International Journal of Evaluation and Research in Education (IJERE)
Vol. 15, No. 6, December 2026, pp. 4977~4991
ISSN: 2252-8822, DOI: 10.11591/ijere.v15i6.40237

Students' views on the integration of basic future-adaptation competencies within gifted programs

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Article Info

Article history:

Received May 2, 2026
Revised Aug 28, 2026
Accepted Oct 25, 2026

Keywords:

Core competencies
Delphi
Future adaptation
Gifted programs
Gifted students classes

ABSTRACT

This research aimed to identify the degree of familiarity with the core competencies necessary for future adaptation in gifted programs, across three main levels: knowledge, skills, and attitudes. A sequential exploratory mixed design was employed. In the first phase, the Delphi method was used to collect mixed data from experts to construct the instrument. In the second phase, the instrument was applied to students to collect quantitative data. The findings revealed variation in the extent to which the six core competencies were incorporated into gifted student programs: four competencies were highly included, while two were minimally included. The competencies with a high degree of inclusion were, respectively: analytical thinking, creativity, executive function, and inquiry-based learning. The two competencies with a low degree of inclusion were, respectively: learning how to learn in technology and interdisciplinary skills. Overall, the degree of inclusion of the six core competencies was moderate across the three levels (knowledge, skills, and attitudes).

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1. INTRODUCTION

The concept of competencies has appeared in the research literature in various forms, giving rise to models and frameworks for core competencies that can be used to develop competency-based programs and strategies for gifted students. For instance, Voogt and Roblin [1] discussed competency in the context of using one's resources effectively to meet needs. Similarly, Alkharusi [2] noted that knowledge, skills, and characteristics are necessary for performing tasks effectively and sustainably.

There are basic competencies that researchers consider essential for gifted students to acquire, enabling them to engage more effectively in life and work and to achieve the goals expected of them. The specific competencies identified tend to vary somewhat across researchers, which can be explained in two ways. First, researchers typically build on prior research in the field. Second, several different methodologies and tools are used to develop these competencies, drawing on experts, employers, interviews, observations, and documentary analysis. Some variation in results is therefore to be expected; however, these findings generally align in content and complement one another.

For example, previous study [3] identified three competencies required of gifted students: independent behavior, use of intellectual tools, and social interaction. The same study by Best and Miller [3] further identified an additional set of competencies for gifted students: knowledge and skills competence, creativity competence, and personal competence. Similarly, another study by Kotsiou *et al*. [4] developed the following set of competencies: intellectual ability, creativity, leadership, and self-direction. Additionally, study by Kim and Lee [5] developed a broader set of core competencies, including creative problem-solving,

information processing and tool use, communication and collaboration, situational preparedness and practice, achievement orientation, community spirit, higher-order reasoning, and convergence and application. Finally, Callahan *et al.* [6] identified a set of competencies required of gifted students, comprising communication and collaboration, critical thinking and problem-solving, creativity and imagination, citizenship, digital literacy, learning to learn, and self-efficacy.

Following the classification issued by the European Union in 2006, which comprised eight competencies driving efforts to develop and restructure curricula and reform teaching methods, a distinguishing feature of core competencies is that each one focuses on three key levels: knowledge, skills, and attitudes [7]. It should be emphasized that these competencies are learned within a social and cultural context, such as through practice [8]. For example, one such core competency is information literacy, as defined by the European Union [7]. The level of knowledge, skills, and attitudes is defined as: the ability to use information technology confidently and critically in work, life, and communication, based on fundamental information technology skills and the ability to use computers and the internet.

Therefore, some researchers have begun focusing on the workplace to identify the competencies employers seek when hiring, as well as those they wish to develop in their employees. This is because the workplace is where these practices are applied, and employment reveals the practical aspects of knowledge, skills, and attitudes valued by employers. Consequently, these aspects are, in turn, highlighted for students during their education. A study by Beghetto and Kaufman [9] conducted a qualitative analysis focusing on one such competency, namely "informational competence", collecting data from employers regarding the competencies they assume to be present in newly graduated employees. They identified a set of informational competencies found to be lacking among recent university graduates, the most frequently occurring of which were four: engaging team members during the research process, retrieving information using a variety of formats, identifying patterns and making connections, and thoroughly exploring a topic.

When conducting research aimed at predicting future competencies, it is necessary to consider the three levels of knowledge, skills, and attitudes within each competency, so that stakeholders can include them in a balanced manner across both the research and educational scales. In research that aims to measure competencies through a questionnaire, for example, these three competencies are considered when constructing the axes of the instrument, such that each axis measures the targeted competency at the levels of knowledge, skills, and attitudes. As for the educational scale, these levels are reflected in reform plans during curriculum development, in the strategies teachers use to cultivate these competencies, and in the assessment tools used to determine the extent to which the goals have been achieved.

It is clear from Dubois [10] that adaptability is the ability to respond positively to unexpected situations and problems, to make appropriate decisions and identify suitable solutions, and to remain flexible in emergencies by taking the necessary steps to correct course. There are several aspects of adaptability [11], it can be define as a psychological and social construct formed through the readiness and resources needed to successfully cope with professional tasks, career transitions, and unexpected challenges to successfully cope with professional tasks, career transitions, and unexpected challenges. The related term adaptation appears in Savickas and Porfeli [12], which defines it as an individual's ability, skill, or willingness to change to meet the demands of different tasks or social and environmental conditions. Operationally, in this research, adaptability is defined as the ability to cope with rapid future changes and succeed in professional and social environments.

Some research highlighted the educational environment that provides the best opportunities in practice and through which the functional adaptation experiences of gifted students are built [13]. Several aspects of education have been affected by the fourth industrial revolution, including curriculum reform, the integration of technologies employing artificial intelligence and robotics, the development of non-cognitive skills, and the creation of innovative opportunities worldwide. Previous study [14] noted the role of specialized career guidance in educating gifted students about their future careers. Similarly, there is a relationship between professional growth and adaptability in terms of well-being, job satisfaction, engagement, and organizational performance, which requires implementing programs and strategies to develop adaptability [15].

Ongoing global competition and rapid development driven by the fourth industrial revolution continue to generate predictions of further change across all fields. This accelerating pace of change necessitates a rethinking of how to prepare for the future. For example, many jobs are expected to become obsolete, with more than 40% at risk of automation by 2030 [16]. The World Economic Forum also estimates that by 2025, 50% of the global workforce will need to reskill due to the integration of new technologies [17]. This shift calls for a workforce equipped with skills that differ from those of the past, along with greater flexibility to adapt to change. Despite the emergence of several studies examining the core competencies of gifted individuals, whether related to teachers, students, or curricula [6], [18], [19], Arab countries continue to show a deficiency in research addressing core competencies. Although gifted programs successfully develop analytical and creative thinking, they may not sufficiently prepare students with interdisciplinary and technology-based competencies needed to adapt to rapidly changing future environments. Teaching in schools

tends to focus on methodological aspects, as outlined by Lee and Park [20], which lead to academic preparation [6]. Indeed, preparing students for well-known professions is no longer sufficient given the tremendous pace of development; rather, students must be prepared for the unknown [7]. Hence, the importance of reforming education and focusing on developing a framework of competencies applicable to diverse and evolving circumstances, so that these competencies provide the flexibility through which gifted students can adapt to changes in their professional futures. Renzulli [21] catch-a-wave theory of adaptability serves as the theoretical basis for this study. In this theory, Renzulli [21] proposed a set of core competencies considered important for the professional adaptation of gifted individuals. It is the set of competencies that this study takes as a foundation, developing and testing them empirically to establish evidence-based practices.

The research gap lies in the lack of studies in Arab contexts, particularly Saudi Arabia, that examine gifted students' perspectives on future adaptation competencies. The current research therefore develops a scale of core competencies that support the new skills required by the labor market in the context of the fourth industrial revolution, and subsequently measured from the perspective of gifted students. Therefore, the research will answer the following question: what degree of inclusion and core competencies are needed for future adaptation in programs for gifted students, from the students' point of view?

2. METHOD

2.1. Research design

The sequential exploratory mixed design was used [22]. In the first phase, the Delphi method was employed to collect mixed data from experts to construct the study instrument. In the second phase, the instrument was applied to students to collect quantitative data.

2.2. Participants

The sample consisted of experts selected based on the following criteria: i) ≥5 years in gifted education; ii) ≥2 peer-reviewed publications; or iii) leadership in national gifted programs; all provided informed consent. The number of Delphi panel members who agreed to participate was 18. A previous study by Callahan *et al.* [6] indicates that the appropriate number of people to gather different perspectives through a Delphi survey can range from 10 to 18 experts in the field. Following finalization of the instrument, it was administered to a sample of 207 gifted middle and high school students. According to the table in Alarfaj [23], if the number of gifted individuals is more than 2100, then the sample size should not be less than 175.

2.3. Instrument development

Regarding the research instrument, a preliminary version of the list of core competencies, along with their definitions and elements, was developed based on the core competencies proposed by Renzulli [21]. This preliminary version included five core competencies: analytical thinking skills, creativity skills, investigative research skills, executive function skills, and skills for learning how to learn in technology. After preparing this list using Google Forms, it was distributed to the participating experts via an electronic link on WhatsApp, where they were asked to indicate their degree of agreement with each competency on a five-point scale (1=strongly disagree, 5=strongly agree), and to provide positive, negative, and developmental comments. The final version of the scale consisted of six dimensions, totaling 117 items, with each dimension assessed across three levels: knowledge, skills, and attitudes. Full details are provided in https://drive.google.com/file/d/1PdveP9rr_QIv3sCCkUpae0JfzoouImtz/view?usp=sharing.

2.4. Data collection

As for data collection techniques, this was achieved through three Delphi rounds, during which the core competencies were progressively developed and refined. In each round, mixed data were collected, analyzed, and returned to the experts for further consideration in the next round. The quantitative data collected from the students were obtained through a questionnaire developed specifically for this study.

2.5. Data analysis

Concerning data analysis, the collected data consists of two aspects: quantitative and qualitative. The quantitative data were analyzed using SPSS to calculate means and standard deviations, in order to the panel's degree of agreement on the list of core competencies. The qualitative data were analyzed thematically using MAXQDA software. Separately, the quantitative data collected from students were analyzed using SPSS software to calculate means and standard deviations, and a confirmatory factor analysis (CFA) was conducted using Jamovi to validate the structure of the scale.

2.6. Validity and reliability

Content validity was established through expert review across the Delphi rounds, continuing until consensus was reached on the scale as a whole. In each round, the competencies assessed averaged over 3.5 out of 5 (equivalent to over 70%), reflecting a consensus among experts in the Delphi rounds [11], indicating strong agreement among the 18 experts regarding the core competencies considered essential for the future adaptation of gifted students. The Cronbach's alpha coefficient was also calculated to verify the reliability of the experts' responses. All dimensions achieved a Cronbach's alpha coefficient of 0.90. The qualitative data collected from experts in each round underwent guided content analysis, a methodology well suited to this type of data [24]. This approach relies on the researcher possessing pre-existing classifications or concepts, which serve as a preliminary framework to guide the coding and meaning extraction process.

This analysis was conducted in four interconnected stages: i) organizing the data according to the questionnaire's elements and their three classifications; ii) identifying key ideas from the feedback; iii) compiling the most significant strengths, weaknesses, and proposed improvements that would achieve the research objectives; and iv) presenting the revised list of core competencies. Through this process, the instrument's initial five dimensions were expanded to six, with the sixth dimension emerging directly from the guided content analysis. Table 1 illustrates the stages of the instrument's development. The final version of the instrument was also administered to a pilot sample of middle and high school students, yielding a Cronbach's alpha coefficient exceeding 90%. The construct validity of the instrument was also verified through CFA as: given that the scale consists of 117 items, which is considered large relative to the sample size of 207 students, and to avoid problems of normality distribution and instability of the statistical model, the researcher used an item parsing strategy. The items within each dimension were grouped into three parcels based on a periodic distribution to perform CFA [25].

Table 2 shows the descriptive statistics for the scale variables, comprising 18 statistical packages distributed across the six dimensions. To verify the suitability of the data for conducting CFA, the researcher examined the normality of the distribution using the skewness and kurtosis coefficients. The skewness values were between (-1.030 and 0.360), while the kurtosis values were between (-0.775 and 0.002). These values all fall within the scientifically acceptable range for skewness and kurtosis (between -2 and +2) according to the statistical criteria [26]. This indicates that the conditions of normality and one-way normality of the study data were met, and accordingly, the data were suitable for applying the CFA model using Jamovi software.

Table 1. Stages of tool development

Round	Round 1	Round 2	Round 3
Number of items retained	123	78	117
Number of items deleted	0	60	0
Number of items added	15	39	0
Total after modification (retained+added)	138	117	117

Table 2. Descriptive statistics for scale parcels

Parcels	N	Mean	Std. Deviation	Skewness		Kurtosis	
	Statistic	Statistic	Statistic	Statistic	Std. Error	Statistic	Statistic
F1_P1	207	3.7440	1.26722	-0.961	0.169	-0.232	0.337
F1_P2	207	3.8031	1.28856	-0.999	0.169	-0.223	0.337
F1_P3	207	3.8170	1.29534	-1.03	0.169	-0.198	0.337
F2_P1	207	3.7208	1.38308	-0.958	0.169	-0.499	0.337
F2_P2	207	3.7565	1.32454	-0.992	0.169	-0.254	0.337
F2_P3	207	3.7623	1.36813	-0.966	0.169	-0.469	0.337
F3_P1	207	3.6699	1.33445	-0.809	0.169	-0.672	0.337
F3_P2	207	3.7332	1.34354	-0.811	0.169	-0.699	0.337
F3_P3	207	3.6758	1.32335	-0.813	0.169	-0.68	0.337
F4_P1	207	3.6691	1.36921	-0.753	0.169	-0.775	0.337
F4_P2	207	3.7013	1.34742	-0.85	0.169	-0.608	0.337
F4_P3	207	3.7391	1.35265	-0.894	0.169	-0.575	0.337
F5_P1	207	2.8357	0.76675	0.36	0.169	0.002	0.337
F5_P2	207	2.5611	0.81386	-0.017	0.169	-0.653	0.337
F5_P3	207	2.3140	0.70850	0.152	0.169	-0.647	0.337
F6_P1	207	2.7585	0.82930	0.159	0.169	-0.085	0.337
F6_P2	207	2.5447	0.84697	-0.016	0.169	-0.691	0.337
F6_P3	207	2.2536	0.75221	0.307	0.169	-0.445	0.337
Valid N (listwise)	207						

The construct validity of the tool was verified using CFA on a sample of 207 students. As shown in Table 3, the results indicated that the six-dimensional model had a good degree of fit to the data: the comparative fit index (CFI) was 0.977, the value of the Tucker-Lewis index (TLI) was 0.969, the value of the standard root mean square residual (SRMR) index was 0.034, while the value of the root mean square error of approximation (RMSEA) index was 0.096. These results indicate the acceptance of the proposed factor model. The results of the analysis also showed that all standard factor loadings were high and statistically significant at the level of 0.001, as shown in Table 4 and Figure 1, ranging between 0.781 and 0.992, which confirms the validity of the measurement indicators in representing the latent dimensions of the instrument.

Table 3. Conformity indicators

Index	Value
χ^2	332
df	115
p-value	<0.001
CFI	0.977
TLI	0.969
RMSEA	0.096
SRMR	0.034

Table 4. Standard factorial loads for scale dimension packages

Distance	Parcel	Standard factorial load (β)
First dimension (F1)	F1_P1	0.977
	F1_P2	0.986
	F1_P3	0.984
Second dimension (F2)	F2_P1	0.983
	F2_P2	0.983
	F2_P3	0.992
Third dimension (F3)	F3_P1	0.990
	F3_P2	0.984
	F3_P3	0.989
Fourth dimension (F4)	F4_P1	0.978
	F4_P2	0.983
	F4_P3	0.987
Fifth dimension (F5)	F5_P1	0.796
	F5_P2	0.835
	F5_P3	0.825
Sixth dimension (F6)	F6_P1	0.818
	F6_P2	0.840
	F6_P3	0.781

Note: all factorial loads are statistically significant at the (α≤0.001) level.

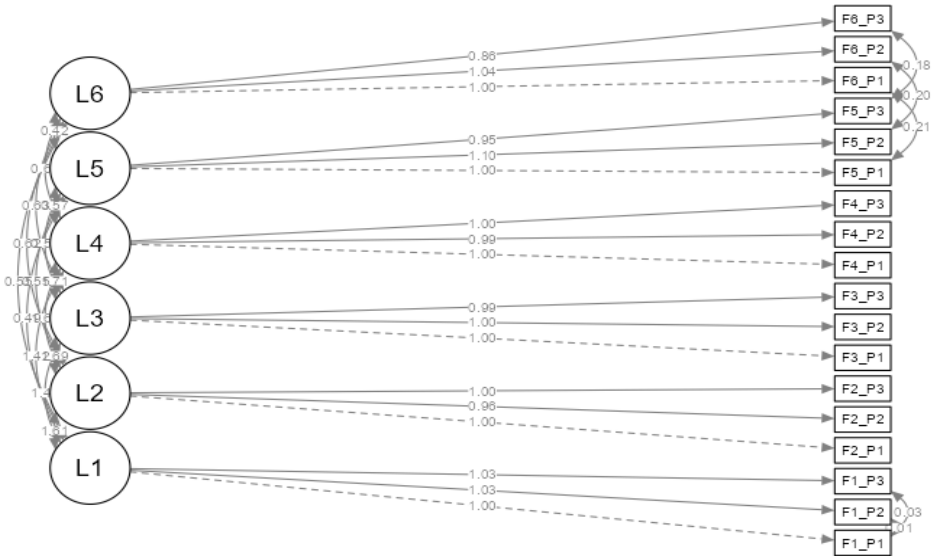


Figure 1. Confirmatory factor model

3. RESULTS AND DISCUSSION

3.1. Analysis and results of scale development in the three rounds of Delphi

The core competency scale included five dimensions in the first and second Delphi rounds. Following further development, the scale expanded to six dimensions: analytical thinking skills, creativity skills, investigative research skills, executive function skills, learning how to learn in technology, and interdisciplinary skills. This revised scale was presented to a group of 18 experts. The reliability of the responses on the core competency scale was then verified using Cronbach's alpha coefficient, and descriptive statistics reflecting the degree of consensus among experts were also calculated.

Cronbach's alpha coefficient indicated a high degree of reliability for each dimension and for the scale, as shown in Table 5. Since all values exceeded 0.90 across the three rounds, the dimensions are considered to demonstrate high internal consistency; the scale can therefore be relied upon as a data-collection instrument for measuring the degree to which core competencies are incorporated into gifted programs. Based on the descriptive statistics of the scale across the three rounds, all statements achieved agreement among the experts, with the average agreement scores exceeding 3.5 for all statements, corresponding to an agreement rate of more than 70%. However, in each round, experts offered recommendations to add to and modify the scale until it reached its final form.

Table 5. Cronbach's alpha coefficient for the competency scale basic

Dimensions of the core competencies scale	Cronbach's alpha coefficient		
	Round 1	Round 2	Round 3
Analytical thinking skills	0.987	0.983	0.997
Creativity skills	0.995	0.987	0.992
Investigative research skills	0.991	0.993	0.997
Executive job skills	0.994	0.977	0.994
Skills for learning how to learn in technology	0.991	0.992	0.997
Multidisciplinary skills	-----	------	0.991
The scale as a whole	0.998	0.996	0.999

3.2. Analysis and results of measuring the degree of inclusion of core competencies in gifted programs

3.2.1. Results of inclusion of the six core competencies in gifted student programs

This section presents the descriptive statistics for each of the six dimensions and their constituent statements, as included in the scale: analytical thinking skills, creativity skills, investigative research skills, executive function skills, learning how to learn in technology, and interdisciplinary skills. The descriptive statistics for the statements in the first dimension (analytical thinking skills), as shown in Table 6, indicate that all statements received high scores. This means that gifted programs focus on developing higher-order thinking skills, and emphasis has been placed on elements of analytical thinking through curriculum content, teacher teaching methods, and classroom activities, which has resulted in a reflection on the rise of their analytical skills.

Descriptive statistics for the statements in the second dimension (creativity skills), as seen in Table 7, indicate that all statements received high scores. This can be explained by the fact that gifted programs have historically focused on developing creativity skills, that teachers have received adequate training in strategies to develop those skills, and that curricula explicitly aim to develop creativity skills. Likewise, descriptive statistics for the statements in the third dimension (investigative research skills), as shown in Table 8 (in Appendix), indicate that all statements received high scores. This indicates an advanced instructional design, addressing real-world issues, and that teachers have been trained in strategies that encourage scientific inquiry. It also shows that students have been trained in formulating hypotheses, collecting data, and analyzing results.

Descriptive statistics for the statements in the fourth dimension (executive function skills), as shown in Table 9, indicate that all statements received high scores. This result indicates a stimulating educational environment that raises student motivation, focuses on equipping students with planning and social interaction skills, and trains them to make well-informed decisions. Descriptive statistics for the statements in the fifth dimension (learning how to learn in technology), as in Table 10, show that all statements show a degree of inclusion ranging from low to moderate. This can be explained by the weak integration of technical activities, and the fact that the curricula do not focus on artificial intelligence and programming applications, which means that the curricula need to be updated to keep pace with the requirements of the fourth industrial revolution. Finally, descriptive statistics for the statements in the sixth dimension (interdisciplinary skills), shown in Table 11, indicate that all statements show a degree of inclusion ranging from low to moderate. This indicates the scarcity of projects that focus on integrating science, mathematics, technology, and the arts, and that the curricula are still almost separate from each other, with each subject being an independent field, as well as the weakness of the professional preparation of teachers to develop multidisciplinary skills.

Table 6. Descriptive statistics for the first dimension: analytical thinking skills

No.	The element	Levels	Descriptive statistics			
			Sample	Average	Standard deviation	Degree of inclusion
1	Critical thinking	Knowledge	207	3.8068	1.42152	High
		Skills	207	3.8744	1.33427	High
		Attitudes	207	3.8696	1.35725	High
2	Systems thinking	Knowledge	207	3.7391	1.37225	High
		Skills	207	3.7585	1.43453	High
		Attitudes	207	3.8213	1.49495	High
3	Problem solving	Knowledge	207	3.8551	1.36469	High
		Skills	207	3.8357	1.36249	High
		Attitudes	207	3.8889	1.35540	High
4	Decision making	Knowledge	207	3.7778	1.39656	High
		Skills	207	3.8068	1.40435	High
		Attitudes	207	3.7826	1.34240	High
5	Analysis	Knowledge	207	3.7150	1.44172	High
		Skills	207	3.6570	1.45256	High
		Attitudes	207	3.7585	1.49095	High
6	Composition	Knowledge	207	3.7246	1.41645	High
		Skills	207	3.9179	1.44747	High
		Attitudes	207	3.8889	1.35181	High
7	Conclusion	Knowledge	207	3.6280	1.38360	High
		Skills	207	3.7536	1.34460	High
		Attitudes	207	3.7005	1.43708	High
8	Calendar	Knowledge	207	3.7053	1.30909	High
		Skills	207	3.8213	1.33727	High
		Attitudes	207	3.8261	1.41720	High
Total dimension			207	3.7880	1.3946	High

Table 7. Descriptive statistics for the second-dimensional statements: creativity skills

No.	The element	Levels	Descriptive statistics			
			Sample	Average	Standard deviation	Degree of inclusion
1	Fluency	Knowledge	207	3.8502	1.44201	High
		Skills	207	3.8261	1.44770	High
		Attitudes	207	3.8019	1.51830	High
2	Flexibility	Knowledge	207	3.6184	1.50541	High
		Skills	207	3.7246	1.37471	High
		Attitudes	207	3.6425	1.45072	High
3	Authenticity	Knowledge	207	3.7005	1.46385	High
		Skills	207	3.7150	1.44508	High
		Attitudes	207	3.8309	1.47649	High
4	Perception of details	Knowledge	207	3.6570	1.45590	High
		Skills	207	3.7246	1.34977	High
		Attitudes	207	3.7343	1.45213	High
5	Sensitivity to problems	Knowledge	207	3.7778	1.48745	High
		Skills	207	3.7923	1.43478	High
		Attitudes	207	3.8019	1.34900	High
Total dimension			207	3.7465	1.4435	High

Table 9. Descriptive statistics for the fourth dimension: executive function skills

No.	The element	Levels	Descriptive statistics			
			Sample	Average	Standard deviation	Degree of inclusion
1	Work orientation	Knowledge	207	3.7923	1.48466	High
		Skills	207	3.8164	1.53443	High
		Attitudes	207	3.8696	1.49996	High
2	Social interaction	Knowledge	207	3.6425	1.54785	High
		Skills	207	3.7198	1.45774	High
		Attitudes	207	3.6570	1.46918	High
3	Ethical leadership	Knowledge	207	3.6232	1.51787	High
		Skills	207	3.6908	1.49142	High
		Attitudes	207	3.6812	1.45642	High
4	Self-regulation	Knowledge	207	3.6425	1.49033	High
		Skills	207	3.6715	1.44757	High
		Attitudes	207	3.6280	1.47858	High
5	Planning	Knowledge	207	3.6232	1.48881	High
		Skills	207	3.6957	1.49079	High
		Attitudes	207	3.7633	1.52551	High
6	Monitoring	Knowledge	207	3.6908	1.47834	High
		Skills	207	3.6135	1.38136	High
		Attitudes	207	3.8357	1.41149	High
Total dimension			207	3.7031	1.4806	High

Table 10. Descriptive statistics for the fifth dimension: learning skills in technology

No.	The element	Levels	Descriptive statistics			
			Sample	Average	Standard deviation	Degree of inclusion
1	Identifying trustworthy information	Knowledge	207	3.1063	1.09647	Middle
		Skills	207	2.7005	89614	Middle
		Attitudes	207	2.6377	92910	Middle
2	Selectively managing broad information	Knowledge	207	2.5749	92587	Low
		Skills	207	2.4686	85771	Low
		Attitudes	207	2.2174	83380	Low
3	Organizing, classifying, and evaluating information	Knowledge	207	2.7150	99558	Middle
		Skills	207	2.5411	93321	Low
		Attitudes	207	2.2271	91463	Low
4	Using work-related information	Knowledge	207	2.8502	1.06661	Middle
		Skills	207	2.5217	1.01363	Low
		Attitudes	207	2.0580	98361	Low
5	Delivering information effectively	Knowledge	207	3.1111	1.15002	Middle
		Skills	207	2.6908	90900	Middle
		Attitudes	207	2.6812	95266	Middle
6	Planning individual learning in a purposeful and gradual manner	Knowledge	207	2.6715	99431	Middle
		Skills	207	2.4589	88516	Low
		Attitudes	207	2.1449	85233	Low
7	Implementing practical projects independently	Knowledge	207	2.8213	1.01538	Middle
		Skills	207	2.5459	90659	Low
		Attitudes	207	2.2319	92135	Low
	Total dimension		207	2.5702	0.9539	Low

Table 11. Descriptive statistics for the sixth dimension: interdisciplinary skills

No.	The element	Levels	Descriptive statistics			
			Sample	Average	Standard deviation	Degree of inclusion
1	Basic understanding of concepts from various disciplines	Knowledge	207	2.9952	1.13419	Middle
		Skills	207	2.6473	89566	Middle
		Attitudes	207	2.6425	96930	Middle
2	Linking phenomena in different fields	Knowledge	207	2.4879	96472	Low
		Skills	207	2.4444	86774	Low
		Attitudes	207	2.1014	85010	Low
3	Using diverse tools from multiple disciplines	Knowledge	207	2.6715	1.00403	Middle
		Skills	207	2.5121	92883	Low
		Attitudes	207	2.1884	93905	Low
4	Providing innovative hybrid solutions	Knowledge	207	2.8792	1.09717	Middle
		Skills	207	2.5749	1.04878	Low
		Attitudes	207	2.0821	1.01351	Low
	Total dimension		207	2.5189	0.9760	Low

3.2.2. Descriptive statistics for dimension levels

The following are the results of the descriptive statistics. For the six dimensions of the scale as levels (knowledge, skills, and attitudes). Descriptive statistics for the knowledge-level dimensions, as shown in Table 12, indicate a degree of inclusion ranging from moderate to high. This indicates that the programs provide knowledge content related to competencies, but do not reach the level of depth or breadth that works to develop these competencies comprehensively.

Descriptive statistics for the skills-level dimensions, as seen in Table 13, indicate a degree of inclusion ranging from low to high. This means that the programs provide opportunities to develop the skills associated with each competency, but are not sufficient to develop skills systematically and continuously. Descriptive statistics for the attitudes-level dimensions, shown in Table 14, indicate a degree of inclusion ranging from low to high. This indicates that the programs promote some positive attitudes towards learning, but they do not build solid attitudes that support self-directed learning, interdisciplinary learning, and the effective use of technology.

Table 12. Descriptive statistics for the level of knowledge

No.	Distance	Level	Descriptive statistics			
			Sample	Average	Standard deviation	Degree of inclusion
1	Analytical thinking skills	Knowledge	207	3.7439	1.3882	High
2	Creativity skills	Knowledge	207	3.7207	1.4709	High
3	Investigative research skills	Knowledge	207	3.6698	1.4811	High
4	Executive job skills	Knowledge	207	3.6690	1.5013	High
5	Skills for learning how to learn in technology	Knowledge	207	2.8357	1.0348	Middle
6	Multidisciplinary skills	Knowledge	207	2.7584	1.0500	Middle
	Total level of knowledge		207	3.3995	1.3210	Middle

Table 13. Descriptive statistics skill level

No.	Distance	Level	Descriptive statistics			
			Sample	Average	Standard deviation	Degree of inclusion
1	Analytical thinking skills	Skills	207	3.8031	1.3896	High
2	Creativity skills	Skills	207	3.7565	1.4104	High
3	Investigative research skills	Skills	207	3.7332	1.4582	High
4	Executive job skills	Skills	207	3.7012	1.4672	High
5	Skills for learning how to learn in technology	Skills	207	2.5610	0.9144	Low
6	Multidisciplinary skills	Skills	207	2.5446	0.9352	Low
	Overall skill level		207	3.3499	1.2625	Middle

Table 14. Descriptive statistics for the level of situations

No.	Distance	Level	Descriptive statistics			
			Sample	Average	Standard deviation	Degree of inclusion
1	Analytical thinking skills	Attitudes	207	3.8170	1.4058	High
2	Creativity skills	Attitudes	207	3.7623	1.4493	High
3	Investigative research skills	Attitudes	207	3.6758	1.4477	High
4	Executive job skills	Attitudes	207	3.7391	1.4735	High
5	Skills for learning how to learn in technology	Attitudes	207	2.3140	0.9124	Low
6	Multidisciplinary skills	Attitudes	207	2.2536	0.9429	Low
	Total level of attitudes		207	3.2603	1.2719	Middle

3.3. Discussion of results

After experts developed the framework and instrument, it was then applied to measure the extent to which core competencies are incorporated into gifted student programs from the students' perspective. The following results were obtained. First, the results yielded a core competencies framework that differs in concepts and elements from frameworks in previous literature, as shown in Table 15. Second, the findings showed that the degree to which the six core competencies were incorporated into gifted student programs varied. Ranked in descending order, the competencies with a high degree of inclusion were, respectively: analytical thinking, creativity, executive function, and inquiry-based learning. The two competencies with a low degree of inclusion were, respectively: learning how to learn in technology and interdisciplinary skills. Overall, the degree of inclusion of the six core competencies was moderate across all three levels (knowledge, skills, and attitudes).

3.3.1. Discussion of the developed core competencies framework

The first five of the six competencies reached in this study share the same names as those proposed by Renzulli [21], but they differ in concept and in many of their elements, shown in Table 15. One of the participants in the third Delphi round confirmed that "*all concepts and elements evolved significantly after the modification*." This difference can be attributed to two reasons. First, Renzulli [21] proposed these competencies as a starting point for the catch-a-wave theory of adaptability; second, substantial changes have occurred in the skills required by the labor market, which experts identified through a new perspective that keeps pace with future developments. Accordingly, a sixth competency also emerged: interdisciplinarity skills. This competency is not new, but it holds future importance given its dynamic interaction with the other competencies. One participant described this competency as "*focus on knowledge integration: it emphasized integrating knowledge from multiple fields rather than being limited to superficial multiplicity*."

3.3.2. Discussing the results on the inclusion of the six core competencies in gifted programs

The current research findings show a high degree of inclusion of four core competencies in gifted student programs: analytical thinking, creativity, executive function, and inquiry-based learning. This pattern of results appears consistent with findings reported in recent literature on gifted education. The increased inclusion of analytical thinking skills confirms that programs for high-achieving students naturally tend to focus on developing higher-order thinking skills. Developing analytical thinking is a fundamental component of teaching higher-order thinking [27], [28]. Both studies explained that enhancing analytical thinking is linked to improving learners' ability to handle complex cognitive tasks that require interpreting relationships and organizing information.

Furthermore, the high degree of inclusion of creativity skills identified in this research aligns with global trends that view creativity as an essential component of gifted programs, as indicated in several studies [29], [30]. Educational environments that support creativity and provide opportunities for experimentation and idea generation enhance the innovative abilities of gifted students. Regarding the increased inclusion of executive job skills, this aligns with what was presented [31], [32]. These studies highlight the importance of skills such as planning, organization, cognitive flexibility, and self-regulation in supporting advanced

academic practices, students' ability to manage self-directed learning, and their capacity to solve complex problems. They also emphasize that fostering executive functions is a crucial component of programs designed to develop higher-order thinking skills in gifted students.

Table 15. Comparison of the development of core competencies

Renzulli [21] previous competency framework		The competency framework developed in this study	
Core competence	Concept and elements	Core competence	Concept and elements
Analytic thinking skills	It enables an individual to gain a deeper understanding of a topic and includes: critical thinking, problem-solving, decision-making, analysis, synthesis, and evaluation.	Analytic thinking skills	They are processes and skills that enable an individual to understand and interpret information in depth, through logical analysis, linking causes and effects, and evidence-based assessment, to make informed decisions in complex situations. These include: critical thinking, systems thinking, problem-solving, decision-making, analysis, synthesis, inference, and evaluation.
Creativity skills	It enables an individual to come up with new ideas and includes: curiosity, brainstorming, substitution, questioning, rephrasing, imagining, modifying, combining, adapting, eliminating, reflecting, magnifying, minifying, and alternative use.	Creativity skills	They are processes and skills that enable an individual to generate original and flexible ideas characterized by novelty and to apply them in new educational or life situations. Through divergent thinking, experimentation, and developing solutions in unconventional ways, they include: fluency, flexibility, originality, perception of details, and sensitivity to problems.
Basic investigative research skills	It helps an individual develop new knowledge and includes: developing a hypothesis or a research question, review of related research, planning and scheduling, finding or developing data collection tools or techniques, organizing and classifying information, data analysis, drawing conclusions, report writing, and communicating the results.	Basic investigative research skills	They are processes and skills that enable an individual to explore phenomena or problems in a systematic manner. It begins by posing questions or hypotheses and ends with data analysis and the extraction of results. To build new, evidence-based knowledge, it includes: developing a hypothesis or a research question, reviewing related research, planning and scheduling, finding or developing data collection tools or techniques, organizing and classifying information, analyzing data, drawing conclusions, writing a report, and communicating the results.
Executive function skills	It enables an individual to execute higher levels of thinking, creativity, and research and includes: work orientation, realistic self-assessment, social interaction, awareness of others' needs, and altruistic leadership.	Executive function skills	They are processes and skills that enable an individual to plan goals, regulate behavior, make appropriate decisions, and engage in conscious social interaction to accomplish tasks efficiently and independently. It includes: work orientation, social interaction, ethical leadership, self-regulation, planning, and monitoring.
Learning-how-to-learn skills in technology	These competencies help individuals keep pace with continuous technological change, including: identifying trustworthy information, selectively managing vast amounts of information, organizing, classifying, and evaluating information, using work-related information, communicating information effectively, planning the individual's learning purposefully and gradually, and implementing practical projects autonomously.	Learning-how-to-learn skills in technology	They are processes and skills that enable an individual to use technology intelligently for continuous, self-directed learning by organizing, evaluating, and applying digital knowledge sources in practical situations, including :identifying trustworthy information, selectively managing vast amounts of information, organizing, classifying, and evaluating information, using work-related information, communicating information effectively, planning the individual's learning purposefully and gradually, and implementing practical projects autonomously.
		Interdisciplinary thinking skills	They are processes and skills that enable an individual to integrate knowledge from multiple disciplines to find innovative solutions to complex problems. They include: a basic understanding of concepts from diverse disciplines, connecting phenomena across different fields, using diverse tools from multiple disciplines, and providing innovative hybrid solutions.

Investigated research skills also received a high degree of inclusion, consistent with the educational literature that emphasizes inquiry-based learning. This latter is one of the most effective methods for developing students' scientific thinking skills, as studies have shown [33], [34]. The two studies showed that inquiry provides learners with opportunities to formulate questions, collect data, and analyze results, which form skills that are appropriate for gifted learners.

Conversely, the study revealed a low level of inclusion for two core competencies: learning how to learn in technology and interdisciplinary skills. This lower degree of inclusion can be explained by recent literature indicating that, while integrating technology into education is important, it continues to face challenges related to teacher preparedness, infrastructure availability, and the clarity of educational frameworks linking technology to the development of higher-order thinking skills. Several studies [21], [35] have shown that adopting technology in education requires a cultural and professional transformation among teachers, in addition to developing new educational practices that go beyond the traditional use of digital tools.

As for interdisciplinary skills, the study results showed a low degree of inclusion, consistent with previous studies [36], [37]. These studies suggest that interdisciplinary learning is among the most complex educational practices, as it requires designing integrated curricula, fostering collaboration among teachers from different disciplines, and providing cross-disciplinary learning projects. They further indicate that the application of this type of learning remains limited in many educational settings, despite its importance in preparing students for 21st-century skills.

Overall, these results reflect the strength of gifted student programs in higher-order cognitive, creative, research, and organizational domains. However, they also reveal a need for further development in digital learning and interdisciplinary integration. This underscores the need to enhance professional development for teachers in technology integration, develop integrated learning modules, and adopt modern educational models such as science, technology, engineering, arts, and mathematics (STEAM). This ensures a greater balance between the six core competencies needed for the future adaptation of gifted students.

Teachers can translate these competencies into tangible classroom activities. For example, they might design interdisciplinary projects that combine science, art, and engineering to solve a real-world problem, assign students digital inquiry tasks that rely on data analysis or the use of digital simulations, or implement future-oriented problem-solving activities that require students to anticipate upcoming challenges and propose innovative solutions. Such examples illustrate how the proposed framework can be integrated into daily practice within gifted classrooms. For policymakers, these findings illustrate how the proposed framework can serve as a tool for assessing the readiness of current curricula and programs, allowing policymakers to examine whether curricula are indeed developing the core competencies needed for future adaptation. The framework can also guide the development of educational policy, ensuring that gifted programs focus not only on academic excellence but also on preparing students for a rapidly changing world.

3.3.3. Discussion of the results of incorporating competencies across the three levels (knowledge, skills, and attitudes)

The study results showed that the degree of inclusion of the six core competencies in gifted student programs was moderate across all three levels: knowledge, skills, and attitudes. This finding carries significant educational implications. On the one hand, this moderate level indicates that current programs provide a foundation in knowledge, skills, and attitudes for the competencies. On the other hand, they still require deeper development to ensure the necessary integration of these three dimensions, a point emphasized in recent literature in gifted education.

At the level of knowledge, studies show that building advanced knowledge among gifted students requires a systematic design that links basic concepts with deeper knowledge and provides students with opportunities for expansion and inquiry [38]. The literature indicates that traditional programs often focus on cognitive content without progressing to deeper levels of understanding, resulting in average cognitive inclusion [28] in an analysis of higher-order thinking programs. This is consistent with the findings of the current study, which indicate that the knowledge associated with the six competencies exists but is not sufficiently structured to achieve the deep cognitive enrichment gifted students need for dynamic interaction at the level of skills and attitudes.

At the skills level, the moderate inclusion of competencies reflects the fact that programs provide opportunities to develop thinking, creativity, research, and executive functions, but may not offer sufficient systematic and continuous educational practices for developing them. Developing higher-order skills requires active learning environments along with problem-solving and inquiry-based practices, as explained before in the literature [29], [33]. It indicates that skills do not develop automatically through content alone, but require clear teaching strategies, continuous feedback, and practical activities, which may help explain the average level observed in this research.

At the attitude level, the moderate inclusion of competencies indicates that the programs foster some positive attitudes toward learning, such as curiosity, perseverance, and openness to new ideas. However, they may not adequately cultivate strong attitudes needed to support self-directed and interdisciplinary learning, as well as the critical and effective use of technology. The literature has shown that developing positive attitudes in gifted students requires learning environments that encourage autonomy, value experimentation,

and support intellectual risk-taking [30]. It also indicates that attitudes are a crucial element in converting knowledge and skills into practical application, and that their weak inclusion may limit the effectiveness of programs even when programs are otherwise rich in knowledge and skills [31].

Taken together, these findings indicate that gifted programs in the current context provide a good foundation for the six core competencies necessary for the future adaptation of gifted students, but they still require balanced development to ensure the integration of knowledge, skills, and attitudes. As the literature demonstrates, deep learning is only achieved when these three dimensions are integrated into the design of curricula and educational activities [27]. Global trends in gifted education also emphasize the importance of shifting from a focus on content to a focus on holistic competencies that combine applied knowledge, higher-order skills, and attitudes that support lifelong learning [36]. Accordingly, the average level reported in the current research indicates clear efforts to incorporate the six competencies into gifted programs. However, it also reveals a gap that must be addressed through curriculum development, teacher training, and the adoption of modern educational models such as project-based learning, multidisciplinary learning, and advanced digital learning, to ensure that competencies are promoted across their three dimensions in an integrated and sustainable manner.

3.4. Theoretical contributions

Given the significant developments of the past five years, new skills have emerged that gifted students must acquire for their future. Therefore, it has become essential to update previous models in this context, such as Renzulli [21] proposal of core competencies. This research updates Renzulli [21] proposal using the Delphi technique. The most important contribution of this update lies in developing the sub-elements, rather than the main headings, of these core competencies. Then measuring the extent to which those core competencies are included in gifted student programs.

3.5. Limitations

This study was conducted on gifted students in the Eastern Province of Saudi Arabia during the period 2025–2026, which limits the generalizability of the results to different settings. Data was also collected via self-report questionnaires. Furthermore, the scale contained a large number of items relative to the sample size.

4. CONCLUSION

This study contributes by providing an empirically validated competency framework for gifted programs that balances knowledge, skills, and attitudes. We also encourage researchers to conduct longitudinal and cross-cultural studies to validate the framework. Furthermore, we recommend testing the tool on a larger sample to address the limitations mentioned earlier.

FUNDING INFORMATION

This work was supported by the Deanship of Scientific Research, Vice Presidency for Graduate Studies and Scientific Research, King Faisal University, Saudi Arabia [Grant No. KFU266340].

AUTHOR CONTRIBUTIONS STATEMENT

This journal uses the Contributor Roles Taxonomy (CRediT) to recognize individual author contributions, reduce authorship disputes, and facilitate collaboration.

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C : **C**onceptualization
M : **M**ethodology
So : **So**ftware
Va : **Va**lidation
Fo : **Fo**rmal analysis
I : **I**nvestigation
R : **R**esources
D : **D**ata Curation
O : Writing - **O**riginal Draft
E : Writing - Review & **E**diting
Vi : **Vi**sualization
Su : **Su**pervision
P : **P**roject administration
Fu : **Fu**nding acquisition

CONFLICT OF INTEREST STATEMENT

Authors state no conflict of interest.

INFORMED CONSENT

Official approval to conduct the study was obtained from the Directorate of Education, which issued a formal letter authorizing its implementation to the administrations of intermediate and secondary schools. An electronic questionnaire was provided to the participants, and the first page contained an informed consent form stating:

- The objectives and nature of the study
- That participation is entirely voluntary
- The participant's right to withdraw at any time without any consequences
- Assurance of confidentiality and that the data will be used solely for research purposes

The study targeted intermediate and secondary schools. Data collection was conducted within the school setting under the supervision and awareness of school administrations, in accordance with the approval granted by the Directorate of Education. All ethical principles related to research involving human participants were strictly followed.

ETHICAL APPROVAL

This study received ethical approval from the Research Ethics Committee at [King Faisal University, number KFU-REC-2025-MAY- ETHICS3401]. The study procedures, data collection methods, and participant protections were reviewed and approved in accordance with institutional and international ethical standards for educational research. All stages of the study were conducted with respect for participants' privacy, confidentiality, and well-being.

DATA AVAILABILITY

The authors confirm that the data supporting the findings of this study are available within the article at https://drive.google.com/file/d/1PdveP9rr_QIv3sCCkUpae0JfzoouImtz/view?usp=sharing

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APPENDIX

Table 8. Descriptive statistics for third-dimensional statements: investigative research skills

No	The element	Levels	Descriptive statistics			
			Sample	Average	Standard deviation	Degree of inclusion
1	Developing a research hypothesis or question	Knowledge	207	3.7101	1.46581	High
		Skills	207	3.6812	1.43628	High
		Attitudes	207	3.6812	1.46638	High
2	Review of relevant research	Knowledge	207	3.7005	1.43031	High
		Skills	207	3.8696	1.39256	High
		Attitudes	207	3.6377	1.42758	High
3	Planning and scheduling	Knowledge	207	3.6908	1.52362	High
		Skills	207	3.7729	1.47853	High
		Attitudes	207	3.7391	1.40027	High
4	Finding or developing data collection tools or techniques	Knowledge	207	3.6184	1.49246	High
		Skills	207	3.7005	1.49015	High
		Attitudes	207	3.6377	1.49404	High

Table 8. Descriptive statistics for third-dimensional statements: investigative research skills (*continued*)

No	The element	Levels	Descriptive statistics			
			Sample	Average	Standard deviation	Degree of inclusion
5	Organizing and classifying information	Knowledge	207	3.5894	1.47486	High
		Skills	207	3.6425	1.48053	High
		Attitudes	207	3.6425	1.39267	High
6	Data analysis	Knowledge	207	3.7101	1.43907	High
		Skills	207	3.6715	1.41019	High
		Attitudes	207	3.7150	1.45846	High
7	Drawing conclusions	Knowledge	207	3.6473	1.49312	High
		Skills	207	3.7681	1.46954	High
		Attitudes	207	3.5556	1.42977	High
8	Report writing	Knowledge	207	3.6908	1.52998	High
		Skills	207	3.7391	1.46796	High
		Attitudes	207	3.6957	1.44448	High
9	Delivering results	Knowledge	207	3.6715	1.48072	High
		Skills	207	3.7536	1.49828	High
		Attitudes	207	3.7778	1.51654	High
	Total dimension		207	3.6929	1.4623	High

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