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A Study Of Scientific Creativity Test For Secondary School Students

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Abstract: A test for Scientific Creativity was formed and tested on secondary school students in this study. Hu and Adey (2002) created a Scientific Creativity Structure Model (SCSM) by examining what Scientific Creativity involves, as stated in various research papers. This model was tried out in China with fifty science teachers. Using their analysis, observations, and experience with the Torrance tests, a 7-item scale to measure the scientific creativity of secondary students was designed and validated with data from 160 students based in England. Analyses were made on each item to evaluate how well different groups did, if items consistently measured the same thing, whether scorers rated the same way, and if the questions were appropriate and aligned with the construct being measured. Analyses demonstrated that the results are trustworthy. The test by Hu and Adey (2002) was adapted, replacing apple with mango in the seventh question of the test. The test of Hu and Adey (2002) was used in the Bilaspur district of Chhattisgarh state. After thoroughly understanding the SCSM of Hu and Adey (2002), a model of 24 cells and a formula of 24 cells were designed.

Keywords: Scientific Creativity, Secondary School Students.

INTRODUCTION

The paper will explain how to develop an assessment tool for scientific creativity. There is not much research on the scientific creativity of secondary students, even though some is available for scientists. Because scientific creativity is believed to be important in secondary education, it would be useful to have a tool that can measure scientific creativity for both guiding learning and assessing outcomes. Regular creativity tests are not enough to measure scientific creativity. Being knowledgeable was previously discussed by Findlay and Lumsden (1988) and Mumford et al. (1991) as having an organized set of information that helps a person respond with ease and efficiency to problems or creative challenges. Approximately everybody agrees that domain-specific knowledge and skills form a main part of being creative. Both Alexander (1992) and Amabile (1987) point out that specialized knowledge and skills in particular fields help promote creative thinking. Other researchers (Albert 1983, Gardner 1983, Feldman 1986) have also pointed out that creativity operates differently in each creative field. According to Barron and Harrington (1981), it is mostly the domain-specific variations of divergent thinking that influence how productive we are in creative tasks.

The nature of scientific creativity

Weisberg (1999) claimed that the process of creativity unfolds through a sequence of incremental advancements, wherein initial concepts are adjusted and expanded upon. The essence of creativity manifests when an individual encounters additional challenges, prompting them to refine and elaborate on previously developed solutions. (Torrance, 1978) defined creativity as “the process of sensing gaps or disturbing missing elements and communicating the result, possibly modifying and retesting the hypothesis”. Creativity can be understood as a cognitive and reactive process that entails drawing upon past experiences, engaging with stimuli, and producing at least one novel combination. Scholars concur that creativity encompasses the generation of valuable new concepts and products, the capacity for curiosity, problem-solving skills, an awareness of the surrounding environment, the pursuit of solutions, and the ability to engage in critical thinking.

When we consider scientific products, we can distinguish between technical products, advances in scientific knowledge, understanding of scientific phenomena, and scientific problem-solving. Cattell (1971) argued that problem solving does not mean solving routine problems using a recipe but finding the answers to new problems. Lubart (1994) pointed out that problem solving can lead to creativity because if a problem exists, then there is the possibility of a creative solution. Sensitivity to science problems is also considered a component dimension of scientific creativity. Ochse (1990) argued that sensitivity to problems is an important feature of the creative process. Einstein and Infield (1938) suggested that the formulation of a problem is often more important than its solution, which may be a matter of mathematical or experimental skill. Products provide us with the second dimension of our model.

Einstein argued that language, as it is written or spoken, did not seem to play a significant role in his mechanism of thought. He referred rather to psychical signs and more or less clear images which seemed to be voluntarily reproduced and combined (Einstein 1952: 43). This role of imagination is also supported by psychologists (Gardner 1983, Johnson-Laird 1987). This suggests a distinction between creative imagination and creative thinking, and this is built into the third process dimension of our model. The three-dimensional Scientific Structure Creativity Model (SSCM), which arises from this analysis, is shown in Figure 1. Research into scientific creativity and the cultivation of scientific creativity may be based on. In summary, and the light of the exploration of creativity in the literature, we define scientific creativity as a kind of intellectual trait or ability producing or potentially producing a certain product that is original and has social or personal value, designed with a certain purpose in mind, using given information. This definition may be elaborated with a set of hypotheses about the structure of scientific creativity: (1) Scientific creativity is different from other creativity since it is concerned with creative science experiments, creative scientific problem finding and solving, and creative science activity. (2) Scientific creativity is a kind of ability. The structure of scientific creativity itself does not include non-intellectual factors, although non-intellectual factors may influence scientific creativity. (3) Scientific creativity must depend on scientific knowledge and skills. (4) Scientific creativity should be a combination of static structure and developmental structure. The adolescent and the mature scientist have the same basic mental structure of scientific creativity, but that of the latter is more developed. (5) Creativity and analytical intelligence are two different factors of a singular function originating from mental ability.

Importance of Scientific Creativity

Scientific creativity is very important for spurring new innovations, findings and technology. It enables scientists to think of new theories, arrange specific experiments and invent answers for tough challenges. If creativity were missing, science would get stuck, using only what is already known and not advancing any further. They (Root-Bernstein et al., 1995) suggest that science creativity involves both thinking up various options and narrowing them down until the best option emerges which is important for making important discoveries. Einstein’s proposal of the theory of relativity illustrates well the importance of considering scenarios beyond testing which is at the heart of creative thinking in science.

Moreover, according to Feist’s (1998) research, creativity in science is not limited to imagining new ideas; it also requires consideration of their contribution and usefulness, thus making scientific creativity different from artistic creativity. This combined need for creativity and effectiveness in science makes science progress. Promoting scientific creativity in schools has been linked to making solving problems easier and knowing science principles better. According to Kind and Kind (2007), encouraging creativity in science helps produce more inspired and creative scientists.

Brief descriptions of the Scientific Creativity Test

The scientific creativity test was prepared by Hu and Adey (2002), named the Scientific Structure Creativity Model (SSCM), and adapted after checking the reliability and validity. The model has three dynamic dimensions: product, trait, and process. The product dimension contains technical products, science knowledge, science phenomena, and science problems; while the trait dimension contains fluency, flexibility, and originality; and the process dimension contains thinking and imagination.

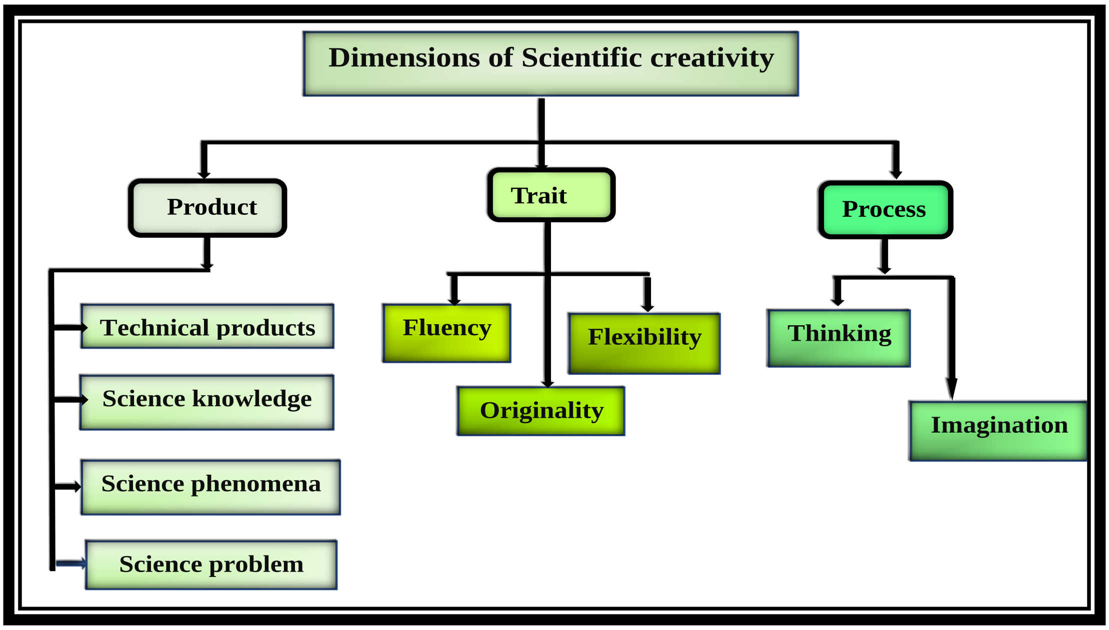

Fig. 1. Dimensions of Scientific Creativity

Product

1. Technical Product (TP)

The first is technical creativity, where people create new theories, technologies, or ideas. This is the type of creativity. The second is artistic creativity, which is more born of skill, technique, and self-expression.

2. Science Knowledge (SK)

Science is the pursuit and application of knowledge and understanding of the natural and social world following a systematic methodology based on evidence. Scientific knowledge allows one to develop new technologies, solve practical problems, and make informed decisions.

3. Science Phenomena (SPh)

Natural phenomena are observable events that occur in the universe and one can use his/her science. knowledge to explain or predict. The goal of building knowledge in science is to develop general ideas, based on evidence, that can explain and predict phenomena. Examples like sunrise, fog, thunder, weather, and tornadoes; decomposition, germination biological processes, wave propagation, physical processes, erosion; tidal flow, and natural disasters such as earthquakes, electromagnetic pulses, and volcanic eruptions.

4. Science Problem (SPr)

A scientific problem is something that is misunderstood but experiments can be done for bestr understanding. Scientific problems are usually based on the observation of scientific phenomena. By designing one's experiment, scientific problems can be identified and addressed.

Trait

1. Fluency(F)

Fluency means the number of original ideas produced, that is that **how fast** a person gets thought to solve a problem, and how fast and independently he can express his thoughts. Its components are thoughts that come into the mind, thoughts conservation, and speed, etc. Fluency in thoughts explains a person's creativity (Sharma et al., 2022), and the ability to produce a large figure of ideas. The number of relevant ideas; shows an ability to produce several figural images (Hee Kim, 2006).

2. Flexibility (Fx)

Flexibility is the ability to change tack. It is the ability to approach a situation differently and develop different solutions regarding the problem. It allows the children to experiment with their ideas, developing their creativity by allowing them to make mistakes so that their skills can be unleashed and develop a sense of wonder (Sharma et al., 2022). Flexibility is the ability to produce a variety of ideas, shift from one approach to another, or use a variety of strategies.

3. Originality (O)

Originality is a must for a thing to be created through creativity. Innovation and uniqueness that are found in the answers are viewed as a basis of originality (Sharma et al., 2022).

Process

1. Thinking (Th)

Cognition, commonly referred to as thinking, encompasses the capacity to process information, maintain focus, store and recall memories, and choose suitable responses and actions. Creative thinking specifically pertains to the ability to generate innovative and original solutions. Also known as creative problem-solving, creative thinking is a valuable and marketable soft skill in a wide variety of careers. To think like a scientist, one must ask questions, make detailed observations, develop a hypothesis, and find answers using tests, and question answers. Thinking creatively makes a better problem-solver.

2. Imagination (I)

Creativity is commonly referred to as the ability to invent something real using the imagination. Whereas imagination is the capability to create in one's mind what does not exist. Imagination is a prerequisite for creativity, whereas creativity does not necessarily lead to imagination. Having an imagination is the ability of the mind to be creative and resourceful. Creativity is children's unique response to all that they see, hear, feel, and experience. A child's individual responses to materials, experiences, and ideas inspire their creativity and imagination. For example, when a person contemplates the smell and taste of a lemon without either seeing or tasting the fruit, he or she is engaging in imagination.

The Three-Dimensional Scientific Structure Creativity Model (SSCM)

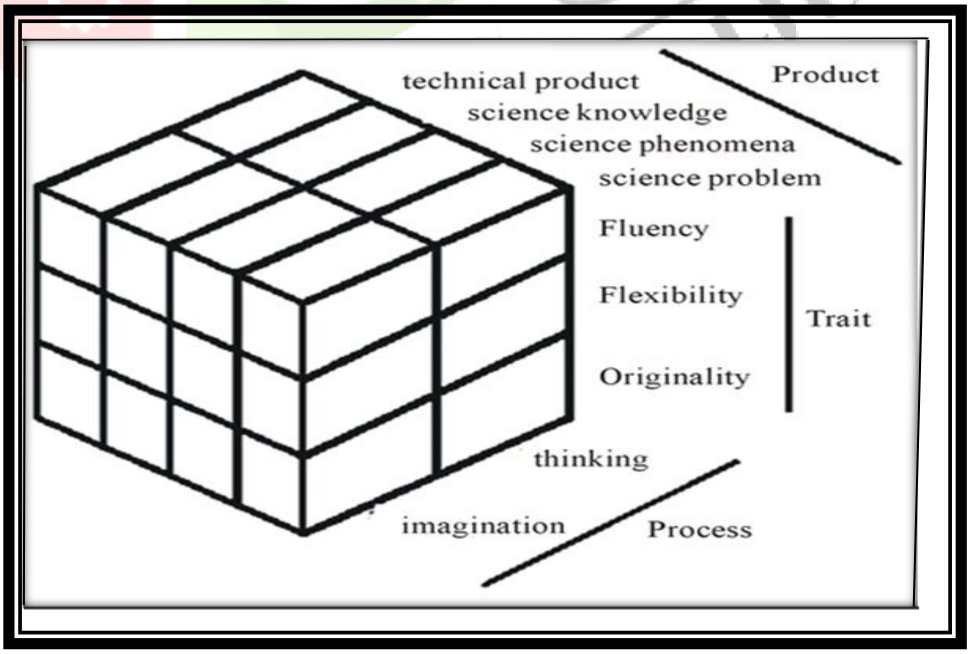

Fig. 2. The Scientific Structure Creativity Model (SSCM) Source: Hu and Adey (2002)

1. **Product** ⟶ 1. Technical Product (TP), 2. Science Knowledge (SK), 3. Science Phenomena (SPh), 4. Science Problem (SPr).
2. **Trait** ⟶ 1. Fluency(F), 2. Flexibility (Fx), 3. Originality (O).
3. **Process** ⟶ 1. Thinking (Th), 2. Imagination (I).

- **Product x Trait ⟶ Product.Trait = 12 cells**
- **Product.Trait x Process ⟶ Product.Trait.Process =24 cells**

The following questions were designed by Hu and Adey (2002) in order to measure the combination of attributes in the Scientific Structure Creativity Model (SSCM).

1. Please write down as many as possible scientific uses as you can for a piece of glass.
2. If you can take a spaceship to travel in outer space and go to a planet, what scientific questions do you want to research? Please list as many as you can.
3. Please consider as many possible improvements as possible to a regular bicycle, making it more interesting, useful, and beautiful.
4. Suppose there was no gravity, Describe what the world would be like.
5. Please divide a square into four equal sections of the same shape using as many different techniques as you can.
6. There are two kinds of napkins. How can you test which is better? Please write down as many possible methods as you can and the instruments, principles, and simple procedures.
7. Please design an apple-picking machine. Draw a picture, and point out the name and function of each part.

These scientific creativity questions measure more than one dimension of the Scientific Structure Creativity Model (SSCM). Each dimension is associated with different sub-attributes among the 24 attribute combinations.

Adapted Version of Scientific Structure Creativity Model (SSCM)

The adapted version of the model consisted of 7 items. The step followed for adapting Hu and Adey (2002) test in order to measure the combination of attributes in the Scientific Structure Creativity Model (SSCM) are as follows:

Step I: Forward Translation

The original standardized Scientific Structure Creativity Model (SSCM) developed by Hu and Adey (2002) consisted of 07 items and was in English. During the first step of adaptation, all the 07 statements were typed in English by the researcher and sent to an expert for translation of these statements into the Hindi version, having knowledge of both English and Hindi language and is also well aware of the psycho-socio context of the study area. While translating the original English version of the scientific creativity to the target language (Hindi), the expert ensured not only linguistic fidelity but also captured the psycho-social relevance of the content.

Step II: Backward Translation

During the second step, the researcher again nicely typed the first draft of the translated Hindi version of the test and handed it to another expert having knowledge of both English and Hindi and also well aware of the psycho-social context of the study area to translate the test from Hindi to English. The main purpose of the backward translation was to validate the accuracy of the forward translation by getting an external linguistic expert who was not involved with the original translation. Backward translation is a method of cross-checking to ensure that the original meaning and intent of the original test was maintained in the translation.

For example, Item 1- Please write down as many possible scientific uses as you can for a piece of glass that measures all three dimensions. This question forces students to plan and carry out a scientific investigation. Therefore, this task is associated with firstly science knowledge in the Product dimension, secondly, fluency, flexibility, and originality in the Trait dimension, and third, thinking in the Process dimension.

The description of each item included in the Scientific Structure Creativity Model (SSCM) are as under:

Item 1: Please write down as many as possible scientific uses as you can for a piece of glass. For example, make a test tube.

The goal of this assignment is to assess your ability to use an object for a scientific purpose with fluency, flexibility, and creativity. This encompasses three of the 24 cells in SSCM: thinking (in the process dimension), fluency, flexibility, creativity (in the trait dimension), and scientific knowledge (in the product dimension).

Item 2: If you can take a spaceship to travel outer space and go to a planet, what scientific questions do you want to research?

The objective of this second task is to assess the level of awareness regarding scientific issues. Evaluation criteria include fluency, flexibility, and originality. In the context of SSCM, this encompasses the dimensions of problem fluency, flexibility, and the originality of thought and imagination, resulting in a total of six evaluative categories.

Item 3: Please think up as many possible improvements as you can to a regular bicycle, making it more interesting, more useful, and more beautiful. For example, make the tires reflective, so they can be seen in the dark.

This task aims to evaluate students' capacity to innovate upon a technical product. In this study, we selected the bicycle as a focal point due to its familiarity among secondary school students and its embodiment of numerous scientific concepts. The assessment of this item encompasses criteria such as fluency, flexibility, and originality. The framework includes six categories: technical product, fluency, flexibility, originality, and the dimensions of thinking and imagination.

Item 4: Suppose there was no gravity, describe what the world would be like. For example, human beings would be floating.

This exercise aims to evaluate students' scientific creativity. It can also serve to assess their fluency, flexibility, and originality. SSCM cells: phenomenon x fluency, flexibility, originality x imagination, three cells.

Item 5: Please use as many possible methods as you can divide a square into four equal pieces (the same shape). Draw it on the answer sheet.

This task is intended to assess creative problem-solving skills in a scientific context. SSCM cells: problem x flexibility and originality x thinking and imagination, four cells.

Item 6: There are two kinds of napkins. How can you test which is better? Please write down as many possible methods as you can and the instruments, principles, and simple procedures.

This assignment is designed to evaluate one's capacity for creative experimentation. Items 6 and 7 are linked to authentic scientific creative endeavors, enabling students to generate genuine scientific outputs. We employ such tasks because the application of real-world problems demonstrates a more robust correlation with various areas of creative performance (Okuda et al. 1991). SSCM: phenomena x flexibility and originality x thinking, resulting in two components.

Item 7: Please design a mango-picking machine. Draw a picture, and point out the name and function of each part (*Apple in Scientific Creativity Test (SCT) replaced with Mango).

The purpose of the seventh assignment is to assess the capacity to build creative science products. SSCM: four cells: technical product x adaptability and uniqueness x creativity and imagination. It will be observed that not all of the SSCM's cells are depicted. It was impossible to write items like the science knowledge x imagination cells within the constraints of a high school paper-and-pencil test.

The three-dimensional model of scientific creativity is described under 24 cells

1. TP X F=TP.F X Th=TP.F.Th — Technical Product (TP) . Fluency(F). Thinking (Th)
2. TP X Fx=TP.Fx X Th=TP.Fx.Th — Technical Product (TP) .Flexibility (Fx). Thinking (Th)
3. TP X O=TP.O X Th=TP.O.Th — Technical Product (TP) .Originality (O). Thinking (Th) — Item 3
4. TP X F=TP.F X I=TP.F.I — Technical Product (TP) . Fluency(F). Imagination (I)
5. TP X Fx=TP.Fx X I=TP.Fx.I — Technical Product (TP) .Flexibility (Fx). Imagination (I) — Item 7
6. TP X O=TP.O X I=TP.O.I — Technical Product (TP) .Originality (O). Imagination (I)

7. SK X F=SK.F X Th=SK.F.Th — Science Knowledge (SK) . Fluency(F). Thinking (Th) → Item 1
8. SK X Fx=SK.Fx X Th=SK.Fx.Th — Science Knowledge (SK) . Flexibility (Fx). Thinking (Th) → Item 1
9. SK X O=SK.O X Th=SK.O.Th — Science Knowledge (SK) . Originality (O). Thinking (Th) → Item 1
10. SK X F=SK.F X I=SK.F.I — Science Knowledge (SK) . Fluency(F). Imagination (I)
11. SK X Fx=SK.Fx X I=SK.Fx.I — Science Knowledge (SK) . Flexibility (Fx). Imagination (I)
12. SK X O=SK.O X I=SK.O.I — Science Knowledge (SK) . Originality (O). Imagination (I)

13. SPh X F=SPh.F X Th=SPh.F.Th — Science Phenomena (SPh) . Fluency(F). Thinking (Th)
14. SPh X Fx=SPh.FxXTh=SPh.Fx.Th — Science Phenomena (SPh) . Flexibility (Fx).Thinking (Th) → Item 6
15. SPh X O=SPh.O X Th=SPh.O.Th — Science Phenomena (SPh) . Originality (O). Thinking (Th) → Item 6
16. SPh X F=SPh.F X I=SPh.F.I — Science Phenomena (SPh) . Fluency(F). Imagination (I) → Item 4
17. SPh X Fx=SPh.Fx X I=SPh.Fx.I — Science Phenomena (SPh) . Flexibility (Fx). Imagination (I) → Item 4
18. SPh X O=SPh.O X I=SPh.O.I — Science Phenomena (SPh) . Originality (O). Imagination (I) → Item 4

19. SPr X F=SPrF X Th=SPr.F.Th — Science Problem (SPr) . Fluency(F). Thinking (Th)
20. SPr X Fx=SPr.Fx X Th=SPr.Fx.Th — Science Problem (SPr) . Flexibility (Fx). Thinking (Th) — Item 2
21. SPr X O=SPr.O X Th=SPr.O.Th — Science Problem (SPr) . Originality (O). Thinking (Th)
22. SPr X F=SPr.F X I=SPr.F.I — Science Problem (SPr) . Fluency(F). Imagination (I) — Item 5
23. SPr X Fx=SPr.Fx X I=SPr.Fx.I — Science Problem (SPr) . Flexibility (Fx). Imagination (I)
24. SPr X O=SPr.O X I=SPr.O.I — Science Problem (SPr) . Originality (O). Imagination (I)

The three-dimensional model of scientific creativity is described under 24 cells, categorized into seven items.

ITEM 01

1. Science Knowledge (SK) . Fluency(F). Thinking (Th)
2. Science Knowledge (SK) . Flexibility (Fx). Thinking (Th)
3. Science Knowledge (SK) . Originality (O). Thinking (Th)

ITEM 02

1. Science Problem (SPr) . Fluency(F). Thinking (Th)
2. Science Problem (SPr) . Flexibility (Fx). Thinking (Th)
3. Science Problem (SPr) . Originality (O). Thinking (Th)
4. Science Problem (SPr) . Fluency(F). Imagination (I)
5. Science Problem (SPr) . Flexibility (Fx). Imagination (I)
6. Science Problem (SPr) . Originality (O). Imagination (I

ITEM 03

1. Technical Product (TP) . Fluency(F). Thinking (Th)
2. Technical Product (TP) .Flexibility (Fx). Thinking (Th)
3. Technical Product (TP) .Originality (O). Thinking (Th)
4. Technical Product (TP) . Fluency(F). Imagination (I)
5. Technical Product (TP) .Flexibility (Fx). Imagination (I)
6. Technical Product (TP) .Originality (O). Imagination (I)

ITEM 04

1. Science Phenomena (SPh) . Fluency(F). Imagination (I)
2. Science Phenomena (SPh) . Flexibility (Fx). Imagination (I)
3. Science Phenomena (SPh) . Originality (O). Imagination (I)

ITEM 05

1. Science Problem (SPr) . Flexibility (Fx). Thinking (Th)
2. Science Problem (SPr) . Originality (O). Thinking (Th)
3. Science Problem (SPr) . Flexibility (Fx). Imagination (I)
4. Science Problem (SPr) . Originality (O). Imagination (I)

ITEM 06

1. Science Phenomena (SPh) . Flexibility (Fx).Thinking (Th)
2. Science Phenomena (SPh) . Originality (O). Thinking (Th)

ITEM 07

1. Technical Product (TP) .Flexibility (Fx). Thinking (Th)
2. Technical Product (TP) .Originality (O). Thinking (Th)
3. Technical Product (TP) .Flexibility (Fx). Imagination (I)
4. Technical Product (TP) .Originality (O). Imagination (I)

THREE-DIMENSIONAL SCIENTIFIC STRUCTURE OF CREATIVITY MODEL (SSCM)

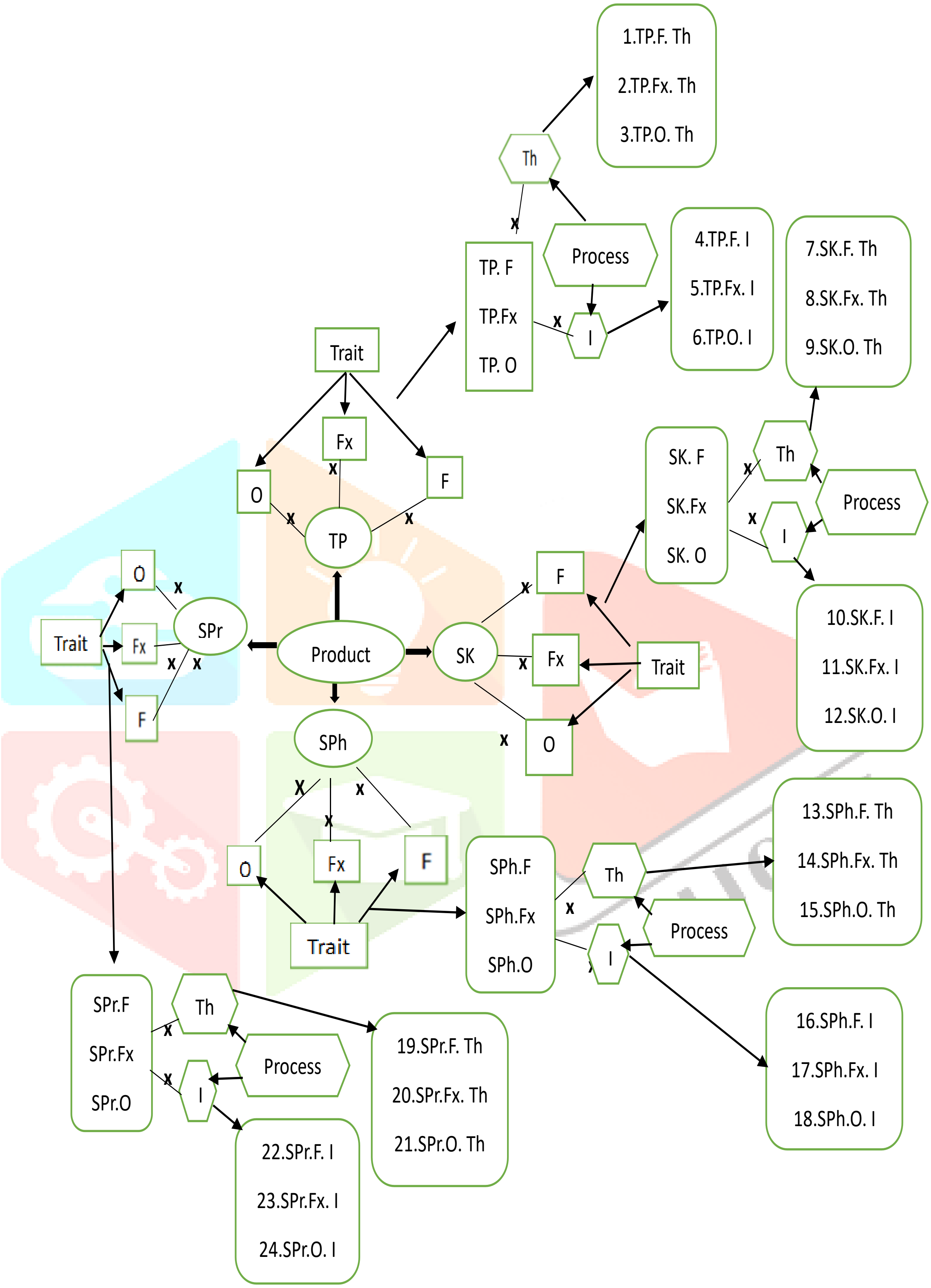

Fig. 3: 24 Cells of Scientific Structure Creativity Model (SSCM).

Scoring Procedure of Scientific Creativity

The **Scientific Structure Creativity Model (SSCM)** measures the product (science, technical product, science problem, science phenomenon), process (thinking, imagining), and character/trait (originality, flexibility, fluency). The criteria given below were for the scoring of the items.

Table 1.*Scoring Procedure of Scientific Structure Creativity Model (SSCM)*

Questions	Types	Formula design	Cells
First question	Different, unusual uses	SK.F.Fx.O. Th	3
Second question	Discovering and finding the problem	SPr.F.Fx.O.Th. I	6
Third question	Product development	TP.F.Fx.O.Th.I	6
Fourth question	Scientific imagination	SPh.F.Fx.O.I	3
Fifth question	Problem-solving	SPr.Fx.O.Th.I	4
Sixth question	It includes a science experiment	SPh.Fx.O.Th.	2
Seventh question	Product design	TP.Fx.O.Th.I	4

The scores for tasks 1 through 4 are derived from the total of the fluency score, flexibility score, and originality score. The fluency score was calculated by tallying all individual responses provided by the participants, without regard to their quality. The flexibility score for each task was determined by counting the various approaches or domains utilized in the responses. The originality score was established through a compilation of the frequency of all responses collected. Frequencies and percentages for each response were subsequently calculated. 2 points were given if the probability of response was found less than 5%, 1 point was given if the probability response was between 5 to 10%, no point (0 points) was given if the probability of a response could be greater than 10%.

Table 2. The Scores of Tasks 1 to 4

S.N.	F	Fx	O	FREQUENCY	%	05%< =02	05%to10%= 01	10%> =0	F+Fx+O=Total
Total									

The score for task/item 5 was initially determined by compiling the responses from all participants and subsequently evaluating each specific answer based on its rarity. Answers with a probability of less than 5% are awarded 3 points; those with probabilities ranging from 5% to 10% receive 2 points; and answers with probabilities exceeding 10% are assigned 1 point. Each method of division in task 5 yields a single score. Most students typically achieve scores of 3 or 4 points, while some may attain between 20 and 30 points. It is generally unlikely for a participant to receive a score of 0 points, as there are 3 or 4 relatively straightforward divisions.

Table 3. The score of task/ item 5

S.N.	O	FREQUENCY	%	05%< =03	05%to 10%=02	10%> =1	Total
Total							

The score for task six is derived from the combination of the flexibility score and the originality score. The flexibility score can reach a maximum of 9 points, allocated as follows: 3 points for the instrument, 3 points for the principle, and 3 points for the procedure, contingent upon the correctness of the method. The originality score is calculated similarly to previous tasks: a method that occurs less than 5% of the time earns 4 points; a method with a frequency between 5% and 10% receives 2 points; and a method that appears more than 10% scores 0 points. This task employs a different scoring system due to the increased difficulty students faced in designing an original method for testing napkins compared to generating original answers in tasks 1 through *4.*

Table 4. The score of tasks six

S.N.	Fx =9 Ins=3, prin=3, pro=3	O	FREQUENCY	%	05%< =04	05%to 10%=02	10%> =0	Fx+O =Total
Total								

The evaluation of task seven was determined by the operational capabilities of the machine. Specific functions of the picking machine encompass locating the mangoes, retrieving them, transporting them to the ground, sorting them, placing them into containers, and proceeding to the subsequent tree. Each of these functions was assigned a score of 3 points. In terms of originality, a score ranging from 1 to 5 points was awarded based on a comprehensive assessment of the overall impression after reviewing all other submissions.

Table 5. The score of task seven

S.N.	Functions of the machine (each function 03 points). According to the originality, we give a score of 1-5 points based on an overall impression. Reaching the mangoes, finding the mangoes, picking the mangoes, transporting the mangoes to the ground, sorting out the mangoes, putting the mangoes in containers, and moving on to the next tree.
Total	

Summary and Further Work

The findings in this document are an attempt to establish and confirm an assessment for creativity, focused on secondary school students, so that scientists working in the field can do more research. The questionnaire used comprising 7 items was formulated according to a Scientific Creativity Structure Model, which was based on existing concepts about what scientific creativity is. Results showed that the questions were internally consistent, scorers agreed on scores and the scale was valid for its purpose. The group of students was compared for their age and the degree of science knowledge they demonstrated. This means that using this measure could correctly assess the creativity of students in secondary schools. More efforts are still needed to ensure that the test is correctly validated. How reliable the test is over time should be evaluated. Also, it would be helpful to assess connections between this assessment and other evaluations of creativity, as well those used in general testing. Perhaps the most important factor is that the test has to show that predictions are accurate. To develop this assessment, Hu and Adey (2002) began by sending a questionnaire to both Chinese and English science education researchers and teachers, but only English students were part of the actual study. Researchers should, therefore, use bigger samples that represent many cultural backgrounds in the future. The test was found to have the proper qualities of both reliability and validity. The modified assessment used by Liao, Suriano, and Yu (2004) replaced 'apple' in the seventh question with 'mango'. This test was run in the Bilaspur district of Chhattisgarh. Once I had fully studied Hu and Adey's SSS model (2002), I put together a model of 24 cells and formulated a corresponding formula. We nevertheless think that the tool in this document could be helpful for researchers studying, for example, factors influencing students' scientific creativity and programs aimed at raising students' scientific creativity.

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