard (e.g. Sternberg & Lubatrt, 1995). Therefore, in order to be able to actualize intentions of nurturing students' creativity, one should first select a preferred definition and approach that would enable to translate ideas about creativity into practice. Thinking over how to design a learning environment that support the development of students' mathematical creativity, we held in mind teachers' difficulties in assessing students' creativity and its development (Shriki, 2010). We found Torrance's (1974) psychometric approach to creativity as appropriate to that end, since it permits 'measuring' creativity using quantitative instruments. In addition, drawing on research that relates to the benefits of students' self-assessment of creativity (e.g. Chamberlin & Moon, 2005), we presumed that allowing students to self-assess the level of creativity expressed in their outcomes might contribute to its development.

In this paper, we present partial results from a study that aimed at examining the effect of students' self-assessment of their mathematical creativity and its development in the context of problem posing on the actual development of their creativity.

## LITERATURE BACKGROUND

### Approaches to the study of creativity

Various approaches are implemented for studying and assessing creativity. Among them, the **psychometric approach** of Guilford (1967), who distinguished between convergent and divergent thinking, and his follower Torrance (1974), whose battery of tests are still being widely used today; The **cognitive approach** for the study of creativity focuses on cognitive and mental processes, among them the use of different representations, establishment of mental links among ostensibly unrelated objects, solving problems of various fields, and more (Sternberg & Davidson, 2005); The **social-personality approach** refers to emotional as well as socio-cultural aspects. The Investment Theory of creativity (Sternberg & Lubart, 1995) is rooted in this approach. The theory seeks to understand the foundation of creativity, and assumes that creative performance results from a confluence of 6 interrelated resources: Cognitive resources – *Intellectual skills* (synthetic, analytic, and practical), *Knowledge* (which might help or hinder creativity), and *Thinking Styles* (preferred ways of using one's skills); Affective resources – *Thinking Styles* (as before), *Personality* (willingness to overcome obstacles, to take risks, to tolerate ambiguity, and self-efficacy), and *Motivation* (as related to task); and Environmental resources (whether or not support and reward creative ideas). “*In order for these resources to be used effectively, they must converge in a way that capitalizes upon them both singly and in interaction*” (p. 4). In some cases, ‘strong’ resources may compensate for ‘weak’ resources.

### Self-assessment (SA) of creativity

Students’ SA of their learning supports the development of their confidence and individuality and adds reflection and metacognition to learning of mathematics (NCTM, 2000). Therefore, students should be engaged in SA of their progress, and use it for articulating the value of their own study (Brookhart, Andolina, Zuzza & Furman, 2004). In order to enable students to assess their performance and progress, teachers should provide them with explicit, easy to understand, guidelines (Enz & Serafini, 1995), and a proper support (Brookhart et al., 2004). Students who are trained in SA outperform those who do not receive such preparation (Enz & Serafini, 1995).

SA of creativity is one of the simplest ways to assess creativity (Kaufman, Plucker & Russell, 2012), which in itself requires creativity and enables to refine one's own products in successive iterations. One approach to SA of creativity is asking people to rate their creative accomplishments or ability (Beghetto, Kaufman & Baxter, 2011). The authors acknowledge that SA of creativity may seem as not reliable as it might not be compatible with estimates of external judges, therefore they suggest measuring it by “creative self-efficacy” (CSE), as it represent not only a subjective appraisal of specific creative ability, but also linked to actual creative behaviour or one's perceived ability to accomplish particular behaviours and tasks. The authors found that on average students tended to rate their creative ability similar to how their teachers rated their creative expression.

## THE FRAMEWORK OF THE STUDY

### Background

Recognizing the value of students' SA of their own creativity, and realizing that students are able to assess the extent of their creativity, we incorporate a component of SA of creativity as part of our wider educational effort to foster students' mathematical creativity. In Beghetto et al.'s (2011) study, students' CSE was measured by their rank of 5 Likert-type items. As the authors pointed out that some students tended to underestimate their creative ability, it seemed to us that an approach that is based merely on self-perception, without relating to some specific 'evident', may obstruct some students from reliably self-assessing their creativity. Therefore, we presumed that providing students with something "to hold on" while self-assessing their creativity may support their ability to assess it and may also contribute to its development. This presumption was put to the test in the current study.

### Assessing students' creativity in the context of problem posing

Acknowledging the centrality of problem posing (PP) processes within the mathematical creative act (Silver, 1997), the current study was part of an experiment in which 6 upper-elementary mathematics teachers engaged their students in a series of 5 PP tasks, aimed at nurturing students' creativity. Given an initial mathematical problem, students were asked to pose as many appropriate problems as possible through employing the "What-if-Not?" strategy suggested by Brown & Walter (1990). Relating to the posed problems, students' creativity and its development were assessed through an instrument developed by Shriki (2013). This instrument considers 4 measurable aspects of creativity: fluency, flexibility, originality and organization, as proposed by Torrance (1974). Fluency is measured by the number of different posed problems; flexibility is measured by the number of different categories of the posed problems; originality is measured by the relative infrequency of the problems, and organization is measured by the number of problems stated as generalizations. The scores given to each aspect are of two types: (1) Total scores: the absolute number of posed problems with respect to each of the 4 aspects, and a final score of creativity (based on predetermined relative weights of each aspect); (2) relative scores: each absolute number is transformed into a number that reflects the relative infrequency of the posed problems in student's reference group. For instance, a student who poses 10 problems receives a total score of 10 for fluency. Suppose that the highest total score for fluency in this student's reference group is 15, the student's relative score for fluency is  $10/15 \approx 67$ . Providing relative scores rests on the notion that developing students' creativity requires assessment of each student compared to his/her reference group, rather than comparing him/her with professionals in the field (Leikin, 2009).

### The SA process

The first task was presented only after the students were informed about the meaning of the 4 measurable aspects of creativity and absolute and relative scores. This was followed by several examples of employing the "What-if-Not?" strategy and clarifying

the significance of "an appropriate problem". After every task, each student received a graphical display of his/her relative scores. Starting from the second task, the graphical display included cumulative scores, so that students were able to trace their progress/withdrawal relatively to their classmates. Examining the graphical display of scores, students were asked to reflect on modifications in their relative scores, and try to explain evident changes. As we aimed at examining the feasibility of implementing such a process without any external intervention, the teachers were instructed not to discuss with their students anything that relates to it until its completion.

## **THE STUDY**

The study followed students' perceptions regarding the contribution of the described SA process to the development of their mathematical creativity.

### **Research questions**

Relating to the SA process the following questions were addressed: How do students perceive the contribution of SA to the development of (i) their ability to assess their mathematical creativity; (ii) their self-efficacy as posers of mathematical problems; (iii) their development of mathematical creativity.

### **Subjects**

The study involved 190 students from 6 different regular upper-elementary schools in the northern part of Israel: Two 9<sup>th</sup> grade classes (high level group of 32 students, low level group of 29 students); one 10<sup>th</sup> grade class (medium level group of 34 students); two 11<sup>th</sup> grade classes (high level group of 31 students, medium level group of 36 students); and one 12<sup>th</sup> grade class (medium level group of 28 students).

### **Research tools**

Data was gathered through weekly questionnaires. Subsequent to each PP task the teachers provided the students with an individual graphical display of their relative scores (cumulative scores starting from the second task) and a questionnaire that included 3 open questions: Observing the graphical display, what can you tell about: (i) your creativity with respect to posing mathematical problems?; (ii) your ability to pose mathematical problems?; (iii) your development of mathematical creativity. Try to explain evident changes or lack of changes.

### **Methods for analysing the data**

Students' responses were analysed by means of analytical induction, aiming to identify the main themes and the typical patterns. This process was done through open coding and content analysis in order to form the unifying categories and sub-categories (Strauss & Corbin, 1990).

## **RESULTS AND DISCUSSION**

In this section, we present two case studies, both taken from the medium level group of 11<sup>th</sup> graders. Given space limitations, to avoid the effects of age group, level of study,

and achievements in mathematics, we chose to present examples of students from the same class with a similar average grade in mathematics. The two students, Ruth and Michael, represent two types of students: While Ruth's relative scores consistently increased, Michael's relative scores remained almost unchanged. Ruth's and Michael's average grades in mathematics were 86 and 82, respectively. In Figure 1 appear Ruth's and Michael's cumulative relative scores of fluency, flexibility, originality, organization and creativity for the 5 tasks (t1-t5). The score for creativity was calculated so that each of the four aspects was given an equal weight.

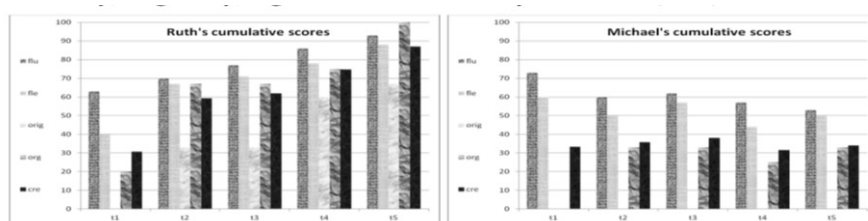


Figure 1: Ruth's and Michael's cumulative scores for task 1 (t1) to task 5 (t5)

Unlike Chamberlin & Moon's (2005) observation, Figure 1 indicates that SA of creativity has a diverse effect on different students. Hence, the question is what are the factors, combined with the SA process, that affect the development of students' creativity? In order to answer this question, we analysed Ruth's and Michael's responses to the questionnaires through the lens of Sternberg & Lubart's (1995) investment theory of creativity. We found the theory as suitable for this purpose since it seeks to understand the interrelations between person and product. Out of the 6 resources, we excluded "knowledge", as both students attended at the same class and their grades were not significantly different. We start with presenting some quotes taken from Ruth's and Michael's responses. Next to each quote appear the number of task (t1-t5) and the number of the questionnaire's question (i-iii) to which it relates. The citations were translated from Hebrew, and we strived to preserve their essence.

### Citations taken from Ruth's responses

"My scores were very disappointing, but I can only blame myself for not giving it enough time...I will surely work harder on the next task" (t1, ii); "I wasn't satisfied with my scores for originality. I think that more than other scores this truly reflects creativity. So I promised myself to think 'big' next time" (t2, i); "I can see that my efforts paid off in all but originality. I think of myself as a creative person, so it's a bit annoying, but I'm not giving up" (t3, iii); "This time I changed my tactic, and it worked! I thought that if I would pose more problems, then I'll increase the chance of being original" (t4, ii); "These tasks truly gave me a chance to think differently. At first, I was afraid to think too wild, because the teacher said that the problem should be appropriate. But when I saw my scores for the three tasks I realized that if I would limit myself to simple problems I will not go far. So I really tried to think of original and generalized problems...and as you can see [the teacher], I am one of the most creative students in the class! Yeeh!!!" (t5, iii).

### Citations taken from Michael's responses

“I tried to think of many types of problems, and I thought it would be enough. But then I saw my score of creativity, and realized it wasn't enough...O.K., so I am not very original and creative, what does it say about me?” (t1, i); “I tried to prove to you [the teacher] that I can be original, but now I know I'm not...Actually, instead of getting better, I'm getting worse” (t2, iii); “It is the same as before. Perhaps I just don't know how to pose problems. We never did it in class...I'm starting not to like these tasks” (t3, i); “It is not hard to see that other students are much more creative than me, so I give up” (t4, iii); “I understand that what we did was some kind of an experiment, but you [the teacher] probably had to explain it better, or tell me what I was doing wrong. If you had asked me a month ago if I could pose mathematical problems, I would definitely say “yes”, but it turned out I'm not very good at it” (t5, ii).

Figure 1 indicates that Michael's starting point was slightly better than Ruth's, and both scores of total creativity were rather low. However, while Ruth exhibited an impressive progress Michael did not. What are the prominent differences between the reactions of both students and how can the investment theory explain them?

Summarizing his extensive research within the area of investment theory, Sternberg (2009) describes the **intellectual skills resource** as relating, among others, to the ability to escape the bounds of conventional thinking, recognize which of one's ideas worth pursuing, and willingness to devote time to think in new ways. Evidently, Ruth's behaviour meets these skills, and she also takes a responsibility for her achievements. At the outset, she realized the need to spend more time working on the tasks in order to achieve the goal she set for herself: improve her relative scores, especially the score of originality (t1, t2). This objective was set following her view of originality as the essence of creativity (t2), and the fact she considered herself a creative person (t3). Through the entire process, Ruth's thinking styles and her personality characteristics facilitated her efforts to improve. **Thinking styles resources** relate to the preferred ways of using one's skills, namely, decisions about how to organize the available skills, and **Personality resources** relate to the willingness to overcome obstacles and take risks, and self-efficacy. These resources are essential for creative functioning (Sternberg, 2009). Apparently, Ruth is able to monitor her actions. Apart from the decision to spend more time, Ruth realized she needed to change her strategy, for example- pose more problems (t4), 'think big' (t3), and think of 'wild problems' (t5). Her self-efficacy as a creative person, combined with her willingness to overcome obstacles and take risks, proved to be what she called 'pay off'. Obviously, the above resources might not be adequate, if Ruth had no motivation. Intrinsic, task-focused **motivation** is essential for creativity. However, motivation is not something inherent in a person, and one decides to be motivated given a certain incentives (Sternberg, 2009). Ruth's motivation to improve was first and foremost intrinsic, driven by her wish to confirm to herself that she was as creative as she believed (t2-t5).

Michael, on the other hand, demonstrated a different pattern of resource exploitation. While, at the first task, he used his **intellectual skills resource** for thinking of various

types of problems, believing this was the right approach (t1), realizing it was insufficient for receiving high scores he did not make any attempt to escape the bounds of his conventional thinking, or altered the use of his **thinking styles resource**. In Michael's responses, there is no evidence for pondering, but rather a message of a 'quick waiver' (t1, t3). Evidently, Michael lacks the **Personality resources** that would enable him to overcome obstacles and take risks, and his low self-efficacy is manifested already after t1. Michael's responses (t1-t4) may indicate that he perceived the process as some kind of a 'competition' among his classmates, and it might be that being uncompetitive hindered the development of his creativity, damaged his self-efficacy and suppressed his intrinsic **motivation**. In fact, it appears that Michael's main motivation was to prove something to his teacher, rather than an intrinsic one (t2). As a result, he tended to 'blame' his teacher for not providing him appropriate conditions to succeed (t3, t5). As Sternberg (2009) pointed out, some people may have all the needed internal resources to think creatively, however, if they do not get support from the **environment**, or alternatively – receive negative feedback on their creative thinking, they will find it difficult to demonstrate their creativity. Such people actually decide not to face environmental challenges, thereby blocking their creative output. Unlike Ruth, who is able to resolve her conflicts by herself, Michael needs his teacher's guidance and support.

In summary, the two case studies described above suggest that SA of creativity can be beneficial for students who possess an optimal mixture of resources from the outset. Such students are able to exploit SA of creativity to further develop it. On the other hand, students who lack a certain degree of threshold for some resources might be damaged from the process. It is possible that Michael could realize his creative potential if he had received a personal feedback from his teacher.

Obviously, as we presented only two examples this observation cannot be conclusive, although it implies the impossibility to say that 'one size fits all'. In addition, we based our conclusions merely on one specific approach of SA and one specific method to nurture and assess students' mathematics creativity. However, our initial findings call for the need to a wide scale examination of the advantages and disadvantages of SA of creativity.

Finally, it would be interesting to ask students to respond Beghetto et al.'s (2011) questionnaire prior to engaging them with the described SA process in order identify some interconnections between students' CSE and the impact of SA of creativity on its development.

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