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CREATIVE THINKING SKILLS ANALYZES OF VOCATIONAL HIGH SCHOOL STUDENTS

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Abstract
Creativity consists of flexible, fluent, unique and unordinary thinking in different situations. In educational systems, one of the most important skills which students should gain is creative thinking. In this study, "creativity scale" (7 items) which is developed by Hu and Adey (2002) and adapted to Turkish is applied to 59 Vocational High School Students, 9-10-11th grade level students. When we compare students' GPA scores and responses of creativity scale of first 4 items in the way of fluency and unique, the results are supported by researches which say there is positive but limited association between students' academic successes and creativity. Other 3 items responses differences are more than related researches. Thus we can say this result is supported by literature which says the knowledge is necessary but not enough for creative thinking. On the other hand, students being teenager and having much more knowledge and much more experiences causes to have much more mental images related creativity scale items and many difference responses.

Key Words: Science education, creative thinking, vocational high school learners.

INTRODUCTION

Creativity consists of flexible, fluent, unique and unordinary thinking in different situations. Senemoğlu (2013) defines authenticity as giving unique responses; flexibility as ability of adapting to changing conditions; and fluency as quick sequencing of ideas. According to Sternberg and Lubart (1996), creativity refers to the capacity of coping with a given problem in authentic ways. Such capacity is about looking at a specific situation and problem from different perspectives. Creativity is beyond creating out of nothing since a new idea or though is often a variation version of an older thought or a combination of thoughts known or possessed previously. Thus, creativity can be defined as synthesizing previous thoughts and redefining previous thoughts (Bessis 1973). Creativity is a basic skill included in all aspects of human beings' life and evolution of human beings (San 1985). According to Torrance (1974: 8), creativity is "being sensitive to problems, insufficiencies, shortage of information, nonexistent elements, and noncompatibility; identifying challenges, seeking for solutions, estimation and hypothesizing or modifying hypothesises in relation with insufficiencies, selecting and trying one of the solutions, retrial, and drawing conclusions accordingly" (cited by Aslan 2001). Seeking an answer for "What's creativity?", Repucci found around 50-60 definitions in the literature in early 1960's (Parkhaust, 1999: 2). Özden (1993) points out that creativity is among innate characteristics, not learnt. Since it does not refer to acquired behaviours, it is much easier to see creativity among children. Children unconsciously possess the willpower to create. Namely, their imagination, feelings and thoughts unite with natural motivation, and children express their ideas freely in this way.

Research on creativity shows that almost all children possess creative thinking skill at different levels. It is easier to observe creative skills in young children; however, it disappears eventually as creative thinking is not reinforced or hindered with comments like "Why don't you do the right?", "Don't be silly!" or "How on earth do you do that like this?" Creativity can be understood different from its basic meaning as thinking from different aspects. It is also related with thinking differently from others and creating instead of necessarily creating out of nothing.

Treffinger (1996) summarized in five headings the approaches placing the concept of creativity into its current place in literature.

1. Rational Approach: It stresses creativity as a mental and cognitive action. In this approach, creativity is not considered as a mysterious and unusual phenomenon. Rather, they regard it as a way of individuals' using their mind in an authentic and efficient manner. In this context, it is a variation of thinking, reasoning, integrating or solving problems.

2. Personality and Traits: In the survey implemented by Berkley Institute of Personality Assessment and Research (IPAR), creative people's decisive personality traits were determined. The pairs which are and are not highly creativity in a sample group of artists, scientists, and writers. In the survey, the data comprised of theories regarding classical personality theories and psychoanalytic interpretations were used.

3. Social and interpersonal factors: These factors include values, role definitions and expectations, norms, definitions of creative expression to be supported or not to be supported by using rewards and approval. It refers to contextual/environmental factors developing or obstructing creativity from environmental, anthropological and sociological perspective.

4. Lifestyle: This approach is built on applying creativity in daily life departing from creative persons' lifestyles. Creativity is defined as personal completion, realizing oneself, positive identity-image or personal growth.

5. Illogical nature: Neuropsychology, biochemistry and other disciplines investigate interactions of biological, physical and psychological factors and take creativity as perceiving the world differently, processing inputs differently or functioning as an authentic system (cited by Aslan, 2001: 21).

Besides such unclear definitions in the science world, Graham Wallas (1926) found 4 stages in his research on "Creative thinking process".

a) *Preparation*: The individual is introduced to and learns a problem at this stage. At this stage, the relation between hypothesis and theorems is studied concerning the problem. The individual first reviews previous studies. In this way, s/he learns from observations of her/himself or others.
b) *Incubation:* Mechanically, it follows the preparation stage. New synthesis and views are put forward at this stage due to the lack of conscious control. Some authentic ideas can emerge as distance to rational thinking increases. According to Yıldırım, this stage can be too short or long. Human brain may not establish all connections with a subject instantly. The brain works even if thoughts are interrupted, we sleep or forget. Rather, the interrupting observation thought and experiences might contribute to emerging of the thought. The incubation period can even be more fruitful if attention is paid to other things from time to time.
c) *Illumination:* The solution rises in the mind all of a sudden. During this stage, it is typical that the individual finds the solution suddenly as a consequence of synthesizing the information in preceding stage.
d) *Verification*: This is a conscious and rational period. Faults of solutions reached at previous stage are eliminated. Also accurate aspects are reviewed (Starko 2001, cited by Demirci, 2007: 66).

Intelligence and creativity have always been regarded distinct from each other especially in the context of artistic creation. The proposition "*A person is talented even though s/he is not very intelligent*" implies that cognitive characteristics that are not verbal or mathematical are regarded inferior to intelligence as "talent" (Kırışoğlu, 1991). Getzels and Csikszentmihalyi (1972) argue that intelligence and creativity represent separate processes and creative efforts in separate areas might require intelligence at differing levels. For instance, a creative artist does not need high intelligence, but a Nobel-winner physician definitely does (Sternberg and

O'Hara, 1999). A certain level of intelligence is a prerequisite for creativity; however, an individual highly creative in any area may not be motivated by a high level of ordinary intelligence. At the same time, a very high level of intelligence may not include creativity at the same level. There are individuals who are both highly intelligent and creative; however, it cannot be generalized. It is a fact that electronic brains are not capable of imitating even the simplest competences concerning affective domain, which is not defined as a supreme mental activity and recently despised in contemporary approach. Machines do the same transactions as school children are asked to do at school. To put it another way, electronic brains are successful in all domains on which education system is focused. It is concluded that creativity is dominant over all systems of rationalism and conceptual thinking. Owing to visible achievements of rationalism and requirements of the era, schools, which had the minimum goal of teaching how to read-write by the 19th century, placed increasingly more emphasis on teaching arithmetic and conceptual thinking (San, 1979a).

Creativity draws new relationships between experience and knowledge. It also proposes new solutions for problems. On the other hand, Bailin (1988) thinks that creativity can be out of question if the product was not established strongly on the past. Some source framework has to exist and such sources should have correspondence with the past. As one makes some innovations, s/he should establish connections with what was done before. It is obvious that we cannot keep up with such a rapidly and constantly changing age by thinking within predetermined categories and classifications. New thinking schemes and classifications emerge rapidly and new information is produced. In an era of change with many temporary constructs, it is a must to give training in a way to enlighten the interaction between different groups of information (San 1979b). Creativity is not necessarily possessed by individuals that are regarded intellectual, know every subject in depth, and can do quick mathematical operations. Still, lacking knowledge about the subject might be limiting for scientific creativity.

Creative Individuals' Characteristics

One can identify creative people with behaviours peculiar to them in their community if s/he observes diligently. Characteristics of such people include showing tolerance to tidiness; enjoying thrills; being so friendly; thinking of others; being aware of the existence of others; surprising others by doing something all the time; showing interest in what's complex and mysterious; enjoying coping with hard tasks; being shy to the outer world; always giving constructive feedback; being brave; wanting what's excellent; being determined; having a different hierarchy than others; being disturbed by excessive orderliness; having control over where they are; being sentimental and sensitive; finding mistakes in everything; not being afraid of thinking differently from others; believing beauty is what's extraordinary; being so curious; having inner piece; enjoying being on their own; having strong intuitions in making decisions; being hardworking, spending time on extraordinary activities, lacking business skills, accepting their mistakes, having unusual habits; having constantly preoccupied brains; preferring complex thoughts; suspecting and inquiring; favouring fundamental changes; being open to external stimuli; being open to others' opinions; refusing suppressing their desires; refusing also being suppressed; being starters; being aware of themselves; being self-content; being self-sufficient; having a high sense of humour; being sensitive to what's beautiful; remaining distant from power (authority); being sincere; dealing with trivial details; struggling for distant goals; having sensitive enthusiasm; being careful; being indifferent to power and authority; being pure and simple; not accepting what others say without investigating; producing charming but unpractical opinions; being versatile; being willing to take risk; and speaking less (Torrance 1962). Bowden (1994) suggested some other characteristics which link bipolar psychiatric disorders with creativity to guide future research and reflect causal relations: associating several concepts expanded across a large area, speed, determination, energy increase, decrease of sleep, focusing on oneself explicitly and increased sexual desire.

It is as difficult to give definitions as measuring creativity of individuals. Most scientists developed "Creative Thought Tests" assuming that they measure creativity. Cropley (2000), Fishkin and Johnson (1998) and Kirshcenbaum (1998) developed their own taxonomy in an attempt to measure creativity.

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Table 1: Classification of Creativity by Researchers

Kirshcenbaum (1998)	Fishkin and Johnson (1998)	Cropley (2000)
• Associating • Moral Feeling • Interest • Fantasy (imagination) • • • • Creative connections • Inspiration • Product • • Verification	• Process, divergent thinking • Personality, Expressing oneself, Perceiving oneself/attitude • Personality, (Explaining oneself), Biography/ Interest • Personality, (to be reported by others), Personality attitude/Biography • Products Incubation period • Pressure (situations) • Compound measuring • Alternative measuring • Personality or Attitude • Indirect relationship in creativity • Ability • Visual and practical arts • Decision-making systems, classification	• Product • Process • Motivation • Personality/ Skills

From the three classifications above, it can be concluded that creativity is multidimensional rather than unidimensional and linked with many psychological structures, and a good consideration requires proper measurement devices (Tekindal, 2009: 113).

The measurement devices which are still popular and contemporary in science world include;
1. Scientific creativity test; Developed by Hu and Adey (2002), the test shows dimensions of the scientific creativity in Figure 1. In this model, creativity is dynamic and has three dimensions. Its dimensions are product, process and trait. Dimension of product has sub-dimensions of technical product, scientific knowledge, scientific phenomenon and scientific problem. Process is comprised of sub-dimensions as thinking and imagining. Lastly, property has sub-dimensions of fluency, flexibility and originality. The model constitutes the theoretical infrastructure for measuring of scientific creativity and consists of 24 (2x3x4=24) cells (Balım and Çeliker 2012). The products to be obtained as a conclusion of scientific creative thinking need to be technical ones, put forth scientific information, be related with a scientific phenomenon and be designed for solving a scientific problem (Atasoy, Kadayıfçı and Akkuş, 2007; Hu and Adey, 2002).

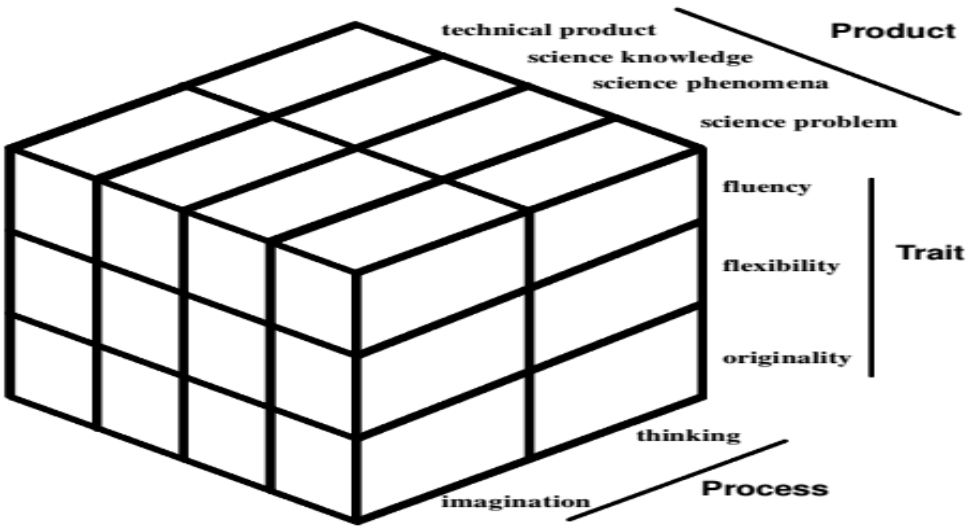

Figure 1. The Scientific Structure Creativity Model (SSCM).

2. *Creative thinking test*; Developed by Torrance in 1974. Though preliminary research started in 1958 yılında, Minnesota University stated between 1958 and 1966 that the test can be used for various age groups, professions and education levels. During those studies, challenges were faced in relation with (1) validity of the creative thought test (2) the relationship of intelligence with creativity (3) the relationship of creative thought with academic success, and (4) improving creative development with special training experiences. The test which was developed in 1966 included 10 tests in total "Seven in verbal part and three in formal part". Later in 1984, streamline scoring system and standard score and norm table were added to the test (Aslan, 2001).

3. *Creativity Assessment Packet*; It was developed by Frank E. Williams in 1980. This scale is a pencil-paper scale used for measuring creativity of individuals aged 6–18. It can be administered in groups. The Creativity Assessment Packet is comprised of three sections as "Test of Divergent Thinking", "Test of Divergent Feeling", and "Williams model" to show how children's creativity is perceived by their parents and teachers. The test is based on the Williams model and assesses the following cognitive-intellectual modes; fluent thinking, flexible thinking, original thinking and elaborative thinking. This scale is easy to implement but difficult to grade and requires specialized labor especially for grading. "The affective-feeling domains are examined: risk taking, complexity, curiosity and imagination. Scoring criteria and examples are provided as well as a rationale for each domain in the Divergent Thinking Test. For the Divergent Feeling Test, objective scoring is accomplished by the use of two templates. Test of Divergent Thinking consists of two parallel norms as A and B, and subtests of Fluency, Flexibility, Originality, and elaboration thinking" (Shaughnessy, 1995, 9).

METHOD

Quantitative research method was used in this study. Study data were analysed with "One-Group Post-test Only Design".

Population and Study Sample

The study was implemented in order to investigate creativity of students. Sample selection was made with convenience sampling. As a result, 59 students participated in the study. The participants attended İ. POLAR Ege Seramik Anatolian Technical High School in İzmir Kemalpaşa District during 2013-2014 academic years.

Data Collection Instrument

Hu and Adey's The Scientific Creativity Test was used for collecting data in this study. The test was adapted to Turkish by Çeliker & Balım. In calculating originality score of the first four items in the scale, of all responses, those listed in the 5 % were given 2 points, 5-10 % were given 1 point, and the others were given 0 point. In evaluation of the item 5, the respondents listed in 5 % were given 3 points; 5-10 % was given 2 points, while the others were 1 point. As for item 6, the respondents in 5 % were graded with 4 points, 5-10 % was 2 points, and others were given 0 point. Under item 7, the participants' responses were obtained, but no grading was made due to the small number of respondents.

FINDINGS

Below are listed frequencies of answers given by students for each question. Question 1: "Please specify below in what scientific ways a piece of glass can be used. Example; making an experiment tube" (cited by Çeliker and Balım 2012).

Question 2: "If you could travel to another planet on a space ship, what scientific questions would you study? Please write as many questions as possible concerning such planet considering things you wonder. For instance, for the question if there are any creatures living on that planet, the answers are given with frequencies in Table 2.

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Table 1: Frequency Analysis

Originality score	Answers and frequencies
0	Window (26), Glasses (26)
1	Automotive glass (22), Glass (19), Mirror (14), Lamp (13),
2	Bottle (12), Jar (11), Place (9), Vase (9), Aquarium (9), Frame (8), Television (7), Jug (6), Microscope (5), Clock (5), Door (5), Decoration object (5), Chandelier (4), Table (4), Telescope (3), Cupboards (3), Focusing glass (3), Enlarging lens (3), Solar energy panel (2), Pipe (2), Shop window (2), Flower pot (2), Boron glass (2), Lighter, (2), Pen (1) Dustbin (1), Cap (1), Gas lamp (1), Lens (1), Key chain(1), Shower cabin (1), Coffee table (1), Pencil case (1)

Table 2: Frequency Analysis of Question 2

Originality score	Answers and Frequencies
0	Is there life on the planet? (34), Is there water on the planet? (21)
1	Is there air on the planet? (11), Is there gravity on the planet? (11), Is there nature on the planet? (9), What do the live creatures look like? (8),
2	What do they live on? (6), Do they speak as we do? (6), What is the soil like on that planet? (6), How long is the life period? (3), What are the climates like? (3), How many planets are there? (3), Are there human beings on the planet? (3), Is it a developed planet? (3), Do they grow fruit and vegetables? (3), How far is it from the Sun? (3), Have they got houses? (2), What are the geographical formations like? (2), Are they happy with their lives? (1), Do they wish to visit the Earth? (1), What do they think about humans? (1), Do they breathe? (1), What is the planet made up of? (1), Is there an end to the universe? (1), How is the time calculated? (1), How do they receive training? (1), How was the planet formed? (1), What colour is the sky? (1), How many degrees is the temperature? (1)

Question 3: "If you could turn an ordinary bicycle into an interesting, useful and beautiful object, what would you do? Please specify. Example, "I would make flashing wheels to be noticed in dark". The responses are given in Table 3.

Table 3: Frequency Analysis of Question 3

Originality score	Answers and Frequencies
0	I would put light (23),
1	I would put an engine (10), I would assemble a horn (9), I would fix an umbrella for rainy weather (8), I would put an accumulator (7),
2	Auto cruiser without pedalling when tired (5), I would fix a loudspeaker (4), I would paint it in flashing colour (4), I would make the buffers bigger (3), I would make holeproof wheels (3), I would annex a signal arm (3), I would put a seat (3), I would put thicker tyres (3), I would assemble a TV and radio (3), I would make the seat more comfortable (3), If it runs into an object, it would detect it and stop (2), I would assemble a navigation device (2), I would place an airbag (2), I would fix 3 wheels (2), I would make a flying bike (2), I would make it automatic (gear) (2), I would fix a basket (2), I would assemble a car's steering wheel (2), It would go in the water (2), It would slow down automatically when it accelerates excessively (1), I would make it lighter (1), I would put light working with kinaesthetic energy (1), I would make a jumping tyre (1), I would make a jumping seat (1), Flat tyre would repair itself (1), I would assemble an air-conditioner (1), I would assemble an alarm (1), I would put an electrical mirror (1), I would put caps onto wheel rims (1), There would be just one wheel (1), I would put a tent to break the wind (1)

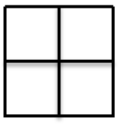
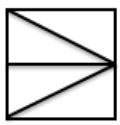
Question 4: "What do you think would happen on the Earth if there weren't gravity? Example: "People would be flying in the air". Frequencies are given in Table 4.

Table 4: Frequency Analysis of Question 4

Originality score	Answers and Frequencies
0	Everything would be flying in the air (25), There would be no life (17),
1	Humans couldn't travel (9), We couldn't eat (9), Houses would fly (6),
2	Cars would fly (5), We couldn't drink water properly (5), Trees would fly in the air (5), All waters of the Earth would fly (5), Transportation would be easier (3), There would be no environmental problems (3), Objects would crash with people (2), We couldn't pour liquid into glass (2), We couldn't do sports (1), We couldn't sleep (1), There would be more inventions (1), Animals would fly in the sky (1), Humans would not get older (1), Transportation would be hard (1), Trees wouldn't have fruits (1), We couldn't write (1), Breathing would be difficult (1), We wouldn't be buried in the soil (1), Things wouldn't stay in their places (1), There wouldn't be climate events (1)

Question 5: "How many different methods maximum can you use for dividing a square into four equal pieces? Please specify drawing below." Students' answers are given in Table 5.

Table 5: Frequency Analysis of Question 5

							
Frequency	48	45	38	34	3	3	3
Originality score	1	1	1	1	2	2	2

Question 6: "If you were given two types of napkins, how would you test to see which one is better? Please list all probable methods, tools and procedures you can mention with a simple language." Answers are displayed in Table 6.

Table 6: Frequency Analysis of Question 6

Originality score	Answers and Frequencies
0	I would test with water (36), I would check which one is softer (10), I would check plies (10).
2	I would check its roller (9), I would check its thickness (9), I would check its endurance by pulling (6),
4	I would smell it (3), I would check its size (3), I would compare their weight (2), I would stick it into tables and put a ball to check its tearing (1), I would wrinkle like a ball and measure its radius (1), I would place a piece of ice and see which one is of poor quality according to the one which falls first (1), I would toss them and measure lengths of falling time (1), I would tear it in pieces and count (1), I would rub them (1), I would use as handkerchief (1)

Question 7: "Please design an apple picking machine. Draw the machine and specify name and function of each part"**.** Examples of students' drawings are revealed in Figure 2. It was observed that the students designed apparatus similar to vacuum cleaner, human arm (robot), sticks for falling apples and other devices for shaking the trees. It can be said that the students designed the apple picking machine by using flexibility property of realia. It can be argued that drawings besides verbal answers allow observing creativity more clearly.

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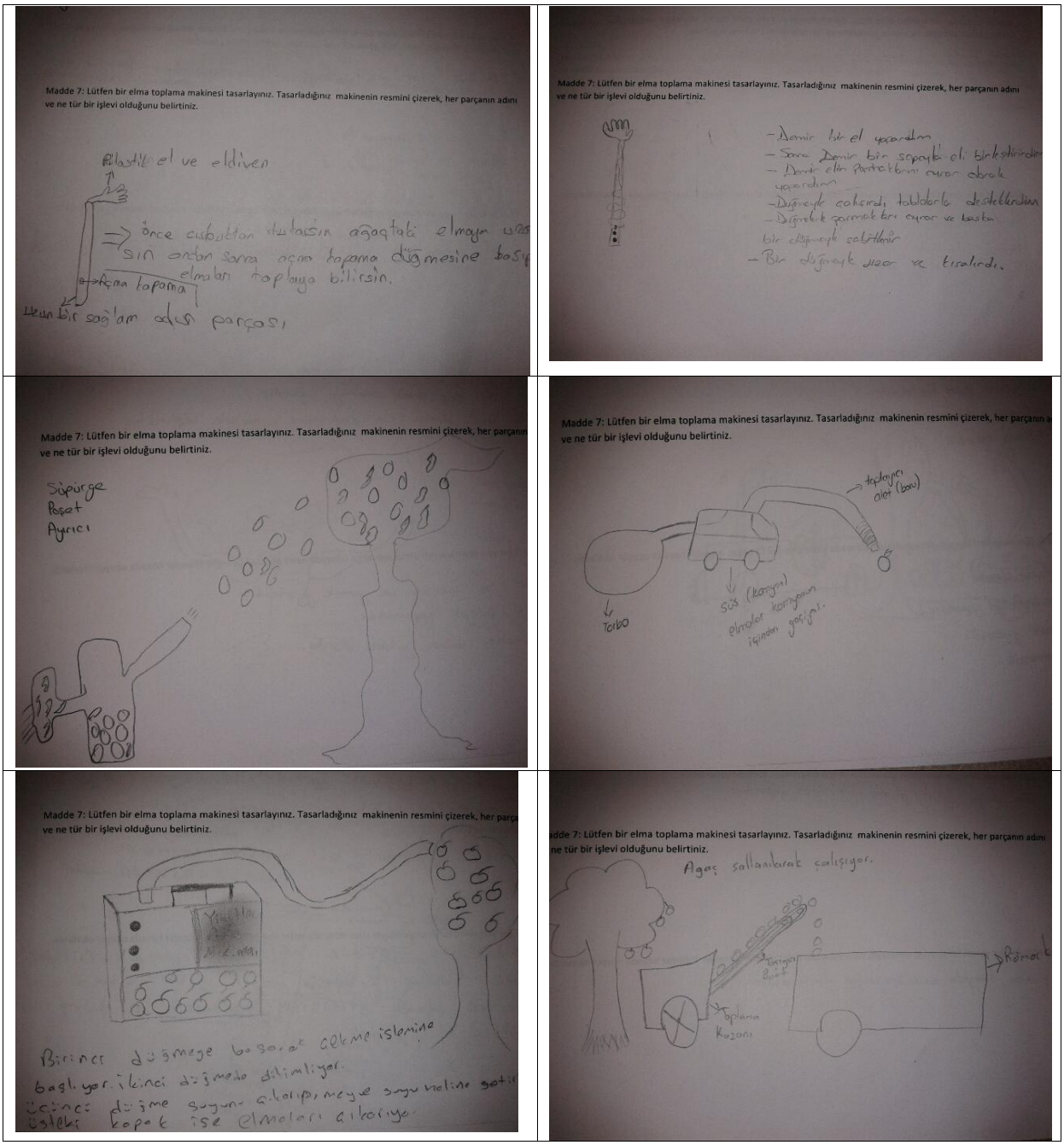

Picture 1: Machines that draw students to Question 7

DISCUSSION AND CONCLUSION

It seems that administering Hu and Adey's scientific creativity test (2002) is easier than administering the other creativity tests. Since it is impractical to produce a product by using pen and paper, the test's capacity to measure all dimensions is limited. Comparison of previous academic success of participant students with fluency and authenticity of their answers seems to support the argument that there is a positive still weak relationship between academic success and creativity. On the other hand, it is obvious that variety of students' responses is high. It might support the literature in that knowledge is necessary but not sufficient for creativity. It is one of the main objectives of science education to support scientific creativity. To this end, the creativity

tests can be applied more times. As a result, testing and using of the creativity tests may provide concrete contribution for reaching to goals.

Electrical appliances, transport and communication means, pieces of art, books, programs, foods and even most laws are products of human creativity. Doubtlessly, production and exportation as fundamentals of a developing economy can also be improved thanks to creativity. Failure to bring up individuals who are able to think creatively causes using of many innovations in technology, law, sociology and many other fields by derivation, which in turn results in inability to produce required solutions satisfactorily.

The path taken in traditional education is alien to the society, technology, and innovations. Moreover, stereotyped questions and knowledge affect students' creativity negatively. Taking into consideration that only those who are good at mathematical operations can achieve in university entrance exams, many individuals are lost despite their potentials in various fields. Consequently, teachers should create a learning environment where students can feel and produce authentic ideas in order to develop creativity at school (Demirci, 2007).

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