Journal of Education and Practice
ISSN 2222-1735 (Paper) ISSN 2222-288X (Online)
Vol.6, No.17, 2015

Perspectives of Science Teacher Candidates Regarding Scientific Creativity and Critical Thinking

Dr. Sibel Demir (Corresponding Author)
Ondokuz Mayıs University, Science Teaching Department, Samsun/Turkey
Tel: 0362 445 90 90

Abstract
This Study Was Performed With The Participation Of 31 Science Teacher Candidates In Their Second Year Of Higher Education, Enrolled In The Science Education Department Of A University In Turkey. During The Study, The Teacher Candidates Were Asked Two Open-Ended Questions. The Validity Of These Questions Developed Specifically For This Study Was Evaluated By Two Expert Researchers. The Aim Of The Study Was To Determine How Science Teacher Candidates Viewed The Concepts Of Scientific Creativity And Critical Thinking. The Results Of This Study Indicated That The Science Teacher Candidates Did Not Have An In-Depth Understanding Or Interpretation Of The Concept Of Scientific Creativity, And That Their Knowledge Of Critical Thinking Was Correct, Yet Insufficient.
Key Words: Science Teacher Candidates, Scientific Creativity, Scientific Thinking, Originality, Fluency, Flexibility.

Introduction

Creative Thinking And Critical Thinking Are Two Higher Thinking Skills That Support One Another. In The Present Age Of Innovation, Individuals With Strong Creative And Critical Thinking Skills Are In High Demand In All Sectors. Critical Thinking Not Only Allows Individuals To Gain A Deeper Insight And Understanding Of Events, But Also Enables To See Them More Accurately, Openly, Comprehensively, And Rationally (Nosich, 2012). In The Mental Model He Developed, Guilford (1967) Distinguished Convergent Thinking From Divergent Thinking, And Emphasized The Importance Of Divergent Thinking In The Development Of Creative Thinking (Lee And Therriault, 2013). According To Özden (2011), Critical Thinking Is An Active And Organized Mental Process That Aims To Understand The Events, Situations, And Thoughts In Our Surrounding World, As Well As Our Own Person, By Taking Into Account Our Own Thoughts And The Thoughts Of The Persons With Whom We Interact. Critical And Creative Thinking Are Skills That Involve Producing Or Selecting Ideas Based On Information/Knowledge And Logic (Carroll, 2013). Critical Thinking Is More Associated With Rational And Conscious Processes, While Creative Thinking Tends To Be Associated With Irrational Or Unconscious Processes (Alghafri And Bin Ismail, 2014). Scientific Creativity Is A Higher Skill That Has A Significant Effect On The Innovative Approaches Of Individuals. In Contrast To General Creativity, Scientific Creativity Is Strongly Associated With Scientific Knowledge, Scientific Skills, And Scientific Attitudes (Jo, 2009). Park (2011) Describes That Scientific Creativity Consists Of Three Dimensions, Which Are Creative Thinking, Scientific Knowledge, And Scientific Inquiry. Hu And Adey (2002) Previously Developed A "Scientific Creativity Model" For Field-Specific Creativity, Which Consists Of The Following Dimensions: Fluency, Flexibility, Originality, Imagination, Thinking, Scientific Knowledge, Scientific Problem, Scientific Fact, And Technical Product. Within The Frame Of Scientific Creativity, "Fluency Can Be Defined As The Collection Of All Ideas That Are Scientifically Correct; Flexibility Can Be Defined As Fluent Thoughts Formed In Different Areas And With Different Approaches; And Originality Can Be Defined As Fluent Ideas That Are Present At A Certain Percentage/Ratio Within The Relevant Group" (Demir, 2014).

Teachers Who Can Think Creatively And Critically Based On A Scientific Perspective, And Who Can See Events From Different Angles Occupy An Important Place In Education. Training Science Teachers Who Have Creative And Critical Thinking, As Well As A Scientific Perspective, Is Particularly Important For Raising Future Generations Who Also Possess These Thinking Skills. For This Reason, We Believe That It Is Particularly Important To Assess And Determine The Level Of Scientific Creativity And Critical Thinking Among Science Teacher Candidates.

In This Context, The Aim Of This Study Was To Determine How Science Teacher Candidates Assessed Their Own Level Of Scientific Creativity And Critical Thinking.

Methods

This Study Was Performed With 22 Science Teacher Candidates In Their Second Year Of Higher Education, Attending The Science Education Department Of A University In Turkey. In This Study, The 22 Science Teacher Candidates Were Asked Two Open-Ended Questions, Which Were, "*What Does The Concept Of Scientific Creativity Mean For You*?" And, "*What Does The Concept Of Critical Thinking Mean For You*?" Qualitative Data Obtained With The Open-Ended Questions Were Classified According To Predefined Codes And Themes, And The Data Were Interpreted Based On The Number Of Times The Codes Were Repeated. The Validity Of These Questions Developed For This Study Was Evaluated By Two Expert Researchers.

Results

Data Obtained In This Study Were Organized And Presented In Tables. Table 1 And Table 2 Show The Frequency Of The Themes And Codes Identified In The Qualitative Data Obtained From The Teacher Candidates.

Table 1. The Themes And Codes Of The Definitions Of Scientific Creativity Provided By The Teacher Candidates

Scientific Creativity Themes	Codes	N
Originality	Originality	3
	Difference/Innovation	9
Scientific Knowledge	Science/Scientific Thinking	12
	Scientific Knowledge	2
	Knowledge	1
Flexibility	In-Depth/Detailed Examination	1
	Making Associations With Other Ideas	0
Fluency	Producing Numerous Ideas	0
	Producing Ideas/Thoughts	5
Product	Making Inventions	1
	Designing	3
	Products	4
Imagination	Imagination	2

As Shown In Table 1, The Science Teacher Candidates Used Various Different Terms To Describe The Concept Of Scientific Creativity. It Is Was Determined That The Terms “Science/Scientific Thinking,” “Difference/Innovation,” And “Producing Ideas/Thoughts,” Were The Most Frequently Used; That The Terms “Making Associations With Other Ideas,” “Producing Numerous Ideas," “Making Inventions,” And “Performing Experiments” Were Not Used At All; And That The Terms “Originality,” “Scientific Knowledge,” “Knowledge,” “In-Depth/Detailed Examination,” “Designing,” “Product,” And “Imagination” Were Mentioned Only Occasionally.

Table 2. The Codes Of The Definitions Of Critical Thinking Provided By The Teacher Candidates.

Codes	N
Identifying Problem In An Idea	1
Accepting/Rejecting Views Based On Facts	5
Expressing A Positive/Negative View Based On Facts	1
Being Inquisitive	3
Looking At A Subject From All Angles	4
Being Objective/Impartial	5

As Shown In Table 2, The Expressions Most Commonly Mentioned By The Science Teacher Candidates Regarding The Concept Of Critical Thinking Was “Accepting/Rejecting Views Based On Facts,” “Being Objective/Impartial,” And “Looking At A Subject From All Angles.” Although These Definitions Were Correct, They Did Not Cover Or Describe All Aspects Pertaining To The Concept Of Critical Thinking.

Conclusion And Discussion

Science Applications Generally Involve Problem-Finding And Solving, As Well As The Use Of Critical Thinking To Discover And Inquire (Gomes, 2005). According To Aizikovitsh-Udi And Amit (2011), Critical Thinking Involves Questioning The Reliability Of Knowledge, Of Accepting Facts Supported By Examples From Daily Life, Rejecting Poorly-Structured Arguments, And Using Skepticism. Scientific Creativity Can Be Defined As The Use Of Scientific Perspectives To Solve Daily Problems And Satisfy Everyday Needs And Requirements (Demir, 2014). In Other Words, *Scientific Creativity Can Be Described As A Thinking Skill That Enables Individuals To Produce May Original Ideas In Different Areas By Utilizing An Interdisciplinary And Innovative Approach In Science, Technology, And Arts (Aesthetics) – Generally With The Aim Of Resolving A Particular Problem* (Demir, 2014).

An Evaluation Of The Dimensions (I.E. Themes And Codes) Expressed By The Science Teacher Candidates When Describing Concepts Of Scientific Creativity Revealed That The Most Commonly Used Terms Were “Science/Scientific Thinking,” “Difference/Innovation,” And “Producing Ideas/Thoughts;” While The Terms “Making Associations With Other Ideas,” “Producing Numerous Ideas," “Making Inventions,” And “Performing Experiments” Were Not Used At All; And The Terms “Originality,” “Scientific Knowledge,” “Knowledge,” “In-

Depth/Detailed Examination," "Designing," "Product," And "Imagination" Were Mentioned Only Occasionally. This Result Indicates That The Science Teacher Candidates Had A Rather Superficial Understanding Of The Concept Of Scientific Creativity. The Study Results Also Indicated That, When Defining The Concept Of Critical Thinking, The Expressions Most Commonly Used By The Science Teacher Candidates Were The "Expressing Positive/Negative Views Based On Facts," "Being Objective/Impartial," And "Looking At A Subject From All Angles." These Results Demonstrated That The Answers Provided By The Students Were Correct Yet Insufficient. The Students Failed To Mention Other Important Characteristics Associated With Critical Thinking, Such As The Ability To Make Detailed Observations, Careful Examination, The Ability To Identify Problems, And The Ability To Develop New Approaches/Perspectives For Solving Problems.

The Results Of This Study Indicated That The Science Teacher Candidates Did Not Have An In-Depth Understanding Or Interpretation Of The Concept Of Scientific Creativity, And That Their Knowledge Of Critical Thinking Was Correct Yet Insufficient. Science Classes Support The Development Of Scientific Creativity Among Students; As Such, Placing Further Emphasis On Creativity During These Classes Would Allow Students To Be Better Prepared For The Future (Kind And Kind, 2007). For This Reason, It Important To Evaluate And Determine The Opinions Of Science Teacher Candidates Regarding The Concepts Of Scientific Creativity And Critical Thinking. In This Context, We Believe That It Is Necessary To Conduct Further Studies Aiming To Assess And Develop/Improve The Scientific Creativity And Critical Thinking Of Science Teacher Candidates.

References

Aizikovitsh-Udi, E., & Amit, M. (2011). Developing The Skills Of Critical And Creative Thinking By Probability Teaching. *Procedia Social And Behavioral Sciences, 15*, 1087–1091.

Alghafri, A. S., & Bin Ismail, H. N. (2014). Effects Of İntegrating Creative And Critical Thinking On Schools Students' Thinking. *International Journal Of Social Science And Humanity, 4(6),* 518-525.

Carroll, J. M. (2013). *The Brutal Reality Of Bringing Kids Up To Level: Are Critical Thinking And Creativity Lost İn The World Of Standardized Testing?* Unpublished University Of New Orleans, New Orleans.

Demir, S. (2014). *Bilimsel Tartışma Ve Araştırmaya Dayalı Tasarlanan Laboratuvar Programının, Fen Bilgisi Öğretmen Adaylarının Bilimsel Yaratıcılıklarına Etkisi.* Yayınlanmamış Doktora Tezi, Marmara Üniversitesi, Eğitim Bilimleri Enstitüsü, İstanbul.

Gomes, J. (2005). *Using A Creativity-Focused Science Program To Foster General Creativity İn Young Children: A Teacher Action Research Study.* Unpublished Ed.D. Dissertation, Fielding Graduate University, United States -California.

Hu, W., & Adey, P. (2002). A Scientific Creativity Test For Secondary School Students. *International Journal Of Science Education, 24(4),* 389-403.

Jo, S. M. (2009). *A Study Of Korean Students' Creativity İn Science Using Structural Equation Modeling.* Unpublished Doctoral Dissertation, The University Of Arizona.

Kind, P., & Kind, V. (2007). Creativity İn Science Education: Perspectives And Challenges For Developing School Science. *Studies İn Science Education, 43(1),* 1-37.

Lee, C. S., & Therriault, D. (2013). The Cognitive Underpinnings Of Creative Thought: A Latent Variable Analysis Exploring The Roles Of İntelligence And Working Memory İn Three Creative Thinking Processes. *Intelligence, 41,* 306–320.

Nosich, M. G. (2012). *Eleştirel Düşünme Ve Disiplinlerarası Eleştirel Düşünme Rehberi* (B. Aybek, Çev.) Ankara: Anı Yayıncılık.

Özden, Y. (2011). *Öğrenme Ve Öğretme.* Ankara: Pegem A Akademi. 11. Baskı.

Park, J. (2011). Scientific Creativity İn Science Education. *Journal Of Baltic Science Education, 10(3),* 144-145.

-

The IISTE is a pioneer in the Open-Access hosting service and academic event management. The aim of the firm is Accelerating Global Knowledge Sharing.

More information about the firm can be found on the homepage:
http://www.iiste.org

CALL FOR JOURNAL PAPERS

There are more than 30 peer-reviewed academic journals hosted under the hosting platform.

Prospective authors of journals can find the submission instruction on the following page: http://www.iiste.org/journals/ All the journals articles are available online to the readers all over the world without financial, legal, or technical barriers other than those inseparable from gaining access to the internet itself. Paper version of the journals is also available upon request of readers and authors.

MORE RESOURCES

Book publication information: http://www.iiste.org/book/

Academic conference: http://www.iiste.org/conference/upcoming-conferences-call-for-paper/

IISTE Knowledge Sharing Partners

EBSCO, Index Copernicus, Ulrich's Periodicals Directory, JournalTOCS, PKP Open Archives Harvester, Bielefeld Academic Search Engine, Elektronische Zeitschriftenbibliothek EZB, Open J-Gate, OCLC WorldCat, Universe Digtial Library , NewJour, Google Scholar