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The Inclusion of Science Passion Criteria in Chemistry and Earth Sciences Textbooks for 10th Grade in Jordan

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Abstract

This study aims to analyse the 10th grade Chemistry and Earth Sciences textbooks, to identify the extent to which these textbooks incorporate the criteria of scientific passion, and to draw a comparison between the two textbooks. Qualitative descriptive study and content analysis methods were used. The research instrument included a special measurement tool designed by the researchers, consisting of eleven main criteria, with additional sub-indicators for each. The frequencies and percentages of each criterion were calculated. The results showed that the “Flexibility” criterion ranked first in the level of inclusion of criteria in both textbooks at 23.3% in Chemistry and 24% in Earth Sciences textbooks, followed by “motivation”, “Get involved”, The “Lifelong learning” and “Research and investigation skills” criteria, "Sharing”, “Independence" and “create positive emotion". Whereas, “Behavioural persistence and practice”, “Adventure” and “Directing goals” criteria did not exist in both textbooks.

Keywords: Inclusion, Science passion, Chemistry, Earth Sciences, 10th grade, Textbooks.

1. Introduction

Learning is not an end by itself, but it is a means of progress, development, and success. Therefore, those who have not benefited from learning have technically wasted their time, effort, and money. A person will not reap the fruits of learning unless what they learn reflects positively on their life, and they have been influenced by it, and turned their good ideas into projects, concrete realism and scientific achievements that lead them to success (Al Araify, 2010).

Furthermore, textbooks are the most important means of preserving and transmitting science among generations and have significant contributions to the emergence of young scientists. (Al Araify, 2010). Looking at passion as part of the textbook, it can be considered as learning something new and giving importance to it. It can be characterized as the constant search for the new in the quest for learning. Passion has the ability to transmit and create action. Passion is motivation, seeking the new and the willingness to learn. Passion is simply showing a strong tendency and willingness through spending time and energy on an activity that someone likes or believes that it is important (Carbonneau et al., 2008). Being passionate is closely related to learning and experiencing new ideas. Likewise, passion

is identified with hope, loyalty, care, and enthusiasm, which are key features of effective teaching (Oslon, 2003).

Curran (2015) believes that passion is a human experience without which the individual does not find meaning in his life, as that experience provides the individual with a psychological energy to participate and integrate with activities of value. More specifically, scientific passion is considered as strong tendency of the individual towards a specific activity, and there are two main components of passion, an affective component that includes the individual's intense admiration for the activity and a cognitive component that includes integrating this activity into the identity of the individual. Somewhat, it reaches to be one of the main aspects in the individual's life and identity, which results in the individual achieving a set of passionate results, the most important of which are satisfaction, integration, and happiness (Curran et al., 2015).

From this point of view, the researchers analysed 10th grade Chemistry and Earth Sciences textbooks in order to: (1) identify the extent to which those textbooks incorporate the criteria of scientific passion, (2) compare between the two books, (3) stand on the importance of these criteria in student achievement, (4) and make recommendations for standards that were ignored in these books, which have a role in increasing passion. This is reflected in the Scientific student's development of their skilful performance, motivation, and the enhancement of educational achievement. Therefore, students should be trained in both scientific thinking and scientific passion in textbooks.

Some research was conducted related to this study such as Vallerand (2012) which was aimed to show the role of passion for activities in sustainable psychological well-being. The model proposes the existence of two types of passion: harmonious and obsessive. In the field of education, most studies have focused on harmonious passion because of its benefits in education. It affects student performance, perseverance, goal guidance and a strong drive for learning (vallerand, et al., 2003).

Al-Harithi's study (2015) aimed to investigate the level of passion and happiness of high school students in Saudi Arabia, with a sample of 1,157 students. His study found that the level of both harmonious passion and happiness was high, while the level of acquisition passion was average among individual's sample study.

Additionally, Serin (2017) conducted a study about "The Role of Passion in Learning and Teaching" focusing on differences passionate teachers make and pointing out the effects of passion on effective learning and teaching. Passion has a motivating factor; therefore, it is a significant need for high quality learning and teaching. Passion is seeking for the new and experiencing new ideas. Passion is at the core of effective teaching. Passion which is indispensable for learning and teaching, facilitates learning thorough the desire and enthusiasm it creates. Passionate teachers endeavor to increase the learning potentials of their students through creating effective learning environments.

Moreover, the main aim of the Sigmudsson et al., (2020) study was to explore the associations between passion, grit, and mindset in a group of young Icelandic adults. The results indicate gender differences in associations between passion, grit, and mindset.

Whereas, Al-Jarrah (2020) study aimed to explore the relationship between academic passion and academic burnout, in light of the variables of: Gender, occupation, program and income level. The results indicated that the level of harmonious desire in the sample was high; the level of obsessive-

compulsive desire was moderate, and the level of academic burnout, whether at the total level or the at the dimensions' levels, was moderate. Moreover, there were significant differences in the level of obsessive passion, in favor of the doctoral program. The results also showed a negative relationship between the two dimensions of passion and academic burnout.

On the other hand, the Elsayed Taha (2020) study aimed to investigate the causal relationships among optimism, hope, academic passion, and academic engagement. The study found that there were statistically significant direct effects of optimism and dimension of achieving hoped goals on both dimensions of passion, and statistically significant direct effect of dimension of goals specifications on obsessive passion. There were also statistically significant direct effects of dimension of obsessive passion on three dimensions of academic engagement. Finally, there were statistically significant indirect effects of optimism on three dimensions of academic engagement through the intermediate variable academic passion (harmonious and obsessive passion).

Furthermore, the study of Sigmudsson (2021), investigate the relationship between passion, grit, and mindset across the lifespan. The eight-item Passion Scale was used to assess passion, and the Grit-S scale to assess grit. Mindset was measured with the Theories of Intelligence Scale (TIS). The scale has 8-items. The results showed that for the group as a whole there was a significant relationship between passion and grit (r = .325); passion and mindset (r= .166) and grit and mindset (r= .167).

From previous literature, researchers have noted the limited research on scientific passion. Some studies have tackled the role of passion for activities in sustainable psychological well-being (Vallerand ,2012). And some of them investigate the level of passion and happiness of high school students (Al-Harithi, 2015). Elsayed Taha (2020) investigated the causal relationships among optimism, hope, academic passion, and academic engagement. While Some of them investigate the relationship between passion, grit, and mindset (Sigmudsson 2020, 2021), However, none of the previous literature addressed the extent to which standards of scientific passion were included in textbooks.

2. Research questions

1- What are the criteria for scientific passion that should be included in the chemistry and earth sciences textbooks for the 10^{th} grade?

2- To what degree does the 10^{th} grade chemistry and earth sciences textbooks include criteria for scientific passion?

3. Methodology

Descriptive qualitative method and content analysis were used to suit the nature of the study based on the analysis of life science textbooks to determine the degree to which they include the criteria of scientific passion.

3.1 Population and sample of the study

The population consisted of Chemistry (Part II) and Earth sciences (Part1) textbooks for the 10th grade in Jordan. The paragraph was adopted as an analysis unit. Table (1) shows the distribution of chemistry (Part II) and earth sciences (part1) textbooks by number of units, chapters, and pages. And Table (2) shows the distribution of the number of pages and the number of paragraphs that have been counted and analysed in Chemistry (Part II) and Earth sciences (Part1) textbooks for the 10th basic graders.

Table (1): Distribution of 10th graders Chemistry and Earth sciences textbooks according to number of pages and codes.

Distributions of textbooks	Chemistry textbook	Earth sciences textbook
No. of codes	116	96
Number of pages	73	45

3.2 Tools of the study

The Study Tool is a special measurement tool designed by the researchers after the careful consideration of educational literature and reviewing previous studies relevant to the subject matter, in addition to other relevant literature interested in curricula and criteria for their selection and analysis. The tool consisted of eleven main criteria, each of which is derived from sub-indicators as shown in table 3. The frequencies and percentages of each criterion were calculated.

The rates of inclusion of science passion criteria were determined by consulting a group of experts in Science Education Methods from educational supervisors and science teachers. The findings represent the range of the reference ratios in the criteria. For “Research and investigation skills” and “lifelong learning” is 20-30%. In the criteria for “flexibility”, “motivation”, “Get involved”, “Sharing”, “Behavioural persistence and practice” and “Create positive emotions”, the percentage for use is 15-10%, while in the criteria of "Goal guidance" and “Independence”, the range of the reference ratio is 5-10%, and in the criteria of adventure, 1-5%.

3.3 Validity and Reliability

The study tool was presented to a group of arbitrators, some specialists in curricula and science teaching methods. The required adjustments were made in accordance with the opinions and proposals of the arbitrators.

The researchers check the reliability of the tool by interrater, through the researchers themselves by analysing one semester of each book (each researcher performed the analysis separately using the prepared analysis tool), after that the researchers introduced it to this tool, its components, and its indication. Then the reliability factor of the analysis process was calculate using the Holste equation (Holsti, 1969).

C.R=(2*M)/(N1+N2)

C.R: Reliability coefficient.

M: Number of analysed paragraphs that agreed between two researchers.

N1+N2: The total number of paragraphs analysed.

The Reliability coefficient for chemistry book (Part II) was 95%, and 91.4% for earth sciences textbooks for 10^{th} graders, the substantial values (>0.80) for the two textbooks indicated a good measure of agreement, which guaranteed a higher reliability for the research.

4. Result and Discussion

4.1 The first question

"What are the criteria for scientific passion that should be included in the Chemistry and the Earth Sciences textbooks for Basic 10^{th} graders?".

To answer this: a tool has been designed to measure the criteria of scientific passion that must be included in science books. The main criteria in the tool have been derived from the review of previous studies and the writings of those interested in passion. Table (3) shows the tool that was designed and relied upon in this study.

Table (2): Domains for scientific passion and their indicators.

Passion Criteria	Sub-indicators
Get involved	The book allows the student to live many experiences.
	The topics are related to real life.
	The topics include full engagement so that the student is part of the learning process.
	Includes all-time activities.
Motivation	The book allows the student to pass through unforgettable experiences.
	The book enables the student to think deeply.
	The book fulfils the desire to interact with the environment.
Independence	The topics give the possibility to choose and make decisions.
	It creates a sense of personal initiative.
	The book includes expression of self-esteem.
	The book includes topics and tasks that are compatible with the identity, environment, and nature of the learner.

Behavioural persistence and practice	The book includes topics and tasks that positively affect students' performance and skills.
Flexibility	The book provides various examples in introducing concepts.
	The book allows students to solve the questions in their way.
Create positive emotions	The book creates feelings of enthusiasm and energy through enjoyable experiences.
	The book allows the student to discover his unique skills.
Adventure	The book enables students to experience new challenges so that they can discover and test new things.
	The book provides topics that motivate learners to overcome obstacles and difficulties.
Sharing	Realizing the desire to communicate with others, exchange ideas, and practical cooperation.
Lifelong learning	It enables students to reflect on what they learn in their reality.
	Topics and tasks allow the student to search for similarities in everything they learn and relate it to previous experiences.
Directing goals	It allows the student to set plans and set goals.
Research and investigative skills	It allows the student to learn the arts of deduction, questioning, dialogue, and thinking.
	Enables the student to explore the environment.
	Provides task-oriented learning.

Table (2) shows the main criteria to be included in the Chemistry and Earth Sciences textbooks for 10^{th} grade, which are divided into eleven main criteria. Each criteria includes several sub-indicators.

The criteria indicate the extent to which a learner has acquired scientific passion through textbooks. Passion is a powerful influence on students' performance, perseverance, and goal guidance, and is also a powerful motivation for focus, learning and flexibility.

Whereas, the passion gained from education is characterized by its connection to positive emotions, which help the learner to increase his/her self-esteem and expectations and increase optimism, giving the learner additional energy, enthusiasm, and determination to carry out tasks with greater pleasure and achievement. This in turn makes the learner wiser and better able to make independent and sound decisions.

On the other hand, an important criterion for gaining passion is the ability of the learner to set clear and specific goals, to review and adjust them to variables, so that he/she can evaluate his/her performance, review his/her achievements, and create high goals with which to challenge himself or herself, thereby enabling him/her to plan and implement to produce at his/her best.

Also, sharing activities with others is closely related to creating passion and excitement for learning by listening to others, sharing them, and discussing their different opinions. This contributes to stimulating imagination, enriching thought, and looking at things from different angles. This develops the culture of the learner, making him think of a new way that can help him in all matters of his life.

The possession of scientific passion is linked to what the learner experiences in his/her life and learns through the experiences of others, the environment, and the circumstances, so it is important to link what the student learns to the realities of his/her daily life. In addition to the above, the acquisition of research and survey skills enables learners to build their own knowledge and develop their thinking capabilities, so they can apply ideas to new situations, and that helps learners gain passion.

The achievement of all these standards among learners, as well as behavioural perseverance, motivation, and adventure, enhance their scientific passion, improve their level of educational performance, better address the requirements, and challenges they face in their studies and lives and achieve higher rates of educational achievement, thereby contributing to the achievement of educational goals.

4.2 The second question

"To what degree does the 10th grade chemistry and earth sciences textbooks include criteria for scientific passion?".

To answer this, frequencies, percentages, and total frequencies were extracted for each main criterion.

Table (3): Results of the analysis of chemistry and earth sciences textbooks for the basic 10th graders.

Passion Domain	**Chemistry textbook for the 10th graders /part two** **Frequencies &Percentages** **frequencies** **%**		**Earth Science textbook for the 10th graders/ part one** **Frequencies &Percentages** **Frequencies**	**%**	**Total Frequencies and percentages** **Frequencies.** **%**	
Get involved	16	13.8	17	17.7	33	31.5
Motivation	18	15.5	24	25	42	40.5
Independence	1	0.9	1	1	2	1.9

Behavioural persistence and practice	0	0	0	0	0	0
Flexibility	27	23.3	23	24	50	47.3
Create positive emotions	1	0.9	1	1	2	1.9
Adventure	0	0	0	0	0	0
Sharing	2	1.7	0	0	2	1.7
Lifelong learning	13	11.2	13	13.5	26	24.7
Directing goals	0	0	0	0	0	0
Research and investigation skills	13	11.2	12	12.5	25	23.7
Total Frequencies and percentages	91	78.5	91	94.7		

It is noted from table 4, that the total frequency of the "flexibility" criterion in the textbook of Chemistry was 27 with a percentage of 23.3% compared to the textbook of Earth Sciences, for which, the frequency of the same criterion was 23 and a percentage of 24%, representing the highest total frequencies, and thus ranked first among the criteria of scientific passion found in both textbooks.

While the frequency of the "motivation" criterion in the textbook of Chemistry was 18 with a percentage of 15.5 % compared to the textbook of Earth Sciences, for which, the frequency of the same criterion 24 with a percentage of 25%. Thus, the motivation criterion ranked second among other criteria.

The "Get involved" criterion ranked third in both textbooks, with frequency in Chemistry 16 with a percentage of 13.8%, and frequency 17 in Earth sciences with a percentage of 17.7%.

The "Lifelong learning" and "Research and investigation skills" criteria ranked fourth in both textbooks, with frequency of 13 and a percentage of 11.2% for both criteria in the Chemistry. The

frequency of the “Lifelong learning” criterion in the Earth Science was 13 with a percentage of 13.5%, while the frequency of “Research and investigation skills” criterion was 12 with a percentage of 12.5%.

The frequencies of the "Sharing" criterion was only 2, with 1.7% in the textbook of Chemistry compared to the textbook of Earth Sciences, in which the frequency of the same criterion was 0. While the frequencies of the "independence" and "create positive emotion " criteria were 1 and 1% each, and thus ranked fifth among the other science emotion criteria.

Finally, the frequencies of each of the following criteria, “Behavioural persistence and practice”, “adventure” and “Directing goals”, were zero in both textbooks.

Previous results suggest that the degree to which the following criteria incorporate “flexibility”, “motivation” and “Get involved” in both textbooks are significant according to the ratios previously determined by the study. This indicates an interest in the qualitative development of the science curriculum, measured by student learning levels and student- centered learning.

As for the “Lifelong Learning” and “Research and investigation skills” Criteria, the degree of inclusion in both textbooks was average according to the reported ratios. This indicates that the content encourages students to acquire scientific research and survey skills and link science to life, but it has not reached the point of significant inclusion. This result may be due to the existence of an accompanying activity book for both major textbooks focusing on scientific experiments.

The degree of inclusion of criteria for “Sharing”, “independence” and “create positive emotion” was very low and inadequate. On the other hand, attention has never been given to incorporating criteria of “Behavioural persistence and practice”, “adventure” and “Directing goals”. This result may be attributed to the absence of a clear matrix of criteria of scientific passion available for the authoring team to incorporate them in appropriate contexts.

To explain those results and their connotations, Table (4) showed an accurate and detailed analysis for all the main criteria of scientific passion and sub-indicators.

Table (4): Frequencies and total frequencies of scientific passion domains and sub-indicators in Chemistry and Earth Sciences textbooks for Basic graders.

Passion Criteria	**Sub-indicators**	**Frequencies of Chemistry textbook for the 10th graders**	**Frequencies Earth Science textbook for the 10th graders/**	**Total Frequencies**
Get involved	The book allows the student to live many experiences.	0	0	0
	The topics are related to real life.	6	6	12

	The topics include full engagement so that the student is part of the learning process.	7	11	18
	Includes all-time activities.	3	1	4
Motivation	The book allows the student to pass through unforgettable experiences.	2	3	5
	The book enables the student to think deeply.	3	16	19
	The book fulfils the desire to interact with the environment.	13	5	18
Independence	The topics give the possibility to choose and make decisions.	0	0	0
	It creates a sense of personal initiative.	0	0	0
	The book includes expression of self-esteem.	0	0	0
	The book includes topics and tasks that are compatible with the identity, environment, and nature of the learner.	1	1	1
Behavioural persistence and practice	The book includes topics and tasks that positively affect students' performance and skills.	0	0	0
Flexibility	The book provides various examples in introducing concepts.	25	20	45
	The book allows students to solve the questions in their way.	2	3	5
Create positive emotions	The book creates feelings of enthusiasm and energy through enjoyable experiences.	1	1	2
	The book allows the student to discover his unique skills.	0	0	0
Adventure	The book enables students to experience new challenges so that they can discover and test new things.	0	0	0
	The book provides topics that motivate learners to overcome obstacles and difficulties.	0	0	0

Sharing	Realizing the desire to communicate with others, exchange ideas, and practical cooperation.	2	0	2
Lifelong learning	It enables students to reflect on what they learn in their reality.	10	11	21
	Topics and tasks allow the student to search for similarities in everything they learn and relate it to previous experiences.	3	2	5
Directing goals	It allows the student to set plans and set goals.	0	0	0
Research and investigation skills	It allows the student to learn the arts of deduction, questioning, dialogue, and thinking.	7	7	14
	Enables the student to explore the environment.	1	5	6
	Provides task-oriented learning.	4	0	4

Table (4) reveals a marked disparity in the interest in incorporating key criteria into the chemistry and earth sciences textbooks of the 10th grade. More precisely, the 5 major criteria have taken the degrees of inclusion between high and medium, based on the ratios reported previously.

In considering the criterion of "flexibility", the focus was on the first sub-indicator in both textbooks, possibly because of the nature of chemistry and earth sciences, the extent to which the concepts are related and the need to focus on many examples to clarify the concepts for students.

In the "motivation" criterion, the focus was on the third sub-indicator in the textbook of Chemistry, compared to the textbook of Earth Sciences, where the focus was on the second indicator. This emphasized the need for science curricula to be closely linked to the surrounding environment and to be able to detect and interact with them. On the other hand, there's a need to focus on developing thinking so that things can be looked at in-depth and different ways.

In the criteria for "Get involved", the focus was on the last sub-indicator in both textbooks, which is evidence of the interest of science curricula in making the learner the focus of the educational process so that learning becomes the best and the longest.

It was identical to the of "lifelong learning" criterion, where the focus was on the first sub-indicator in both textbooks. This emphasizes the relevance of science textbooks to human life and interests and the need for learners to be skilled in the opposite of what they learn about the reality of their lives.

As for the "Research and investigation skills", the focus was on the first sub-indicator in both textbooks, which was due to the curriculum's interest in survey-based science through practical applications and thought-provoking tasks through scientific methodology.

5. Conclusion and Recommendations

Starting from these results, attention should be given to incorporating the criteria of scientific passion in a balanced, integrated, and coherent manner in order to enable learners to become passionate about their science and life and to improve their level of scientific progress and achievements. The lack of clear balance in the inclusion of criteria in science textbooks may be explained by the fact that authors of textbooks and supervisory committees are not informed of the importance of scientific passion.

Based on the results of this study, the researchers recommend the following:

-The need to focus on incorporating science passion criteria through content in science curricula in particular and other curricula in general.

-Application of studies on the analysis of other materials in terms of the degree to which they incorporate the criteria of scientific passion and in different classes.

-The possibility of holding lectures, courses and training workshops for decision makers involved in the design and development of science curricula with a view to providing them with the importance of scientific passion, acquisition and practice and the need to include it in the curricula in general.

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