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Fostering STEM Learning: Exploring the Integration of Design Thinking in Islamic STEM Education

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Abstract

This study investigates the integration of Design Thinking in STEM education within an Islamic context, focusing on thermal packaging as a learning module. The research examines differences in STEM Interest, Design Thinking skills, and Subject Knowledge across 7th and 8th-grade students, as well as the relationships between these constructs. A quantitative approach was employed, involving 64 preparatory students from an institute of religious studies in Qatar. Participants engaged in a Design Thinking-based STEM workshop on thermal packaging, followed by a comprehensive survey assessing the three key constructs. The Independent-Samples Mann-Whitney U Test revealed no significant differences between grade levels for STEM Interest ($U = 424.500$, $p = .434$), Design Thinking skills ($U = 494.000$, $p = .843$), or Subject Knowledge ($U = 469.500$, $p = .873$). However, bivariate correlation analysis showed strong positive relationships among the constructs for both grade levels. For 7th-grade students, STEM Interest and Design Thinking Skills were strongly correlated ($r = 0.856$), while 8th-grade students showed a robust correlation between Design Thinking Skills and Subject Knowledge ($r = 0.884$). These findings suggest that integrating Design Thinking approaches in STEM education within an Islamic context can effectively enhance students' interest, skills, and knowledge simultaneously. The study highlights the potential of Design Thinking-based STEM workshops to create a synergistic learning environment that aligns with Islamic principles and values while preparing students for contemporary challenges. The research contributes to the growing body of literature on culturally responsive STEM education and provides insights for educators seeking to bridge traditional Islamic teachings with modern technological advancements.

Keywords: *STEM learning; Islamic Education; Design Thinking; Middle school students*

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Introduction

The integration of Science, Technology, Engineering, and Mathematics (STEM) into Islamic education indicates a change in pedagogical perspectives today. This combined connection does not only comply with the Islamic culture of knowledge seeking but it also equips students with the necessary critical skills for this century where people have to live in a complicated world driven by technology. The STEM method if properly blended with Islamic principles has the potential for increased cognitive ability among students that can lead them towards becoming better thinkers who understand scientific ideas and religious teachings at a deeper level too. Recent studies underscored the effectiveness of integrating STEM within Islamic schooling systems thus; Halim *et al.,* [1] found out that problem-solving abilities were enhanced while understanding different concepts were made clearer among secondary school learners when they used science activities during their lessons in Islamic subjects. In addition, Rahim *et al.,* [2] suggested a holistic approach towards knowledge integration whereby they emphasized the importance of including all areas such as arts and humanities alongside sciences under one roof called "Islamic schools". Also Aswirna ; Fahmi [3] discovered that teaching methods which integrate both science learning together with religion could foster student's cognitive development especially analytical thinking spatial ability and abstract reasoning among others while conducting an investigation on impacts created by introducing these two disciplines within single setting . Again Latif *et al.,* [4] demonstrated quasi-experimental study design targeting critical thinking skills through doing various activities related to math while still within context where it is taught based on Islamic religion belief system. Furthermore, Rahman *et al.,* [5] examined potential innovation by investigating project-based learning inspired from Islamic values, which indicated higher levels of creativity as well as entrepreneurial mindsets among university learners involved in such projects. Besides this Zain *et al.,* [6] looked into challenges faced during the implementation phase regarding project-based learnings associated with Islamic stem education therefore identifying what can be done better or differently next time round. Salleh *et al.,* [7] showed metacognitive abilities within themselves by becoming aware about their own thinking processes, hence becoming self-regulated learners who are able to think critically about what they have learned and how it connects with other areas of knowledge. As well, Ahmad *et al.,* [8] suggested that STEM could be used as a bridge between faith and science for modern Islamic curricula.

The practicality of incorporating STEM into Islamic education has been explored in the literature too. For example, in a study by Mustapha & Salleh [9], teachers' views on implementing STEM education were investigated within the

Malaysian context where the majority of schools are Muslim-based; this was done to come up with best practices that could help others succeed or excel when faced with similar challenges. Another one conducted by Yaacob *et al.,* [10] focused more on values-driven through religious teachings also known as moral ethics thus showing how they can be promoted using an approach like STEM education?. These articles signify importance given towards training teachers adequately so that they may successfully implement these ideas into their classrooms since success stories have been witnessed elsewhere but mainly due to proper teacher preparations. Additionally Kasim ; Abdurajak [11] noted that there are some issues related to integration process itself like those associated with time constraints or lack thereof while trying marry two different subjects together under one banner called "Islamic values" within stem curricular activities. Furthermore, Mohd-Yusof *et al.,* [12] demonstrated the versatility aspect through its application across various levels suggesting engineering should be taught from the bottom upward starting at elementary stages and then progressing up until the university level where students already know much about general concepts hence better equipped for dealing with technicalities involved during engineering studies.

Engineering design is the most important part of STEM education, which applies science, technology, and mathematics principles. Integration into curriculums of science, technology and mathematics creates opportunities for students to solve problems through practical work that matches real-life challenges hence instilling creative thinking as well as innovation skills. Recent research indicates that this approach increases student involvement in learning activities such as understanding abstract concepts among others [13-14]. The principles used in engineering design have deep roots within Islamic civilization and can be traced back to Quranic teachings too. According to Al-Quran, it is encouraged to observe and think about nature (QS. Alghashia; 17) while also stressing balance and proportion (QS. Ar-Rahman; 7) thus sharing some common grounds with essential engineering design ideas. Current studies investigate how these two worlds connect by showing possible ways in which modern Engineering Design could draw inspiration from the worldview presented by the Qur'an besides emphasizing ethical considerations alongside sustainability during practice sessions [15-17].

STEM programs integrated with Islamic education have gained popularity in many Muslim countries over recent times. Malaysia has been leading this initiative where Shukor *et al.,* [18] carried out a study on implementing STEM curriculum at Islamic schools; findings showed positive attitude despite challenges linked to teacher preparedness and resource allocation. In Indonesia Rahmawati *et al.,* [19] discovered that when taught in primary level madrasahs located within predominantly Muslim communities these subjects increase critical thinking skills together with scientific literacy among students compared to what would happen if they were not offered there at all. Turkey too made effort towards incorporating religious content into its science-teaching syllabus mainly targeting Imam Hatip schools, which yielded good results because according Akgündüz and Ertepınar [20], students became more interested in sciences thus improving their performance. In Pakistan there has been an ongoing debate regarding whether or not to introduce Science, Technology, Engineering & Mathematics (STEM) subjects into Madrasahs; Khan and Rodrigues [21] identified challenges as well as opportunities within this context. The United Arab Emirates invested heavily in all levels of education including Islamic institutions where Alblooshi and Alghazo [22] found out that learners gained a better understanding about science as well as Islamic teachings after integration was done properly. Qatar also recognized the importance of these fields hence actively promoting them among schools with Islamic backgrounds; for instance, Al-Thani *et al.,* [23] indicated that when STEM projects were introduced alongside Quranic principles-based studies at Qatari schools it helped improve problem-solving skills among learners while fostering appreciation towards harmony between science and religion especially Islam.

By introducing Design Thinking-based workshops into STEM approaches can greatly enhance Islamic education since it promotes creativity, critical thinking skills, and problem-solving within an Islamic context. Recent findings indicate that such a combination increases the ability of learners to apply relevant principles drawn from their faith when dealing with worldly matters [24]. Additionally, nurtures innovative capacity while deepening understanding about moral values associated with Islam [25], produces higher learning outcomes through active engagement in colleges [26], and incorporates technology development, which bridges traditional teaching methods with modern pedagogical approaches among others [27]. Collaboration as well communication abilities are also enhanced by this kind of training given its alignment with Islamic beliefs [28]. Overall, the researches show that using design thinking in workshops may make Islamic education more dynamic, relevant, and impactful towards equipping students for present-day challenges without abandoning religious teachings.

This study is aimed to enhance STEM education in Islamic contexts while fostering innovative thinking and practical problem-solving skills among students. Despite the increasing emphasis on STEM education globally, there is a noticeable lack of research exploring the integration of Design Thinking principles within Islamic STEM curricula. The main objective of this research is to investigate how incorporating Design Thinking in STEM education within an

Islamic context can affect students' STEM interest, subject knowledge, and design skills. What has been done so far is that no one has looked into this gap by examining the unique intersection of Design Thinking, STEM Education, and Islamic values. While previous studies have examined STEM education in different cultural contexts, and others have investigated the benefits of Design Thinking in general educational settings, little is known about how these approaches can be effectively combined within an Islamic educational framework. Thus, this study seeks to fill this gap by providing empirical evidence on the effectiveness of Design Thinking-based STEM education in Islamic schools which may provide a model for culturally responsive and innovative STEM instruction that aligns with Islamic principles and values

Study objective and research questions

These research questions aim to investigate the impact of the Design Thinking-based STEM workshop on academic performance, considering potential variations across different grade levels. This question looks at how the workshop's effectiveness varies with students' educational stages. Further, it also considers the interplay among three main variables: interest in STEM fields, design thinking skills proficiency, and subject-specific knowledge acquisition. This query examines possible correlations between these elements thereby revealing a wider view of what the workshop does for children's learning and involvement. Below are two Islamic-based research questions that use the Design Thinking framework within STEM education to investigate grade variance and correlation between STEM interest, design thinking skills as well as subject knowledge:

RQ1: In an Islamic contextualized Design Thinking oriented STEM program, what are the differences in academic achievement across grade levels?

RQ2: How statistically is students' interest in STEM-related to their ability to think like designers and understand different subjects taught in an Islamic context through the STEAM approach?

Theoretical and Conceptual Framework

The Design Thinking framework, initially created by Stanford D. school [29] and adapted for schools, offers a structured method that highlights human-centered problem-solving and STEM education innovation. The Design Thinking framework has five main stages: Empathize, Define, Ideate, Prototype and Test. Teachers can foster critical thinking skills while integrating Islamic values into students' minds by getting them involved in these processes. For instance during this phase of design thinking; compassion or pity should be practiced towards others so as to understand their needs better (empathy), which aligns with teachings such as those on empathy found within most religions including Islam where it encourages care for one's neighbor who may be different from oneself. Moreover, at the ideation stage learners employ divergent thought strategies thus developing ideas that are more creative but still taking into account ethical implications from an Islamic point of view.

Putting into consideration that prototypes together with test levels require learners to come up with physical presentations of their thoughts followed by evaluating their efficiency promotes a hands-on learning method that resonates well with the Islamic principle emphasis on knowledge gain through practice as they seek the truth about Allah's world by doing things themselves (practical). By applying this model in science education within Muslim schools will be able to create activities that enhance necessary skills for the 21st century while at the same time infusing morals based on religion so that learners become better equipped when dealing with intricate technological or scientific problems involving creativity, critical reflection, and strong moral standing. Recently there have been some research works done regarding utilization of design thinking approach in STEM subjects. Goldman *et al.*, [30] showed how innovation abilities are nurtured through designing thinking procedures within various educational settings; Cook and Bush [31] also noted a significant increase in student engagements as well understanding of concepts related to STEM while using design thinking framework in K-12 education.

Method

To investigate how social support can help foster STEM interests and aspirations among 48 preparatory students in Qatar who were in grade seven or eight at a religious studies institute, this research used a quantitative method. The focus of the study was on finding out if Design Thinking workshops affect students' engagement with fields related to science, technology, engineering and math (STEM). Data was collected using an extensive survey instrument shown as Table 1, which was designed for assessing Science Technology Engineering Mathematics (STEM) interest levels among Qatari seventh and eighth graders [32-33]; it also measured Design Thinking Skills as well as subject knowledge about these subjects taught within Islamic education context. This type of approach made it possible to examine systematically connections between social support, Design Thinking interventions and STEM involvement within Islamic educational framework targeting middle school kids during their years spent at religious preparatory stage. By doing this study within such setting teachers would be able, learn more about different teaching methods that might be effective when dealing with students from diverse cultures.

Table 1. Statements that measure the three factors for the students

No	Dimension	Statement
1	**STEM Interest**	Learning Science, Technology, Engineering, and Math (STEM) is essential for my future success
2		We live in a better world because of Science, Technology, Engineering, and Math (STEM)
3		I would consider my future to be in Science, Technology, Engineering, and Math (STEM)
4		I can do well in Science, Technology, Engineering, and Math (STEM)
5		I can handle most subjects well, but I cannot do well in Science, Technology, Engineering, and Math (STEM)
6		I like to participate in activities from Science, Technology, Engineering, and Math (STEM)
7		If I learn Science, Technology, Engineering, and Math (STEM), then I can invent useful things
8		I like to watch videos on Science, Technology, Engineering, and Math (STEM)
9		I am interested in joining an after-school workshop in Science, Technology, Engineering, and Math (STEM)
1	**Design Thinking Skills**	I can accurately define the key principles of design thinking.
2		I am familiar with the various stages of the design thinking process.
3		I understand the importance of empathy in design thinking
4		I can clearly define a problem following design thinking.
5		I know how to frame a problem statement following the design thinking.
6		I am knowledgeable about techniques for ideation and brainstorming.
7		I understand the significance of prototyping and iteration in design thinking
8		I am a familiar with test procedures for a product

9		I am a familiar that the design thinking is a non linear process
10		I actively seek feedback on my ideas and use it to improve my solutions.
1	**Subject Knowledge**	The thermal packaging effectively maintains the desired temperature range for my product
2		The thermal packaging materials are environmentally friendly and sustainable.
3		I understand the concept of conduction as a mode of heat transfer.
4		I am aware that materials with high thermal conductivity are better conductors of heat
5		I can differentiate between insulators and conductors in the context of heat conduction.

Learning Module and Participants

To explore the incorporation of Design Thinking into STEM education in an Islamic environment, this research employed a quantitative approach. This was done through thermal packaging as the module for learning. Even though it is not part of Islamic teachings traditionally, the subject of thermal packaging is related to various Islamic principles such as conservation of health and environment, and avoidance of wastage among others. In addition to scientific inquiry that is encouraged by Islam also, it has practical applications within halal food industry thereby linking conventional teachings with current technological advances. A total number of 64 students from Qatar religious studies institution were involved in a "Thermal Packaging" workshop after getting permission from the Qatar University Institutional Review Board (QU-IRB). The total number of grade 8 students was 24 and 40 for grade 7. The five stages that make up Design Thinking namely; Empathize, Define, Ideate, Prototype, and Test were implemented during this workshop.

Participants were engaged in hands-on experiments where they investigated material properties; package thickness effects as well as convection heat transfer before embarking on group projects aimed at applying Design Thinking toward coming up with solutions for thermal packaging among other things. Data was collected using survey instruments, which had been developed specifically for assessing students' interest levels in STEM subjects post-intervention knowledge gains related to Design Thinking skills and content illustrated by example Table 1. The main output variable was each group's poster presentation displaying their thermal packaging solution by four students per group. This approach enabled a quantitative assessment of how effective it can be when we merge design thinking with stem concepts within an Islamic educational setting using thermal packaging as an example since it's tangible and relevant culturally while still conforming to Islamic values.

Survey Procedures

A post-workshop questionnaire was employed to evaluate the growth of learning strategies. It has four sections that include participant demographics, and three study constructs. The STEM interest part had a 3-point Likert scale [34-35] with responses coded as 1 (agree), 0 (uncertain/don't know) and -1(disagree). In all, there were 24 statements in the survey across all sections. The completion time for the survey was estimated between fifteen and thirty minutes after which students filled it up immediately after the workshop. Arabic answers were translated to English for analysis purposes. Informed consent was sought from students, teachers, and school administrators before conducting the survey.

Data Analysis

Data collected were coded, stored, and analyzed using SPSS (Statistical Package for The Social Sciences) software. Descriptive statistics were computed to provide an overall assessment of the data. Various statistical tests were used to evaluate the reliability of data taking into account particular characteristics of the data under consideration. We firstly conducted Cronbach's Alpha and McDonald's Omega tests on questions that were included in the analysis of the study.

Table 2 shows alpha and omega values as computed for each survey construct. The reliability test results indicated that all questions used for analysis demonstrated high reliability. Usually, alpha and omega values beyond 0.70 are considered as indicators of reliability while those greater than 0.8 are widely perceived as indicative of high reliability [36]. Apart from reliability tests, descriptive statistics, and non-parametric analyses also addressed research questions in this study adding weight to it.

Specifically, groups were compared by using the Mann–Whitney U test and Bivariate correlation analysis was carried out between variables to determine relationships among them. Significance levels 0f .05 and .01 were taken when interpreting results thus providing a robust framework for statistical inference that enhances valid findings in researches.

Table 2. Cronbach's Alpha and McDonald's Omega Reliability Tests for Grade 7 and Grade 8

Constructs	No of Items	Cronbach's Alpha	McDonald's Omega	Cronbach's Alpha	McDonald's Omega
		Grade 7		Grade 8	
STEM Interest	9	0.773	0.744	0.741	0.718
Design Thinking skills	10	0.752	0.750	0.768	0.796
Subject Knowledge	5	0.726	0.763	0.755	0.757

The data normality was assessed using tests of Shapiro-Wilk and Kolmogorov-Smirnov as shown in Table 3. The dependent variables were the summation of individual responses from each construct to form total scores across the three dimensions by students. The independent variable consisted of different school grades (7th, 8th). Both tests for normality had significant results at $p < 0.05$ implying that they deviated from a normal distribution. With this, if their p-value is below 0.05, then the null hypothesis do not hold water. This finding supports our conclusion that the data are not normally distributed; hence, non-parametric methods would be used for further analysis of the data.

Table 3. Normality Test for the two groups of students (Grade 8 and Grade 7)

Dependent Variable	Independent Variable	Kolmogorov-Smirnov				Shapiro-Wilk		
		Statistic	df	Sig.		Statistic	df	Sig.
STEM Interest	Grade 8	.185	24	.032	.848	24	.002	.185

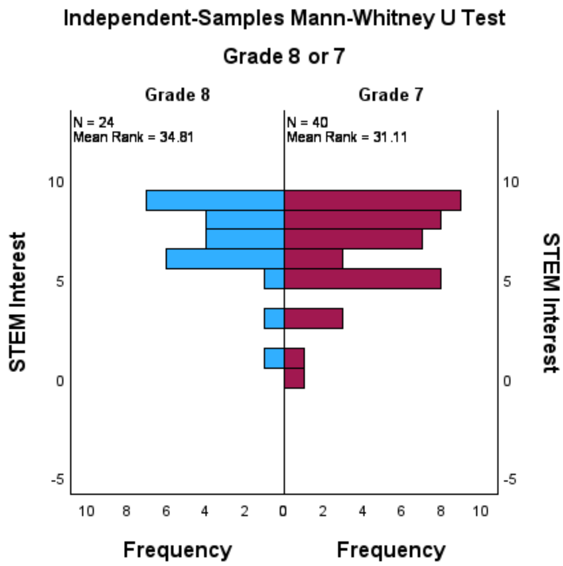
	Grade 7	.178	40	.003	.882	40	<.001	.178
Design Thinking Skills	Grade 8	.164	40	.009	.865	40	<.001	.164
	Grade 7	.323	24	<.001	.703	24	<.001	.323
Subject Knowledge	Grade 8	.185	24	.032	.848	24	.002	.185
	Grade 7	.178	40	.003	.882	40	<.001	.178

Results and Discussion

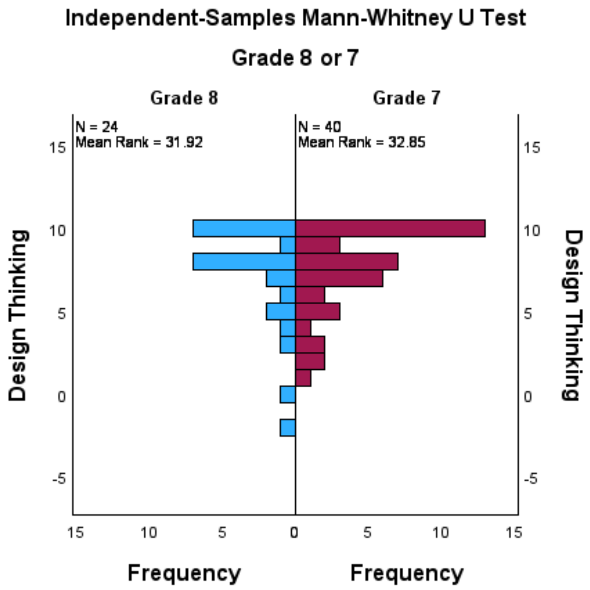
The first research question that this study addresses is about the differences in STEM Interest, Design Thinking skills, and Subject Knowledge among seventh and eighth-grade students by using the Independent-Samples Mann-Whitney U Test. The results in Table 4 showed no statistically significant differences between the two grades for any of the three variables: STEM Interest ($U = 424.500$, $p = .434$), Design Thinking skills ($U = 494.000$, $p = .843$), and Subject Knowledge ($U = 469.500$, $p = .873$). These findings are remarkable as they suggest that levels of interest, skills, and knowledge in STEM subjects remain relatively consistent across these two grade levels.

However, given that there was no substantial improvement it raises doubts on whether there were any benefits derived from the current educational approach on developing these critical areas for learners as they progress with their studies. Fig(s) 1(a-c) graphically depicts the distribution of students' scores across three constructs (STEM Interest, Design Thinking, and Subject Knowledge) as determined by Independent-samples Mann-Whitney U Test. In each figure the axis denotes numbers/frequency of students while y axis reflects the score/score for each construct such as STEM Interest scores "x-axis" or "scored on the y-axis". The plots on both graphs represent distributions of individual scores for a single construct such as those for 7th graders and 8th graders separately. Figure 1-a shows how grades were distributed according to STEM interests. Figure 1-b provides information on how different groups scored in relation to design thinking. Figure 1-c depicts how subject matter competence varied among different students. This visual representation is supported by results from the Mann-Whitney U test, which did not show any significant difference between both grade levels in all three constructs tested above.

(a)


Independent-Samples Mann-Whitney U Test
Grade 8 or 7
Grade 8
Grade 7
N = 24
Mean Rank = 34.81
N = 40
Mean Rank = 31.11
STEM Interest
STEM Interest
Frequency
Frequency

(b)


Independent-Samples Mann-Whitney U Test
Grade 8 or 7
Grade 8
Grade 7
N = 24
Mean Rank = 31.92
N = 40
Mean Rank = 32.85
Design Thinking
Design Thinking
Frequency
Frequency

(c)

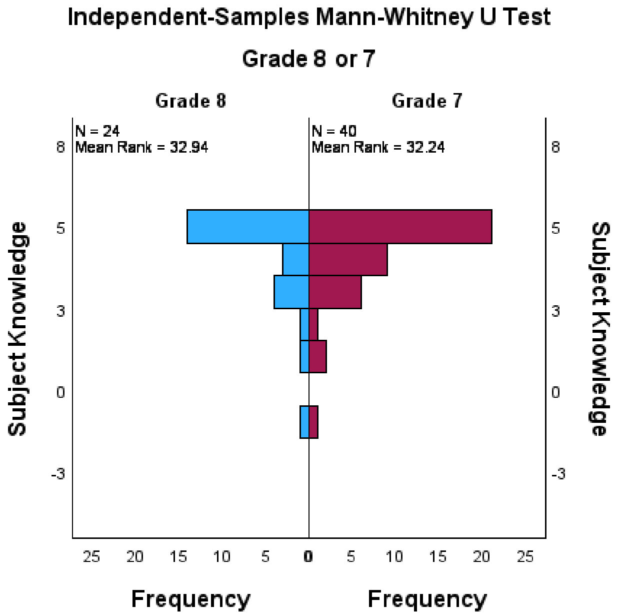


Fig. 1 Independent-samples Mann-Whitney U test for (a) STEM Interest (b) Design Thinking skills (c) Subject Knowledge

Table 4. Non-parametric Test Analysis for Primary, Preparatory, and High School grade level

No	Variables	Groups	Test Statistics	Values
1	STEM Interest	Grade 8	Mean rank	34.81
		Grade 7	Mean rank	31.11
			Mann Whitney U	424.5
			p-value	0.434
2	Design Thinking	Grade 8	Mean rank	31.92
		Grade 7	Mean rank	32.85
			Mann Whitney U	494.0
			p-value	0.843
3	Subject Knowledge	Grade 8	Mean rank	32.94
		Grade 7	Mean rank	32.24
			Mann Whitney U	469.5
			p-value	0.873

To answer the second research question, bivariate correlation analysis presented in the correlation tables below shows a statistically significant association between STEM Interest, Design Thinking Skills and Subject Knowledge Scores of 7th-grade students and 8th-grade students in an Islamic education setting. For example, for 7th graders, there is a strong positive relationship between STEM Interest and Design Thinking Skills as seen through Pearson's r = 0.856. This strong correlation implies that it is substantive enough to support the idea that improvement in Design Thinking skills stems from enhancement in interest in STEM among these learners with the help of Design Thinking/STEM workshops; thus developing their design thinking abilities. Similarly, there was a positive correlation between STEM Interest and Subject Knowledge Scores (r = 0.700) which indicated that when stem interest rises so does subject knowledge acquisition within any learning situation.

Meanwhile, other related findings obtained from both groups have shown high correlations between those three factors for grade levels under consideration. Pearson's r = 0.884 between Design Thinking Skills and Subject Knowledge Scores suggests an exceptionally strong association while showing how much better are grades in subject matters where resources are replaced by design thinking processes in comparison to other approaches. The same can also be said concerning another r-value (r = 0.733) reveals again a strong positive relationship but there is a need for more emphasis on these findings because they point towards different things happening within various grades of learners' education during workshops based on design thoughts linked with STEM. Teachers could foster curiosity through inquiry-based learning methods customized according to pupils' abilities needs stage development within an Islamic educational setting where culture values play important roles like this one we find out here today so don't underestimate power yet about what happens at each grade level workshop.

Table 5. Bivariate correlations of the relationship between the factors for Grade 7 students

Construct		**STEM Interest**	**Design Thinking Skills**	**Subject Knowledge**
STEM Interest	Pearson Correlation	1		
Design Thinking skills	Pearson Correlation	0.856**	1	
Subject Knowledge	Pearson Correlation	0.700**	0.716**	1

**. Correlation is significant at the 0.01 level (2-tailed).

Table 6. Bivariate correlations of the relationship between the factors for Grade 8 students

Construct		STEM Interest	Design Thinking Skills	Subject Knowledge
STEM Interest	Pearson Correlation	1		
Design Thinking skills	Pearson Correlation	0.732**	1	
Subject Knowledge	Pearson Correlation	0.733**	0.884**	1

**. Correlation is significant at the 0.01 level (2-tailed).

Consequently, concerning both grade levels, the results of this research indicated a significant relationship between STEM Interest and Design Thinking Skills as well as Subject Knowledge; thus implying that there could be benefits in integrating Design Thinking methods into Islamic-based STEM education. In other words, a structured but flexible framework for dealing with science subjects is opened up by the steps involved in the Design Thinking process; which involves empathy, problem definition, ideation, prototyping, and testing ideas, especially among students within Islamic schools.

The differences that have been recorded in correlations between students of the 7th and 8th grades are thought-provoking as to how we understand the development of STEM education and Design Thinking in an Islamic context. Regarding pupils in the 7th grade, it can be said that there exists a strong correlation between interest in science, technology, engineering, and mathematics (STEM) and skills related to design thinking; this means that at this stage their passion for these subjects is closely connected with the ability to engage into creative problem-solving processes. Such a finding supports Kelley & Knowles' [37] as well as Çevik's [38] studies which established that among young people of these ages, scientific curiosity may arise through hands-on activities which imply design principles inherent therein being reflective.

In an Islamic setting, such could be aligned with teachings from the Quran urging humankind to observe things around them critically (QS. Alghashia; 17), thus fitting perfectly within the exploratory nature characteristic for design thoughts. Conversely, the students in grade 8, it should be noted that subject knowledge has a significant association with design thinking skills but indicates more advanced cognitive operations so far not witnessed among younger children. This implies therefore older learners have already internalized various ways or methods used while thinking through designs thereby applying them better towards deepening their understanding of different parts making up STEM disciplines. This discovery agrees with what was found out by Li & Schoenfeld [39] besides corresponding also with Islam's belief system, which emphasizes on gaining practical experience coupled with critical reasoning to acquire new information always necessary for one's growth intellectually.

The move from general interest toward specific involvement with science subjects happened because according to English [40]. Students start showing greater concern over particular topics during their later years when they begin narrowing down choices based on what captures attention most thus making use of this choice is available and then guided by Design Thinking competencies acquired at this stage which are expected to grow in sophistication year after another as proposed by middle school development theorists. These results reinforce the need for differentiated instruction in STEM and design thinking within Islamic education systems. For grade 7 students, it is important to foster science curiosity through engaging in design-based activities that incorporate Islamic principles; while grade 8 students should be given chances to apply Design Thinking skills on complex subject-related problems rooted in Islamic values and ethics to enhance their interest in learning at all levels. This method not only improves students' abilities but also deepens their knowledge regarding integration between these two subject areas alongside religious teachings based on examples provided.

Conclusion

This research study evaluated the use of Design Thinking within STEM education in a Muslim environment, particularly in terms of thermal packaging as a module for learning. It compared 7th and 8th graders concerning differences in STEM Interests; design thinking skills; subject knowledge; and how these three concepts interrelate. The findings showed that there were no significant variations between grades in any of these areas, which implies that interests are steady while moving from one level to another but also indicates equal skills acquisition and knowledge development among students at different levels. However, there were strong positive correlations between STEM Interest, Design Thinking Skills, and Subject Knowledge for both grade levels although some correlation strengths differed between students from 7th and those from 8th grade. These results emphasize the need for integrating Design Thinking into Islamic based STEM teaching showing that this can be done successfully which acting as a bridge between traditional teachings of Islam with current technological advancements. The study suggests that through workshops such as those based on Design Thinking students' interest in science will be enhanced greatly because they work hand in glove heightening their passion even more while gaining ground intellectually not forgetting what matters most according to Islamic principles.

The present investigation offers valuable insights but it has some limitations which should be taken into account. First, the sample size used was relatively small hence generalization may not be applied to larger populations or different settings within education. Secondly, the study being cross-sectional does not allow for concluding long-term effects or developmental trajectories related to motivation and skills required by science subjects. Thirdly, it would have been better if there was a control group to know whether observed correlations were only due to intervention through workshops anchored on a Design thinking-based approach under STEM.

Additionally reliance on self-reports might have introduced bias thereby affecting accuracy when evaluating skills. Fourthly, the fact that this research took place at an institute of religious studies in Qatar with thermal packaging as its context limits wider applicability to other Islamic educational setups or even STEM themes. Fifthly, personal factors such as previous knowledge, individual learning differences, and socioeconomic status could have acted as confounding variables that were not fully considered. Lastly, limited qualitative data may have hindered a deeper understanding of students' experiences during integration of Design Thinking with Islamic principles. Cultural and linguistic issues specific to Qatar could also affect generalizability across different Islamic contexts for instance within education systems in this country. Future investigations should address these limitations to provide a more comprehensive perception of how efficient Design Thinking activities are under diverse Muslim educational environments involving various grade levels and different science subjects.

Author Contributions

Abubaker M. Elbashir: Conceptualization, Methodology, Writing – review & editing, Workshop delivery, Data Collection & analysis. **Shahad Alkhair**: Methodology, and Investigation. **Noora J. Al-Thani**: Supervision, Project administration.

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Conflict of Interest

The authors declare no conflicts of interest.

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