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The Effectiveness of the Mawhiba Program for the Development of Critical Thinking Skills among Gifted Female Students at the Secondary Levels

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Authors' contributions

This work was carried out as a collaboration between both authors. Author AKHA designed the study, wrote the protocol and supervised the work. Authors AKHA and NASH carried out all of the statistical work and performed the statistical analysis. Author NASH managed the analyses. Author AKHA wrote the first draft of the manuscript. Both of the authors read and approved the final manuscript.

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ABSTRACT

This study explores the effectiveness of the *Mawhiba* (Giftedness) program in developing critical-thinking skills in students in Saudi Arabia. This quantitative study involved the assessment of 30 gifted female secondary-school students in the Eastern Province of Saudi Arabia who participated in the *Mawhiba* program. The Critical Thinking test used in this study, prepared by Jabir Abdulhameed Jabir and Ahlam Al-Baz [1], is designed to measure critical-thinking skills. The results indicate that these students began to ability to enhance their ability to think critically after attending the five-week intensive training course. Furthermore, this study illustrates how critical thinking could be developed to supplement academic programs with reasonable levels of success. Saudi policymakers, teachers and faculty members should consider finding and refining ways to improve critical-thinking skills in female students as part of the university environment and in order

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to support and capitalise upon the learning that happens beyond the conventional classroom. In addition, this study illustrates how critical thinking could be developed to supplement academic programs.

Keywords: Effectiveness critical thinking; critical-thinking skills; development of critical thinking; Mawhiba; gifted students; Saudi Arabia.

1. INTRODUCTION

Education in Saudi Arabia has progressed tremendously over the last half century and especially over the last two decades. The higher-education system in particular has changed primarily to advance the country and its citizens in several areas. Change has been influenced by an increase in the student population, in the demands of the job market and in the influence of international higher education [2]. Saudi Arabia has started to follow the global trend by focusing on exploring the development of talent, especially among young students. Over the last decade there has been a particular interest in gifted students and their thinking abilities.

Teaching critical thinking, an educational goal that has been widely discussed over the last 30 years [3], is an essential element of professional and higher education as it promotes reasoned judgments under 'conditions of uncertainty', which is a hallmark of professionalism ([4-6], as cited in [7]). Critical thinking has become a buzzword at the global level, and many studies connect it with talent development and giftedness. The same trend has become prominent in Saudi Arabia.

Although the Kingdom of Saudi Arabia has started to pay closer attention to talented students who have special abilities, there are relatively few studies that discuss the effectiveness of giftedness programs for improving skills. This study explores the effectiveness of the *Mawhiba* (Giftedness) program in developing Saudi students' critical-thinking skills. A recent study by Batterjee [8] explores the nature of gifted education in Saudi Arabia in the context of the long tradition of educational programs and philosophies oriented towards the elite. 'Since Plato, many modern scholars have promoted the development of the intellectual elite, their cognitive abilities, and their contributions to the technical, economic, political, and cultural development of society' [8].

The aim of this research paper is to explore how female Saudi students attending the summer *Mawhiba* giftedness program developed and improved their critical-thinking skills, including the extent to which they benefited from the fact that 'These programs aim at providing the circumstances and opportunities enough to take the learners to their utmost potentials and capabilities' [9].

The paper starts with an overview of gifted education and critical-thinking skills and with an overview of the Mawhiba Summer Talent Program. It then continues with the research problem and questions, followed by the study results and discussion and by the implications for practice.

2. PROBLEM STATEMENT/DESCRIPTION

2.1 Objectives

This study had two main objectives:

- To assess and measure critical-thinking skills among gifted middle- and secondary-school female students in the Eastern Province of Saudi Arabia; and
- To examine/verify the effectiveness of the activities of the *Mawhiba* program in developing critical-thinking skills.

2.2 Research Questions

The research problem can be identified by answering the following questions:

1. Are there any differences in critical-thinking skills that resulted from the impact of the *Mawhiba* program training on gifted students?
2. Is there a relationship between critical thinking and academic achievement among gifted students?
3. Are there any differences in critical-thinking skills that are attributable to the specific characteristics of the school stage (middle or secondary)?

This study followed a quasi-experimental approach and implemented an experimental

design with one group (pre- and post-measurement). It assessed the effectiveness of the training program (the Talent Program), which was the independent variable, on the development of critical-thinking skills among gifted students, which was the dependent variable.

3. LITERATURE REVIEW AND THEORETICAL FRAMEWORK

Gifted children offer special challenges when it comes to the development of critical-thinking skills. This is particularly due to their possession of talents and gifts that require special attention from the teacher to ensure that they are not left behind in the program [10]. Gifted and talented students are considered to be those pupils whose intellectual abilities and related needs are more advanced than those of their peers [11]. The concept of giftedness, and the task of identifying which students fall within this category, is the subject of extensive debate, and many scholars have provided their own distinctive interpretations of the term. It was in 1972, however, that the concept of giftedness was laid out in a comprehensive manner in the Marland Report, which was provided to the Congress of the United States; this document stated that gifted children are those who by virtue of outstanding abilities are capable of unusually high performance. These abilities may include general intellectual ability, creative or productive thinking, a particular academic aptitude, excellence in the visual or performing arts, or a particular psychomotor ability [12].

Stoeger [13] suggests that in the past the concept of giftedness was associated primarily with high IQ: gifted students were those who were born with high intellectual ability and who could be identified through their high grades in examinations. It was suggested that they were the ones who excelled in all areas of life and school [13]. These assumptions are still held, but nowadays there are a number of alternative ways in which a person can be identified as gifted.

A review of the literature related to gifted education yields a variety of other characteristics that indicate advanced skills in gifted students. Research has identified the characteristics set out hereunder.

- Gifted students process information faster, for both simple and complex tasks, in comparison with their non-gifted peers [14].
- Gifted students are generally more thorough problem solvers, employing a wider variety of strategies for problem solving [15].
- Gifted students appear to make use of more metacognitive strategies during learning than their non-gifted peers [16].
- Gifted students are able to sustain attention towards a task or problem in a manner that non-gifted students are not able to do [17].
- Gifted learners, or those with higher cognitive abilities, have superior memories and their retrieval system is more efficient when compared with that of their non-gifted peers [14].
- Gifted students have instructional needs that are different from those of their non-gifted peers: They require minimal instruction for learning and understanding [18].

Thus, gifted students' superior analytical abilities, aptitude for complex, higher-order thinking, and greater metacognition make it challenging for teachers to teach gifted students in inclusive classrooms. These characteristics serve as the basis for using differentiation of instruction in gifted education, or for initiating a separate program for the development of critical thinking in gifted students or learners [19].

3.1 Critical Thinking Skills

In recent years, the development of critical-thinking skills has increasingly been considered a worthy and important educational goal. In this age of globalization, critical thinking is considered one of the most essential skills that is needed for the twenty-first century [20]. Moreover, critical thinking is also increasingly being associated with educational outcomes. Multiple studies have found that critical thinking has a significant impact on students' learning ability and academic achievement [21,22]. This implies that critical thinking is directly related to students' academic success, which makes it an important area in the contemporary world of education. Many written works by educators have surfaced highlighting the importance of fostering critical-thinking skills, and instruction related to this type of development has been increasingly incorporated into the curricula of education programs.

Critical thinking is considered an important life skill for all learners, and its development is linked with making learners adept at handling challenging and complex life situations [23]. Hence, considerable attention is now being directed towards fostering critical-thinking skills in learners. This includes the fact that critical or higher-level thinking processes have emerged as an important component of the curricula of gifted programs as well as of the regular instruction provided in classrooms.

Despite the widespread recognition of the importance of critical-thinking skills, there is no consensus on its definition. Some researchers define critical thinking in terms of theories of psychology and philosophy, while others have explain it drawing on various educational perspectives. The underlying assumptions differ to some extent, with each providing valuable insights related to what the concept entails. In this regard, in 1956 Benjamin Bloom and his associates presented a taxonomy for information-processing skills, which remains one of the sources that is most widely cited by educational practitioners when it comes to assessing and teaching these skills. The taxonomy is in the form of a hierarchy, with 'comprehension' at the bottom and 'evaluation' at the top, and with the three highest levels (analysis, synthesis and evaluation) being related to the concept of critical thinking [24].

The educational approach has its basis in years of observing student learning and the experience of educators in the classroom. There are some specific abilities encompassed within the definition of critical thinking. Lau [20] is of the view that a critical thinker is someone who is able to understand the logical connections between ideas; to identify, construct and evaluate arguments; to evaluate the pros and cons of a situation; to analyse problems in a systematic manner; to reflect on and evaluate their own thinking skills; and to detect inconsistencies and common fallacies in reasoning. A closer look at these characteristics reveals that the definition of critical thinking has two major components, these being skills and attitudes.

Other scholars have associated critical thinking with other skills such as metacognition and creativity. Magno [25] suggests that metacognition plays an important role in the development of critical-thinking skills, while Ku and Ho [26] think that the use of metacognitive strategies is crucial to the thinking process. Apart from metacognition, critical thinking is also associated with creativity, and scholars suggest that some amount of creativity is essential for critical thinking [27].

3.2 Giftedness and Critical Thinking

The promotion of critical thinking has developed into one of the most important goals of schooling. It has been acknowledged that critical-thinking skills are not innate, but rather that they can be acquired through education, practice and training [28]. Nevertheless, many observers continue to believe that gifted children have an innate ability to think critically. Many researchers have advocated for explicitly teaching critical thinking to all learners (including to gifted children) and consider such an approach to be more effective for fostering this kind of thinking [28]. It should be acknowledged that the mere fact that a gifted child has superior intellectual abilities does not necessarily mean that he or she will have critical-thinking skills without having been provided with an understanding of key strategies for thinking in this manner [29]. The basic assumptions and concepts largely suggested in the research literature are that the critical-thinking skills that should be taught explicitly to average students should also be taught to gifted students, albeit taking into account differentiation of instruction. The only main difference is the pace at which they are expected to learn the skills. This is particularly true because the foundations of critical thinking are similar and do not differ on the basis of the cognitive abilities of the learner [30]. Furthermore, since gifted students learn at a faster rate and are typically better at the skills necessary for critical thinking, instruction should involve tasks or activities that they find challenging (i.e., those that involve a higher expectation on them with regard to process and content demands) [31]. On the other hand, even though many of the critical-thinking tasks are performed better by gifted learners than by students who have average abilities [30], this does not mean that gifted students do not require critical thinking to be taught to them.

Vygotsky's theory of zone of proximal development (ZPD) is particularly relevant in this regard. ZPD is directly related to differentiation of instruction, which is a central premise of gifted education. This is because the teacher is required to provide his or her students with activities that are challenging for them. For learning to take place, there is a need for students to employ a more advanced approach

to thinking [32]. Since there are differences among gifted students as well as among other students, the teacher not only has multiple cognitive characteristics to focus on but also has a range of social and emotional needs to address. Thus, in accordance with the ZPD theory, instruction needs to fall within the ZPD of each of the gifted students in order to ensure that the development of critical-thinking skills is effective [33].

There is debate surrounding whether teaching critical thinking to gifted students would lead to better results within a homogenous or a heterogeneous learning environment. Notwithstanding this debate, researchers broadly agree that there needs to be differentiation of instruction for both types of learning environments. Hence, programs have been initiated in all parts of the world that are aimed at teaching critical-thinking skills to gifted students.

3.3 Educational Programs

The teaching of critical thinking has become the focus of many educational institutions, not only for students with average intelligence but also for those who are identified as gifted [33]. In recent years educational decision-makers have favoured inclusion to address, through modifications to curricula and instruction, the needs of gifted students in a heterogeneous classroom [34]. However, Hertberg-Davis [35] has identified the fact that the effective differentiation of the curriculum, in order to address the specific and special needs of gifted students in a mixed-ability classroom, is difficult to accomplish. Within the field of gifted education, differentiated learning is considered a foundational idea and is defined both by heterogeneous grouping and by separate programs, especially for gifted learners.

Educational reforms in the mid-1920s saw the emergence of many programs and curricula tailored to the gifted and talented population of many developed countries [33]. Over the years, the many enrichment programs designed for children with special abilities came to be regarded as having significant influence. The structure of these programs allowed for flexibility in meeting the diverse needs of these gifted learners and in providing them with differentiated kinds of learning environments.

A review of the literature reveals the fact that little research has been conducted on the subject of gifted education itself; however, researchers have examined the teaching of thinking skills and have prioritized critical-thinking skills to gifted students [35]. Despite the availability of many studies on the subject of fostering critical thinking, only two key strategies are considered in this study for the specific development of critical thinking in gifted students: the Dixon-Hegelian method [36] and the use of online technologies [36]. The dearth of studies related to the strategies that can be employed for fostering critical thinking in gifted students has not yet been addressed, which makes it difficult for those who are teaching gifted students to employ effective approaches. Another barrier is the fact that many of these gifted students are part of heterogeneous classrooms [37] and are not enrolled in special classes.

Although the importance of critical thinking for many aspects of professional and academic life is mentioned in the literature [38], the literature also shows that schools often fail to effectively promote critical thinking [39]. The field of gifted education generally has regarded the promotion of critical thinking as a desirable goal for gifted programs. Research studies pertaining to gifted education have reported attempts at improving gifted students' critical-thinking skills. Yet, despite the attention that has been directed towards the development of critical-thinking skills among members of this population, the literature does not provide many details about the strategies employed and about the extent to which these programs have been effective.

The literature generally focuses on the critical thinking of older students or learners and, in particular, on the critical thinking of members of university-level student populations; there are only a few studies that have examined critical-thinking skills among members of elementary-level student populations, including within some populations of gifted students. VanTassel-Baska et al. [40] measured growth in critical thinking and reading comprehension among high-ability learners over the course of an instructional intervention as part of Project Athena, which is a set of curriculum units for developing and enhancing students' critical thinking. Significant improvements were observed in the critical-thinking skills of high-ability students; however, over a three-year period, the researchers observed that members of both groups (i.e., the control and experimental groups) made similar gains. VanTassel-Baska et al. [40] observed the fact that the individuals who received a higher IQ score also attained a higher score in the Test for

Critical Thinking, which lends credence to the notion that gifted students are better at critical thinking than non-gifted students. The research literature currently does not offer any studies on the effectiveness of critical-thinking programs specifically designed for developing and enhancing these skills in gifted learners. This lack of published research extends to the Kingdom of Saudi Arabia, where this study was conducted.

3.4 Evaluation of the Effectiveness of the *Mawhiba* Program

In many countries, the education system gives considerable attention to designing programs that promote giftedness and creativity. The Kingdom of Saudi Arabia ranks among these countries as it is making a substantial investment into providing support for gifted services and programs in a variety of pre-university programs [41]. While in the past in Saudi Arabia gifted students were not identified, the last two decades have seen a significant increase in interest in this area. The implementation of a wide range of gifted education programs all over the country by the Ministry of Education in 1998 was the first practical step in this direction; this was followed by the establishment of the King Abdulaziz and his Companions Foundation for Giftedness and Creativity as a solid basis for promoting gifted education and for developing and implementing programs aimed at fulfilling the needs of members of this group. Since that time, many programs for gifted students have been established throughout the Kingdom in order to respond to the social, emotional and cognitive needs of their participants [42]. Over the last decade, these programs have received substantial positive feedback from students, educators and parents.

Although the programs themselves are receiving considerable acknowledgement, less attention is being paid to the evaluation of their actual effectiveness. Program evaluation is a form of systematic analysis for generating information that can help in the processes of making significant judgements related to a future course of action and of gaining an understanding of the extent to which the program has achieved the objectives for which it was created [43]. Thus, program evaluation can be applied to virtually any kind of program, but it is arguably especially relevant to educational programs because it can help to identify future courses of action. Program evaluation is also significant because it may help to determine the need for changes to a program, whether to extend further support to a program, or whether to end a program [44].

The literature review identified gaps in knowledge surrounding the teaching of critical-thinking skills to gifted students and surrounding the evaluation of these programs in order to determine their effectiveness, areas where changes or improvements are needed, and areas of strength in order to inform future courses of action.

The authors emphasise that the rationale for focusing on secondary-school female students is that the gender segregation in Saudi schools meant that the two researchers, both of whom are female, only had access to female students for the purposes of the study.

4. Data Collection

4.1 Exploratory Sample

A pilot test was carried out to assess the validity and reliability of the instruments used in the study. A pilot sample consisted of 40 talented students, all of whom were program participants, originating from the Eastern Province of Saudi Arabia and ranging in age from 12 to 16 years with an average age of 14.26 and with a standard deviation of 1.207.

4.2 The Sample

The sample consisted of 40 gifted female students from the Eastern Province of the Kingdom of Saudi Arabia. The ages ranged from 12 to 16 years with an average age of 14.26 and with a standard deviation of 1.207.

The sample was passed through a succession of stages that depended on a variety of factors, such as their level of academic achievement (95 per cent or higher), an aptitude test held at the National Center for Assessment in Higher Education, and nomination by teachers and the education department.

Students were selected for the research sample according to criteria determined by the Ministry of Education: teachers' nomination; a cumulative GPA of 95 per cent or higher; and success in an aptitude and measurement test (which served as a measure of talent). All of the students in the Mawhiba program were tested before and after their participation in the program.

4.3 Tools

The Critical Thinking test, prepared by Jabir Abdulhameed Jabir and Ahlam Al-Baz [45], is designed to measure critical-thinking skills and consists of 80 items distributed across five dimensions featuring 16 multiple-choice questions. The five dimensions are as follows: the evaluation of arguments; the drawing of conclusions; reasoning; the identification of assumptions; and the dimension profile (which represents the emotional side of the individual, such as flexibility in formulating opinions, self-esteem and accuracy).

To check the validity (the appropriateness and effectiveness) of the scale, we used the validity and reliability of the test content: 60 minutes were required to apply the scale to the students at the intermediate level and 50 minutes were required to apply the scale to the students in secondary school. However, in the current study not more than 30 minutes were required to apply the measurement; this might be a reflection of the fact that the research sample was composed of talented students. Invariability was calculated using Cronbach's alpha coefficient values; the reliability coefficients for the test and its dimensions are provided in Table 1.

Table 1 shows the Cronbach's alpha for each of the five dimensions of the test as well as for the entire test.

We emphasise the fact that the Cronbach's alpha coefficient is a measure of the internal consistency of a test. It is also considered to be a measure of scale reliability.

Note that each of the alpha values set out in Table 1 for each of the five dimensions is greater than 0.70. This proves the internal consistency of each of the test dimensions as acceptable alpha values to confirm the internal consistency of the test range from 0.70 to 0.95.

Stability was calculated in a re-application manner using an interval of 16. On day 1, the sample equalled 40.

In order to assess the impact and efficiency of the Mawhiba program, the mean scores of the students' results before and after the program were compared for each dimension using the t-test.

Table 2 shows the values of the t-test obtained from a sample of 30 students for each dimension.

4.4 Description of the *Mawhiba* Training Program (Talent summer program)

The King Abdulaziz and his Companions Foundation for Giftedness and Creativity is the provider of the *Mawhiba* program. This national cultural foundation is honoured to be presided over by the Custodian of the Two Holy Mosques, who supervises it directly and continuously and who gave the following inspirational statement: 'Let us each play a part and assume responsibility with regard to the initiation of this foundation, which does not exclude anyone, but rather constitutes a partnership involving all of us, we the citizens, without exception' [42]. Female students were selected after completing a test that measured their ability to solve basic math and science problems. The program was designed in 2013 by international staff of the Youth Talent Center and by the staff of the summer program at Johns Hopkins University. On the other hand, the program is administered at the University of Dammam, which is a public university located in the Eastern Province of Saudi Arabia. The program's trial period (five consecutive weeks and five days per week) involves about six hours of training per day.

The program consists of three scientific components: Introduction to Biomedical Sciences, Engineering Design and Electrical Engineering. The program's educational content encompasses problem solving, creative and critical thinking, decision making, planning, time-management skills and teamwork, as well as writing and public-speaking skills.

Through the scientific content of the program the students learn how to ask scientific questions, develop hypotheses, and conduct experiments in order to interpret medical and engineering phenomena; this gives students opportunities to ask questions and form their own conclusions.

Throughout the program the students have many opportunities to work together. They are divided into groups at the end of each task and then are asked to submit a written report describing what they have learned and to present what they have designed. The program also promotes student learning through lessons that link the various activities in science. Discussions follow each subject, which enables the students to interact, understand and extract information more effectively.

Table 1. The stability of the test and its dimensions

The test as a whole	Dimension profile	Identification of the assumptions	Deductive reasoning	Drawing conclusions	Evaluating arguments
88.0	81.0	86.0	84.0	81.0	78.0

4.5 Role of Teachers

In the context of the *Mawhiba* Talent Summer Program, the teacher is a facilitator. She directs and provides assistance when necessary, keeps the students informed about the remaining time for each task, and observes the students' performance to make sure that they carry out their duties.

The supervisors and teachers used cooperative learning strategies, group discussions, mindmaps, meditative writings, strategic questioning, self-assessment and peer assessment in various learning-related activities that focus on learning assessment rather than on knowledge assessment. By practicing these strategies, the teachers contributed to providing a suitable atmosphere for the development of critical-thinking skills, the development of analysis, the realization of contrasts, composition and evaluation.

4.6 Evaluation Methodology

There was an initial assessment on the first day, which served to measure the students' critical-thinking skills, and formative feedback/assessment was provided throughout the program in order to monitor the students' improvement and growth. Assessing students each day helped with planning and setting goals for the next day. A final assessment at the end of the program (in week 5) measured the students' educational growth, together with the effectiveness of the program itself, in developing critical-thinking skills.

4.7 Code of Ethics

One of the key components of the program was that the teachers were keen to sign a code of conduct with the students on the first day. The consensus around a set of guidelines helped to create a safe and positive learning environment.

Given the fact that this was an intervention study, it was considered necessary to obtain informed consent from all of the participants and to make clear that the data collection was for research purposes only and that the students had the right to withdraw from the study at any time. Anonymity was guaranteed to the students and to the teachers.

5. RESULTS AND DISCUSSION

One of the main questions of the study was whether there were any differences in the students' critical-thinking skills that resulted from participation in the gifted training program. In order to answer this question, a statistical t-test for the associated groups with pre and post measurements was used. The results are set out above in Table 2.

From this table it is possible to identify the presence of statistically significant differences among the median scores within the experimental group in the pre and post measurements of critical-thinking skills like deduction, the identification of contradictions and the total scores for critical thinking which, as measured by the t-values, were 2.414, 2.88 and 3.46 respectively. These values are functions at the level of significance of 0.05.

The program appears to have had more of an impact on the development of the skills and critical thinking than on conclusion-drawing skills (0.16). The value for the identification of assumptions (0.222) and the total score for critical thinking (0.292) were high, which confirms the high effectiveness of the training program in developing critical-thinking skills among talented students.

Another key research question was whether there is a relationship between critical thinking and academic achievement among gifted female students. To answer this question a Pearson correlation coefficient was used. This found a correlation at a level of significance between the academic achievement of gifted female students and their critical-thinking skills (the total score); the value of the correlation coefficient was 0.372.

The question also arose around whether there were any differences in critical-thinking skills based on grade level (secondary versus intermediate, for instance).

Table 2. Paired samples t-test comparing the mean scores in the pre-test and post-test for critical thinking

Effect size	Eta square	P level of significance	df.	T value	Measurement				Critical-thinking skills
					Post		Pre		
					S.D	Mean	S.D	Mean	
Insignificant		0.184	29	1.36	1.40	12.60	1.91	12.20	Evaluation of arguments
Highly significant	0.167	0.02	29	2.414	1.75	14.60	2.1	13.53	Drawing of conclusions
Insignificant		0.823	29	0.226	1.06	14.6	0.93	14.56	Deductive reasoning
Significant	0.222	0.007	29	2.88	1.81	12.40	3.79	10.63	Identification of assumptions
Insignificant		0.902	29	0.124	1.53	11.83	1.82	11.80	Dimension profile
Significant	0.292	0.002	29	3.46	4.8	66.60	6.5	62.7	The total score for critical thinking

(S = 30)

Table 3. Results of the t-test for significant differences among the medians of talented students' scores in terms of critical-thinking skills and the overall degree of critical thinking depending on the school level

The level of significance	df.	T value	Grade level				Critical-thinking skills
			Secondary		Intermediate		
			S.D	Mean	S.D	Mean	
Insignificant	28	0.163	1.83	12.11	1.99	12.23	Evaluating arguments
Insignificant	28	0.221	2.06	13.66	2.20	13.47	Deduction
Insignificant	28	1.81	1.05	14.11	0.83	14.76	Reasoning
Insignificant	28	0.555	1.85	11.22	4.38	10.38	Identification of assumptions
Insignificant	28	1.76	1.7	11.42	1.71	11.42	Dimension profile
Insignificant	28	0.625	5.08	63.88	7.14	62.3	The total score for critical thinking

(S = 30)

It is evident from Table 3 set out that there are no statistically significant differences among the median scores of gifted students in terms of critical-thinking skills and among the total scores for critical thinking associated with various grade levels.

The current study has demonstrated the effectiveness of the Mawhiba Summer Talent Program in nurturing critical-thinking skills in secondary-school students [1]. Al-Hunaifi and Al-Lizam [1] demonstrated that it is possible to study the development of critical-thinking skills among middle-school students, though that study focused on the theory of multiple intelligences. Al-Rashid [46], in a similar study, showed that there is weakness in critical thinking in terms of analysis and investigation in eighth-grade science classes in Saudi Arabia. Al-Obaidi [47] showed that gifted students that the gifted students in his sample group have some critical-thinking skills in mathematics, but within a very limited scope. This study also showed that there is a lack of talented teachers in Saudi Arabia who use methods and strategies that contribute to students' critical thinking. Nevertheless, the teachers in the Mawhiba Summer Talent Program played a key role in fostering critical thinking among gifted students in the Eastern Province of Saudi Arabia.

The success of this program can largely be attributed to the systematic use of multiple strategies that have been proven to contribute to the development of critical thinking, as well as to a commitment to following the stages of critical-thinking development throughout the three parts of the program, which are Fundamentals of Electrical Engineering, Engineering Design and Introduction to the Biomedical Sciences; these stages involved the students in searching for information, finding connections among its various component parts, and then evaluating and resolving internal contradictions. Moreover, the students examined facts, observations and data and then analysed, evaluated and judged them. This provided the students with an opportunity to engage in educational activities based on problem solving, experimentation, analysis, comparison and decision making. The students also became accustomed to putting forward their views and to keeping an open mind while assessing the views of others. All this contributed in one way or another to the development of critical-thinking skills [48].

Moreover, these activities put the students in an environment that required the detection of similarities and differences, the use of analytical thinking skills in the process of solving the engineering problems, the reading and analysis of data, and the interpretation of quantitative and qualitative data, as well as the use of oral- and written-communication skills in classroom discussions and presentations. During the implementation of the program sessions, the teachers encouraged the students to explore scientific accuracy in expression, as well as to raise questions and engage in dialogue, discussion and debate.

The results of the current study have shown that the lack of statistically significant differences between the mean scores of talented students in critical-thinking skills, individually as well as the overall degree of critical thinking due to the type of the school stage where there are slight differences in the age variable. In addition, it seems that talent is not affected by age – though this result differs from the results of a study [47] that showed differences between students in the first and fifth grades in terms of their critical-thinking skills, a conclusion that strongly suggests that the growth factor affects the development of critical thinking. However, in the current study, the researchers noticed that the talent variable did not suggest that these differences are due to the chronological age factor.

5.1 Implications for Practice

The results of this study clearly show that the creation of a suitable learning environment, based on interactions and communication that are free of anxiety and stress, is the most important contributing factor to the development of critical-thinking skills. Such a learning environment encourages students to find solutions to the various problems that arise in learning situations, by critically evaluating arguments and by predicting the consequences of a solution to a specific problem.

The sessions were designed to allow students to practice and develop a variety of skills. There were discussions of scientific topics, theoretical analysis, and examination of scientific rules in physics and electrical engineering. The students were encouraged to use critical thinking to discuss and analyse documentary films, analyse results, provide feedback, explore their strengths and weaknesses, and suggest ways to improve. All of these components encouraged the students to engage in conversations and to

actively participate in the analysis of scientific facts according to to clearly defined standards of assessment.

6. CONCLUSION

This study describes, measures and analyses the impact of the *Mawhiba* summer giftedness program on female students in Saudi Arabia. This study is the first to address the effect of a science-condensed program on students' abilities and, in particular, on their critical-thinking skills [49]. The main recommendation based on the results of the study is to establish a database for each group of students that participates in these programs across the Kingdom of Saudi Arabia in order to identify areas of strength and weakness in the program as a whole. There should be additional studies on the effectiveness of this type of program. One of the benefits of the *Mawhiba* program is the tailored environment that it provides, where students can receive constant attention. The *Mawhiba* summer program potentially could also be offered as a camp; however, Saudi parents are not accustomed to boarding schools and might especially resist sending their female children to such schools. As noted by Batterjee [8], more market research to test how acceptable this would be to parents is recommended. In this respect, additional research with larger and more diversified samples is also recommended. Because this study only focused on female students, the literature would be enriched if researchers also studied the effectiveness of this type of program for male students' development of critical-thinking skills.

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COMPETING INTERESTS

The authors have declared that they have no competing interests.

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