AN EXPLORATORY STUDY REGARDING CHEMISTRY AND VISUAL ARTS TEACHERS' SELF-REPORTED USE OF SUBJECT-SPECIFIC SIGNATURE PEDAGOGIES TO FOSTER CREATIVITY

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Abstract. The goal of this exploratory study was to investigate the Romanian Chemistry and Visual Arts teachers' self-reported use of the subject-specific signature pedagogies to foster creativity in class (*i.e.*, research-based learning and project-based learning for Chemistry education and studio thinking and teaching for artistic behaviour for Visual Arts education). Analysis of data revealed that most of the Visual Arts teachers who participated in this study reported the utilisation of studio thinking (100%) and teaching for artistic behaviour (53%) as methods used to foster creativity. Although data shows that Romanian Chemistry teachers are adept at using a variety of methods to foster creativity, only a limited proportion from the Chemistry teachers who participated in this study depicted research-based learning (8.3%) and project-based learning (17%) among the methods they have used to foster creativity. A possible implication of this study may be that lifelong learning programs should be developed on the topic *Use of subject-specific signature pedagogies to foster creativity*, for training Romanian Chemistry teachers.

Keywords: methods used to foster creativity (all subjects), methods used to foster creativity in Chemistry education, methods used to foster creativity in Visual Arts education

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INTRODUCTION

Preamble

In spite of the fact that most lay people associate creativity with Arts, Science is a creative pursuit and Science teachers should consider fostering creativity in Science classes. However, when Romanian teachers are competing for teacher jobs in state schools in Romania, they are not evaluated on their knowledge regarding the strategies to foster creativity or on their ability to apply these strategies in class. Considering this, the purpose of this study was to identify if the Romanian Chemistry teachers report the use of the subject-specific signature pedagogies to foster creativity. A comparison with Visual Arts teachers was envisaged. The results of this study may be useful when selecting the topics for lifelong learning programs for Chemistry teachers in the future.

On creativity

Kaufman and Beghetto (2009) differentiate between four types of creativity: mini-c (the creativity involved in making meaning and in learning), little-c (the creativity involved in quotidian activities), Pro-C (the creativity employed in professional activities), and Big-C (the creativity which refers to the eminent, revolutionary creativity, which has a large impact on the progress of culture and society) (Glaveanu, 2018). Although lay people may believe that creativity is specific only to Arts or writing, creativity occurs in all domains of life, it can be nurtured through instruction and it is influenced by context and social factors (Lucas *et al.*, 2013, Glaveanu, 2018). Glaveanu (2018) describes three ways of defining creativity: creativity as art (this is the most common description of creativity, and involves original work and divergent thinking), creativity as invention (is involved in solving practical problems from science and technology; may require insight and knowledge, convergent thinking, synthesis and analytical skills), creativity as craft (reflects the creativity in daily life activities).

Subject-specific signature pedagogies to foster creativity

The teachers are playing an important role in fostering the development of pupils' creativity, being most of the time a model for the pupils. It is expected that teachers model creativity, show enthusiasm for the subject taught and create a supportive environment for the development of creativity in classroom. Teachers should encourage pupils to voice their ideas and to allow them to have autonomy (Morais *et al.*, 2011). Among the methods which could foster creativity are brainstorming, role play, improvisation (Gruszka, & Tang, 2017), individual assignments based on problem solving and problem finding, group activities, inquiry, problem solving (Fasko, 2000-2001). The signature pedagogies associated with fostering of creativity are: creative partnerships (all subjects), design thinking (all subjects), dialogic teaching (all subjects), metacognitive pedagogy (maths education, all subjects), modern Band movement (music education), Montessori (all

subjects), Orff Schulwerk (music education), project-based learning (science education, all subjects) research-based learning (science education), studio thinking (visual arts education), teaching for artistic behaviour (visual arts education) (Vincent-Lancrin *et al.*, 2019).

Teachers`views on creativity

Data regarding the views and conceptions of teachers and student teachers about creativity exist (Mullet et al., 2016). Teachers' own creativity and their believes play an important role in the way the teachers relate to it in classroom. Most often, teachers are not prepared to use strategies for promoting creativity. Even more, they may use strategies which they think that they foster creativity, and in fact it is the contrary, those methods are suppressing it. Some other teachers abandon the idea of fostering creativity in class and consider that the teachers of arts and creative writing could be better equipped for this activity. Some teachers prefer the less creative students, as they associate creative students with students having a problematic conduct in class. Reversely, most often mistakenly, teachers associate socially-desirable students with creativity. However, in general teachers believe that creativity can be developed in students and this may be a stepping stone in their endeavours to nurture creativity in students.

Fostering creativity in Chemistry classes

Creativity could be expressed when Chemistry students are being involved in the experimental activities specific to Chemistry and Science in general: propose hypotheses, plan and execute experiments, interpret data and draw conclusions (Semmler & Pietzner, 2017). Other means for fostering creativity during Chemistry classes are: solving problems which could not be solved through following an algorithm, solving problems regarding real-life situations (which do not contain all information) (Tomasevic & Trivic, 2014), self-discovery of facts, description of problems and refinement of their definitions, producing solutions to problems, idea generation, posing questions, analytical and divergent thinking, improvement of self-efficacy, and acceptance of mistake-making (Tomasevic & Trivic, 2014; Sternberg & Williams, 2010). Furthermore, utilisation of models is ubiquitous in Chemistry classroom and creativity is also reflected in teachers' utilisation of models (Semmler & Pietzner, 2017).

Kind and Kind (2007) emphasised the ways science educators relate to creativity:

- Creative teaching - it is the opposite of traditional teaching and comprises using the student-centred strategies at class, collaborative learning, solving open-ended problems, activities carried out outside classroom.
- Art and Science - science teaching should adopt processes specific to arts. For example, teachers should encourage pupils' self-expression and pupils should be prepared to approach tasks in such a way that they can accept and overcome failure. Furthermore, pupils should be trained to consider creative approaches when answering problems which do not have a set answer.

- Inquiry – the 'cook book strategy' for science laboratories should be replaced by activities in which students can solve open ended problems and can undertake investigation activities, to find answers to problems. Thus, students could be involved in activities similar to the activities of researchers.
- Nature of science (NOS) – creativity is one of the tenets of NOS. In Science, both creativity and rationality are playing key roles in big discoveries.

Kind and Kind (2007) argue that domain-specific knowledge is very important in creativity and that people who do creative work in chemistry master very well the knowledge in the chemistry field**.**

AIM OF THE STUDY

The goal of this exploratory study was to investigate the extent to which the Romanian Chemistry and Visual Arts teachers self-report the use of the subject-specific signature pedagogies to foster creativity in class (*i.e.*, research-based learning and project-based learning for Chemistry education and studio thinking and teaching for artistic behaviour for Visual Arts education).

DESIGN OF THE EMPIRICAL STUDY

In-service teachers (teachers at secondary school and high school) and university professors involved in Chemistry education and Visual Arts education participated in this study.

Demographic data regarding Chemistry teachers:

- N=24 in-service teachers and university professors, 19 females (79%), 5 males (21%); 19 secondary school and High School teachers, 5 university professors. Years of teaching experience: M=21.1, SD=8.6, min= 2 years, max= 36 years.

Demographic data regarding Art teachers:

- N=19 university professors, 9 females (47.4%), 10 males (52.6%); 2 assistant professors, 8 lecturers, 5 associate professors, 4 full professors. Years of teaching experience: M=16.20, SD=14.4, min=3 years, max=49 years.

The participants were asked to list and discuss 3-5 methods which they have designed during their educational activities, with the aim to foster students'/ pupils' creativity. The frequencies of the methods provided by teachers were calculated.

RESULTS AND DISCUSSION

A limited proportion of the Chemistry teachers who participated in this study depicted research-based learning (8.3%) and project-based learning (17%) amongst the methods they used to foster creativity. Nevertheless, other activities which are specific to science education, such as practical activities, inquiry, analysis, development and utilisation of models were reported by Chemistry teachers as being amongst the methods which they used to foster creativity. Most Chemistry teachers reported that they used problem-based learning (reported by 46% of participants),

educational games (reported by 42% of participants) and practical activities (reported by 29% of participants) to foster creativity. Although problem-based learning and practical activities are not listed among Chemistry specific signature pedagogies, these methods are also known to be used to foster creativity in class.

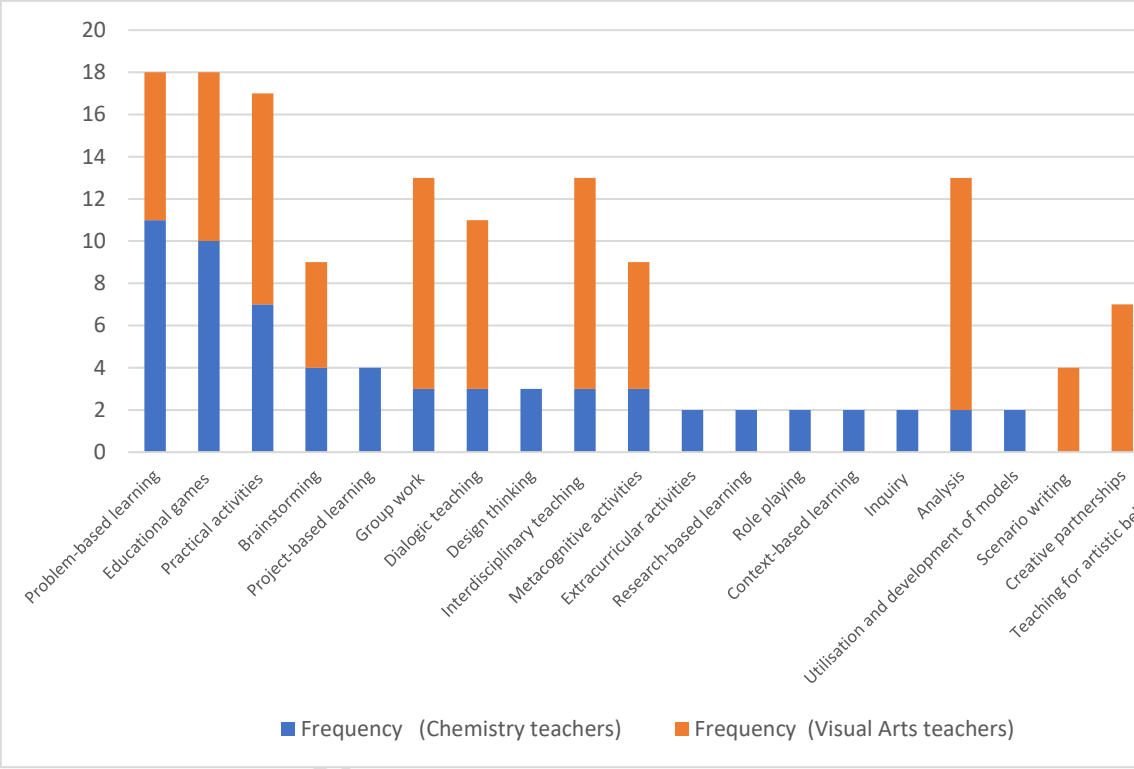

Figure: Comparison of the frequencies of the methods used to foster creativity, as reported by the Chemistry teachers and Visual Arts teachers

Among the methods stated by the Visual Arts teachers were the methods which are specific for fostering creativity in Visual Arts field: studio thinking (reported by 100% of participants) and teaching for artistic behaviour (reported by 53% of participants). Besides these methods, the Visual Arts teachers appreciate that creative partnerships (partnerships between creative practitioners and schools, involving authentic activities for students) and scenario writing may play an important role in fostering creativity. Problem-based learning, educational games, practical activities, brainstorming, group work, dialogic thinking, interdisciplinary teaching, analysis and metacognitive activities appear to have been used to foster creativity by both Chemistry and Visual Arts teachers.

CONCLUSION AND IMPLICATIONS

Whereas most of the Visual Arts teachers who participated in this study reported that they used the subject-specific signature pedagogies to foster creativity, only a limited proportion of the Chemistry teachers stated that they used the two signature

pedagogies specific to fostering creativity in Chemistry education. A possible implication of this study is that Romanian Chemistry teachers should participate in workshops or lifelong learning courses regarding the use of subject-specific signature pedagogies to foster creativity.

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