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# PROSPECTIVE TEACHERS' CREATIVITY FOSTERING BEHAVIORS, PERCEPTIONS ON THEIR TECHNOLOGY SKILLS AND SUCCESS IN PROJECT BASED MATERIAL DEVELOPMENT

**Özge Özyalçin Oskay**
Hacettepe University, Ankara, Turkey
E-mail: ozge@hacettepe.edu.tr

## Abstract

*In this study it was determined how pre-service chemistry teachers' creativity fostering behaviours and their perceptions of their technology skills predict their success in Project Based Educational Technology and Material Development course. A sample of the study consists of 45 pre-service teachers attending Department of Chemistry Education at Hacettepe University. After the applications which took 10 weeks, pre-service teachers presented their materials and evaluated their peers and themselves. In order to determine pre-service teachers' creativity fostering behaviours, "Creativity Fostering Teacher Index Scale" which was developed by Soh (2000) and adapted into Turkish by Dikici (2013) was used. In order to determine pre-service chemistry teachers' perceptions on their technology skills, "Application Based Educational Technology and Material Development Skills Scale" consisting 46 items and developed by Akgül (2010) was used. Descriptive Statistics of "Creativity Fostering Teacher Index Scale" and "Application Based Educational Technology and Material Development Skills Scale" show that prospective teachers have behaviours supporting creativity and their perceptions about their technology skills is over the average. And multiple regression analysis shows that pre-service teachers' creativity fostering behaviours and their perceptions on their technology skills together predict their success in project based material development course.*

**Key words**: *creativity fostering behaviours, perceptions on technology skills, pre-service chemistry teachers, project based educational technology and material development.*

## Introduction

Changes have been occurring in our society in every field, including the social and scientific fields. The most important element triggering the change is the rapid development in technology in general. "Technology has been used in every field. And education is also necessary in every field. Thus, both are the necessities in any field and are indispensable. In this context, technology has effects on education and education has effects on technology" (Yanpar Yelken, 2012). Along with the constructivist curriculum, which has commonly been adopted in Turkey as well as in the globe, student-centred education gained importance and the student profile in which students ask questions, bear the responsibility of their own learning and construct the knowledge in their mind, came into prominence. All these have necessitated self-development and self-training on the part of teachers. In the study entitled "The Contemporary Teacher Profile" conducted by the Ministry of Education (1999), contemporary teachers are described as the individuals who can meet today's educational needs, are proficient in preparing the students for the future in the society of information technology of the 21st century, are competent in their subject matter, have the skills of recognising the students, are capable of planning course activities, can employ methods and techniques suitable to the properties of the teaching point, can

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develop tactics specific to themselves in order to make the lessons more efficient, and who can make use of communication and information technologies.

Teachers' ability to prepare materials suitable to the course objectives, their ability to use the materials in the right time and in the right way through suitable methods and techniques of teaching lie within the scope of instructional technologies. The Instructional Technologies and Material Development courses are very important for prospective teachers in acquiring those efficacies.

An interaction occurs between students, teachers and the instructional materials in the process of teaching. The teaching materials used can appeal to more sense organs and thus can help learners to concretise the abstract concepts, can call their attention to the class, and can help to bring about meaningful learning (Yanpar Yelken, 2012). Prospective teachers should have the ability to prepare materials both by hand and with the help of computers. Prior to preparing the materials, they should be able to design them, be able to select different methods and techniques of teaching, and be able to implement the materials in those methods and techniques. Yet, this requires creativity and creative thinking (Yanpar Yelken, 2009, Yanpar; Koray, Parmaksız, Aslan, 2006).

"Teachers should firstly know what creative thinking is so that they can set creative models. In this way, they can use the knowledge and thus can guide students in learning which can develop creativity in students" (Senemoğlu, 2014). Teachers supporting creativity in their classes encourage students to learn in freely, they have a socially integrating, cooperative teaching style, they motivate students into having a firm basis and detailed knowledge for versatile thinking, they do not judge the students' opinions until they work clearly and specify their views fully, they encourage flexible thinking, they incite self-evaluation on the part of students, they consider students' recommendations and problems seriously, they provide students with opportunities to work with various materials in diverse situations, they help students to cope with failure and disappointment, and thus they encourage them to try the new and unusual things (Cropley, 1997).

Project-based learning is an approach of teaching in which students learn to work in cooperation and play active roles in classes, and which has positive effects on their levels of knowledge and motivation (Birinci, 2008; Tezci and Gürol, 2002; quoted by Arpa, 2010). "PBL is an approach which has the potential to tranform teaching from a boring and passive learning into a process in which learners become actively busy with materials and which results in deeper learning (Hong, Yam & Rossini, 2010). It is a student-centred, comprehensive approach in which students perform a series of cooperation, investigation and questioning in order to solve an original, real problem; answer a meaningful and important question; learn knowledge, skills, attitudes and scientific concepts, and in which they share the results obtained in the form of oral presentations or written reports with others" (Blumenfeld et al., 1991; Krajcik, Czerniak & Berger, 1999; Thomas, 2000; quoted by Temel, Yılmaz, Oskay, Dinçol, 2014). "These projects give learners the opportunity to work relatively autonomously over extended periods of time. Projects may last several weeks or as an evolving activity they may be completed within an academic year or two" (Mioduser & Betzer, 2008; quoted by Rauscher, 2012).

Teachers' use of the educational technologies actively in their classes is closely related with their perception of their self-efficacy in whether or not using those technologies (Albion, 1999; Ertmer, Conklin, Lewandowski, Osika, Selo, Wignall, 2003; Niederhauser and Perkmen, 2010; Andersen, Groulx and Maninger, 2011). Studies conducted in this respect demonstrate that teachers' self-efficacy belief affects their in-class practices closely, and that teachers with strong self-efficacy beliefs are more eager in terms of education (Gibson and Dembo, 1984; Schunk, 1985; Tuckman and Sexton, 1990; Quoted by Akkoyunlu, Orhan and Umay, 2005).

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*Research Focus*

On reviewing the literature concerning the issue, a research study conducted by Yanpar Yelken (2009)- where the effects of creativity-based material development in groups on prospective teachers' portfolios were analysed - was found; and in that research two groups developing materials on creativity basis in groups and individually were compared in the Instructional Technologies and Materials Design course. Significant differences were found between the two groups in portfolio scores in favour of the group performing creativity-based material development activities in groups. The prospective teachers were found to have performed more creative, more authentic and more amusing work when they worked in groups; and they also had higher perceptions of achievement.

In Yılmaz (2006), the effects of project-based learning on students' achievement, on their levels of creativity and on their attitudes towards classes were studied; and it was found that project-based learning approach had positive effects on students' achievement, on their levels of creativity and on their attitudes towards classes. Frank et al (2003) suggest that employing the project-based teaching approach in teaching the Instructional Technologies course to the prospective teachers would be more beneficial in preparing them to their professional life ( quoted by Rauscher, 2012). In a similar vein, Asan (2002) asked the prospective teachers in the Instructional Technologies and Materials Development course to prepare a computer project that they could use in their classes. In consequence of this cooperative practice, the prospective teachers had the opportunity to implement the theoretical knowledge, and thus they began to display a more positive approach towards the use of technology in their classes.

Tinnerman (2008) concludes that individuals with high levels of computational and technological self-efficacy are more eager and more successful in distance education applications. Similarly, internet self-efficacy influences learners' research strategies and the internet assisted applications in web-based environments. It was found that students with higher internet self-efficacy could do better research and were more successful in applications in internet assisted classes (Özyalçın Oskay, 2011).

*Problem of Research*

The research problem was specified as "to what extent are prospective chemistry teachers' perceptions of skills in instructional technologies and creativity fostering teaching styles predictive of their achievement in the Instructional Technologies and Materials course which is performed through project-based teaching method?"

The sub-problems are:

1. At what levels are the prospective teachers' views of creativity fostering in-class behaviours?
2. At what levels are the prospective teachers' perceptions on their technology skills?

## Methodology of Research

*General Background of Research*

The research was performed in the "Instructional Technologies and Materials Development" classes in 14 weeks in a 2014-2015 fall semester.

The prospective teachers were instructed on the basic concepts of instructional technologies and materials development, the historical process, teaching materials, types of materials, the principles of material design and preparation, how to use the materials in classes through

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teaching methods and techniques, material evaluation, and the application stages of the project-based teaching model for the first 3 weeks within the scope of the course. The "Creativity Fostering Teacher Index Scale" was implemented so as to obtain the prospective teachers' views of in-class behaviours supporting creativity, and the "Application-based Instructional Technologies and Material Design Skills Scale" was implemented in order to obtain their perceptions of technological skills.

- In week four, groups of three were formed and the working calendar was set. The prospective teachers were free in terms of the type of materials they would prepare.
- In week five, they collected data from the internet sources and from the printed sources, and had an idea about materials.
- In week six, they exchanged their ideas on materials, eliminated some of the ideas, and decided on the ultimate materials.
- In week seven, they again searched for the sources on the type of materials they had chosen to prepare, and thus they found out the necessary knowledge, the aids and materials necessary in the design process, the probabilities of design and the costs.
- In week eight, they made decisions on at what grade level, in what subject, for what gains, how and when to use the materials to be prepared.
- Weeks nine and ten were devoted to the preparation and the trial of the materials.
- In weeks eleven, twelve, thirteen and fourteen, the groups presented their materials in class, and their materials were evaluated. In this process, the lecturer of the course functioned as a guide, observed the process, and offered help when the need was felt.

The prospective teachers' achievement was assessed in the form of both process evaluation and product evaluation in the research. In the process of project-based learning, the prospective teachers evaluated their team mates in terms of the tasks they fulfilled at the stages of the project and in terms of their performances. In determining their achievement, both their performances in the process of the project were taken into consideration and the suitability of their materials to the goals and the gains of the course, to the grade level they planned to implement their materials were evaluated; the lesson plans they prepared were checked, and the suitability of the materials to the principles of material design and preparation was also taken into consideration.

**Table1. Some examples for the projects prepared in the instructional technologies and material design course conducted in project-based teaching method.**

| | The Topic of the Project | Type of Material |
|---|---|---|
| 5th Group | Making a thermometer with materials to be used at home | Model |
| 8th Group | Examples for describing the experiment conditions using an overhead projector when it is not possible to do an experiment or a computer is not available. Explanation of the experiment set-up through different acetate using techniques. | Acetate |
| 10th Group | An adaptation of daily used cardboard group games into chemistry | Game |
| 12th Group | Designing a separating funnel using a serum bottle, a serum hose. | Model |
| 3rd Group | Designing a computer game in relation to the nomenclature of elements and compounds | Computer assisted material |
| 7th Group | A three-dimensional design of the soap molecule, and removing the dirt | Model |

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*Sample of Research*

45 4th grade students attending Hacettepe University, Faculty of Education, and taking the Instructional Technology and Material Development course participated in the research.

*Instrument and Procedures*

The data collection instruments, used in the research, are as in the following:

*Creativity Fostering Teacher Index Scale:*

The Teachers Index Scale Supporting Creativity, which was developed by Soh (2000) in order to measure prospective teachers' in-class behaviours fostering their creativity and which was adapted into Turkish by Dikici (2013), was employed in this research. The Likert type scale was composed of 33 items and 9 sub-dimensions. The Cronbach alpha coefficient for all of the 33 items was found to be .94 in the reliability analysis. The sub-dimensions of the scale are: independence ( α=0.94), integrating ( α=0.67), motivating ( α=0.77), judging ( α=0.62), flexibility( α=0.69), evaluating ( α=0.57), questioning ( α=0.71), providing opportunities ( α=0.64), and disappointment ( α=0.75). The scores in the 1-10 interval mean "not creative" in the scale. The scores in the 11-15 interval mean "partly creative", the scores in the 16-20 interval mean "moderately creative", and the scores in the 21-25 interval mean "very creative".

*Application Based Instructional Technology and Material Design Skills Scale:*

The 46-item Application Based Instructional Technology and Material Design Skills Scale, developed by Akgül (2010) in order to obtain prospective teachers' perceptions of technological skills, was used in the research. The participating prospective teachers specified the extent to which they possessed each efficacy included in the scale ( as 4- I definitely possess it, 3- I possess, 2- I am indecisive whether I possess it or not, and 1- I do not possess it). The Alpha reliability coefficient was found as .96 for the scale (Varank and Ergün, 2008).

*Data Analysis*

Descriptive statistics method was used to determine the prospective teachers' views of their in-class behaviours fostering their creativity and to determine their perceptions of technological skills; whereas the multiple regression analysis was used in order to determine the extent to prospective teachers creativity fostering behaviours and their perceptions on their technology skills together predict their achievement in the Instructional Technologies and Materials course which was performed through project-based teaching method.

## Results of Research

The descriptive statistics was performed for each sub-dimension so as to analyse the research question "1. At what levels are the prospective teachers' views of creativity fostering in-class behaviours?" The results are shown in Table 2.

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**Table 2. The descriptive statistical results for the sub-dimensions of creativity fostering teacher index scale.**

| | N | Minimum | Maximum | Mean | SD |
|---|---|---|---|---|---|
| Independence | 45 | 7.00 | 10.00 | 8.84 | .8779 |
| Integrating | 45 | 15.00 | 20.00 | 18.4667 | 1.61808 |
| Motivating | 45 | 7.00 | 15.00 | 13.5111 | 1.77895 |
| Judging | 45 | 14.00 | 20.00 | 18.1778 | 1.76183 |
| Flexibility | 45 | 9.00 | 15.00 | 12.6000 | 1.68415 |
| Evaluating | 45 | 9.00 | 15.00 | 12.6000 | 1.68415 |
| Questioning | 45 | 12.00 | 20.00 | 18.4667 | 1.73991 |
| Providing Opportunities | 45 | 12.00 | 20.00 | 18.2222 | 1.86948 |
| Disappointment | 45 | 15.00 | 25.00 | 23.4667 | 2.25227 |
| Total | 45 | 74 | 181.00 | 150.3778 | 22.46036 |

On examining the descriptive statistical results for the sub-dimensions of the Creativity Fostering Teacher Index Scale, it was found that the prospective teachers were not creative on the independence sub-dimension; that they were partly creative on the motivating, flexibility and evaluating sub-dimensions, that they were moderately creative on the integrating, questioning, providing opportunities and judging sub-dimensions; and that they were very creative on the disappointment sub-dimension. On considering the overall scale, however, the prospective teachers were found to have in-class behaviours supporting creativity above the moderate level.

- The descriptive statistics was performed for the items in the scale so as to analyse the research question "At what levels are the prospective teachers' perceptions on their technology skills?" The results are shown in Table 3.

**Table 3. The descriptive statistical results for application based instructional technology and material design skills scale.**

| | N | Minimum | Maximum | Mean | SD |
|---|---|---|---|---|---|
| Perceptions of Skills in Instructional Technologies | 45 | 74.00 | 181.00 | 150.3778 | 22.46036 |

On examining the descriptive statistical results for the application-based instructional technologies and material design skills scale, it was found that the prospective teachers' perceptions of skills in instructional technologies were quite high (x=150.3778). (The maximum score receivable from the scale was 184).

The multiple regression analysis was performed in order to analyse the research question "to what extent are prospective chemistry teachers' perceptions of skills in instructional technologies and creativity fostering teaching styles predictive of their achievement in the Instructional Technologies and Materials course which is performed through project-based teaching method?"

The prospective teachers' achievement in the Instructional Technology and Material Design course is the dependent variable while their perceptions of their technology skills and creativity fostering behaviours are the independent variables. The perceptions of technology skills and creativity fostering behaviours account for 25% of the achievement in the Instructional Technology and Material Development course ($R^2$= .247). The regression analysis performed

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for the dependent variable and for the estimated variables are statistically significant (F=6.889, p=.003).

## Discussion

On examining the sub-dimensions of the teachers index scale supporting creativity which was implemented so as to measure the prospective teachers' in-class behaviours fostering their creativity, it was found that:

They were not creative on the "independence" sub-dimension, that is to say, they were not creative in asking their students open-ended questions to answer and in encouraging them to demonstrate what they had learnt;

They were partly creative in stressing the importance of learning the basic knowledge and skills, in encouraging the learners to think, in providing them with opportunities to judge themselves- in other words, on the sub-dimensions of "motivating", "flexibility", and "evaluating";

They were moderately creative in terms of sharing the learners' ideas and recommendations, listening to their ideas and questions, and encouraging them to do different things- that is to say, on the sub-dimensions of "integrating", "questioning", "providing opportunities" and "judging".

They were very creative in helping the learners to learn from their mistakes, encouraging the learners suffering from failure to find ways of solution, and in offering support to the learners experiencing disappointment- that is to say, on the sub-dimension of "disappointment". On taking the overall scale into consideration, however, it was found that the prospective teachers generally had in-class behaviours supporting creativity above the moderate level. Sungur (1997) also believes that the teachers who attach importance to the learners' freedom, who consider individual differences, who encourage the learners are the creative teachers.

Besides, it was also found that the prospective teachers' perceptions of skills in instructional technologies were quite high (X=150.3778). Their perceptions of their skills in teaching styles and instructional technologies supporting creativity altogether accounted for 25% of the achievement in the Instructional Technologies and Materials Development course (R2= .247 ). In the same vein, Wang, Shannon and Ross (2013) also found that the students with high self-efficacy in using online technology in classes had higher levels of achievement. According to Sawyer (2004), working in groups brings diverse perspectives together, and thus leads to creativity. When teachers have creative view of teaching, they can form cooperative groups and can obtain more fruitful results.

## Conclusions

In the light of the results obtained in this research, some conclusions were reached. The Instructional Technologies and Material Development course has vital importance for prospective teachers, and is necessary for them. The course should be designed in a way as to reflect today's conception of education and as to introduce prospective teachers to such characteristics as creativity and high order thinking skills and as to develop those characteristics. Because process evaluation in addition to product evaluation gained importance in the 21st century, cooperative teaching approaches to develop such abilities as planning, organising, evaluating the data, hypothesising and making choices should be employed in that course.

Prospective teachers should prepare materials both manually and on computers. While assessing prospective teachers' work, the lecturers of the course should evaluate them on the basis of their performance and of their gains from the course. The students should also be provided with the opportunity to evaluate their partners in their groups. This study is limited with 45 prospective teachers. Further research with more sample size can be done.

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***Özge Özyalçin Oskay*** PhD., Associate Professor, Hacettepe University, Faculty of Education, Department of Chemistry Education, Beytepe Ankara/Turkey.
E-mail: ozge@hacettepe.edu.tr