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Comparing the Intelligence of Boys and Girls on the Dimensions of Family Efficiency

Ali Rasooli Fashtami,[1] Tooraj Hashemi,[2] Azar Kiamarsi,[3] Ozra Ghaffari[4]

Abstract

Introduction: Raven's Progressive Matrices Intelligence Quotient (IQ) test is one of the valid intelligence tests that is used to measure general intelligence. This research was conducted to compare the general intelligence of male and female students on the dimensions of family efficiency and on the basis of children's Raven intelligence.

Methods: The research method was causal-comparative and the statistical population was all elementary school students in Rasht city in the academic year 2020-2021. The sample of the study was 1643 elementary students (808 boys and 835 girls), who were selected by cluster random sampling from two privileged and semi-privileged areas. In this study, the children's Raven color matrix test and the non-verbal part of the Stanford Binet version 5 test were used to collect data. Research data were analyzed by independent t-test and multivariate analysis of variance.

Results: The results showed that there was no significant difference between the intelligence of girls and boys in the first, second, third, fourth and sixth grades, but the difference in intelligence between girls and boys in the fifth grade was significant, with the superiority of boys. There was also a significant difference between the mean total score of intelligence of girls and boys in educational levels. In other words, there was a significant difference in the intelligence scores of the students in different grades, and as the grade increased, the age also increased, so did the intelligence.

Conclusion: By examining the background of the research, it was found that social factors, especially the family, could have a great impact on intellectual functions.

Keywords: Girl and boy, Family, Raven's IQ test, student

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[1] - PhD student in Educational Psychology, Ardabil Branch, Islamic Azad University, Ardabil, Iran rasouli5334@yahoo.com

[2] - Corresponding author, full professor, Department of Psychology, Tabriz University, Iran, tourajhashemi46@tabrizu.ac.ir

[3] - Assistant Professor, Department of Psychology, Ardabil Branch, Islamic Azad University, Ardabil, Iran a.kiamarsi52@gmail.com

[4] - Assistant Professor, Department of Psychology, Ardabil Branch, Islamic Azad University, Ardabil, Iran azra.ghaffari@yahoo.com

Introduction:

Among the effective intervention approaches are psychological interventions that emphasize the role of parents in the development of children's cognitive, language and communication abilities. Studies have shown that parents' participation can have an effect on cognitive and social development, academic progress, and health and safety of children with intellectual disabilities (1).

Although the importance of education of both parents for the development of children is known in scientific literature, more attention has been paid to the role of maternal education in children's intelligence. Mothers often act as main careers and spend more time with their children than fathers (2). As a result, they are thought to have a great impact on the child breeding environment (3). In order to grow students with suitable and adequate intelligence growth, parents need to have good social economic contexts to provide a good balanced diet for their children from fertilization throughout childhood to early adulthood. Also, this requires good schools with stimulant and favorable environments for learning (4).

Research in psychology has been constantly trying to explain and understand the impact of gender differences (5). There is a consensus that the origin of gender differences is a complex combination of nature and nurturing (6). Individual differences in childhood intelligence (IQ) has a long-term impact on a wide range of important consequences of life, including academic achievement (7), access to educational facilities (8), job success (9), health (10), and welfare (11). One of the strongest predictors of IQ differences of children is parental academic achievement (12, 13). A large -scale analysis of the data of seven countries showed that parents' education is related to the differences in children's intelligence even greater than family wealth (14).

While the findings have constantly shown gender differences in specific cognitive domains such as verbal and spatial abilities (15), there has been no consensus on the existence of gender differences in general cognitive ability or general intelligence. Waschl and Burns (16) obtained similar results from different studies that consider different experiments, indicating that gender differences, if not trivial, are very small. Most studies concluded that there is male superiority (17, 18). While some reported that women in Factor G work better than men (19, 20). Frik, Ferrara, and Newcombe (21) found gender differences in a task of mental rotation. Palejwala and Fine (22), considered gender differences in visual processing through block design and assembly tasks and found that there were no gender differences between the ages of 2 to 3, while differences appear at the ages of 4 to 7. In contrast, Keith, Reynolds, Roberts, winter and Austin (23) reported gender differences in short-term memory using the hidden variable approach. The performance of girls at the age of 5 to 13 was better than boys and boys at the age of 14 to 17. Lutchmaya, Baron-Cohen and Raggatt (24) showed that girls are superior to boys in vocabulary, so that 2-year-old girls use words more significantly than boys. Zambrana, Ystrom, and Pons (25) recorded gender differences in language understanding at the age of 18 and 36 months for the benefit of girls at both time.

Intelligence increases with age until about 18 years old, and then, in most cases, adult life is relatively stagnant (4). Accumulated evidence about gender differences in cognitive abilities throughout life shows that gender differences in cognition become larger or more common during adolescence (26). One explanation considers the effect of age: according

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to developmental theory, gender differences in intelligence can differ between age groups and are related to differences in the development of puberty between the sexes (27). Although several studies show a significant interaction between age and gender (28, 29), other researchers reported findings that were inconsistent with this developmental theory (30, 31).

Kpolovie (32) stated that intelligence can be effectively defined, as assessed by culture-fair intelligence tests, and emphasized as the general mental ability to learn quickly, respond to new problems, and correct abstractly. Likewise, intelligence is a fundamental factor that can determine academic progress in schools and plays an important role in the future success of students. Similarly, intelligence affects the student's capacity to acquire new knowledge and information and use it as a basis for processing and solving a problem. People's cognitive abilities, such as reasoning, remembering, understanding, need to learn, cognitive flexibility, and communication skills, are strongly related to intelligence. In addition, IQ is a common term to describe a set of mental functions that include reasoning, planning, problem-solving skills, abstract thinking, conceptual understanding, language use, and learning.

For this purpose, IQ is simply called as a person's ability to respond appropriately to received stimuli (33). Also, from a medical point of view, Adeboye et al. (34) stated that the IQ is a numerical representation of a person's intelligence level compared to the statistical distribution for his age range. Naderi et al. (35) showed that intelligence for both genders is not related to academic achievement. However, Furnham and Buchanan (36) discovered that intelligence differs between males and females. According to the researchers' findings, men had a much higher estimate of general intelligence than women. Sluis et al. (37) found that gender differences in intelligence test subtests are due to gender changes in general intelligence. With the exception of alternative subtests, males performed better than females in all subtests (information, arithmetic, and matrix thinking).

Giofrè et al. (38) in their research on broad abilities showed a significant difference in favor of men for visual and crystallized intelligence, while the findings on female/male differences in intelligence were insignificant. On the contrary, the performance of women was superior in the coefficient of processing speed.

Colom and Garcia-Lopez (39) tested more than 4,000 high school students with the Inductive Reasoning Test, the Advanced Progressive Matrices (APM), and the Culture Fair Intelligence Test. They concluded that since no systematic differences were found in intelligence measures, gender differences in general intelligence probably did not exist.

In the experimental investigation, it was found that there are many studies on IQ, the differences between boys and girls and its environmental determinants, their general intellectual performance and other abilities all over the world, but there is no general consensus on the overall superiority of one gender. Only some research has pointed to the partial superiority of some abilities, most of which have been conducted on a single standardized sample; therefore, it is limited to a single country, or it has been done with a limited sample size, so it leads to different psychometric approaches in data analysis. Furthermore, previous studies have mainly focused on adults, while young participants

have often been neglected. The purpose of the present research is to investigate the intelligence status of elementary school boys and girls in Rasht city (first to sixth grades) and to consider whether there is any difference between them or not.

Research Method:

The research method was causal-comparative, and statistical population was all 48,500 elementary school boys and girls in Rasht who were studying in the academic year of 2020-2021. To determine the sample size, the formula $n = \frac{Z^2_{1-\frac{\alpha}{2}} S^2}{d^2} = \frac{1/96^2 \times 6^2}{0/95} = 589$ was used, which the number was 589. To increase the external validity and the possibility of dropping out, the research sample became 1643 elementary school students (808 boys and 835 girls). The inclusion criteria of the selected sample were based on cluster random sampling from two privileged and semi-privileged areas (the privileged schools of the city, such as Goslar Street, and the semi-privileged schools of the city, such as the Iraq-Bridge area of Rasht). The sampling method was such that after obtaining permission from the General Administrative Office in Rasht, the schools were divided, following a lottery, a number of schools were selected equally from the two regions, and approximately 275 people from each grade were chosen. With the coordination of the principal, a lottery was held among the classes of each grade. Then, with the help of the relevant teachers, the researcher appeared in the class, guided the students to the exam hall, and based on the Corona health protocol with a proper distance, groups of 10 students were tested. The exclusion criteria included lack of motivation or unwillingness to complete the questionnaire and its incomplete completion. In order to provide a suitable environment for the optimal implementation of the research and to increase its internal validity, some solutions were applied. That is, the distribution and collection of questionnaires were carried out by the researcher to ensure high accuracy and prevent intentional or accidental deficiencies. After the questionnaire was delivered to the students, the researcher carefully explained the method of answering the questionnaire so that there was no ambiguity, and the subjects fully understood, and the questionnaire was collected in a specified time (15 minutes). The parents and students were given sufficient assurance that the answer sheets will be confidential and will not have any effect on the students' exams and grades. The measuring instrument in this research was the progressive color matrix test for children.

The Colored Progressive Matrices (CPM*):* The Colored progressive matrices were first standardized in England in 1949 on 627 Scottish schoolchildren. At that time, the population under study was different from Raven's progressive matrices, because it was specifically designed for children aged five to eleven and for people who were elderly, mentally retarded, physically disabled, and had no common language (40). Raven's Colored Progressive Matrices consists of 36 problems which are divided into three sets (A, Ab and B), each containing twelve figures. Every set consists of a single painting or matrix of a pattern from which a certain piece is missing. Below the matrix, there are six printed patterns, probably belonging to the gaps of above paintings. In the meantime, the respondent should choose which of the six options matches the best (41).

Therefore, "the respondent must infer a relationship in the completed part of the matrix and then apply the relationship with the incomplete part". Since the test requires the test

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taker to compare, understand and organize space, so the test should be able to stimulate the analysis of visual stimuli and test taker's thinking (42).

In Raven, Raven and Court's (40) study on children aged 4 to 11 years old in Slovakia, the confidence coefficient was 0.85. Also, the experimental results that were repeated in Singapore a year later reported a coefficient of 0.71, while the outcome of the test, which was applied in Nigeria 6 months later, was reported to be 0.59. Given that intelligence tests are validated every 10 years, the researcher has also reported the correlation of children's progressive color matrix scores with Stanford Binet version 5 test (non -verbal sector) as 0.74, which is high and acceptable validity. Besides, for evaluating the validity using the retest method, the correlation coefficient was calculated twice and the amount of 0.75 was obtained, which was significant at 0.01.

Findings:

Table 1 shows individually the mean and standard deviation of the first to sixth grade male and female students' intelligence scores in Rasht.

Table 1. Descriptive Statistics of Intelligence Scores in different Grades and Genders

gender	grade	Mean	SD	Kurtosis	Skewness	number
Male	first	27.85	5.99	0.96	- 1.07	152
	second	29.75	4.75	0.96	- 0.98	123
	third	29.27	4.59	1.01	- 0.98	120
	fourth	29.25	5.04	0.37	- 0.99	158
	fifth	29.33	5.14	- 0.13	- 0.82	108
	sixth	29.80	4.91	1.17	- 1.21	147
	sum	29.18	5.15	0.64	- 1.03	808
Female	first	28.89	5.16	1.83	- 1.14	158
	second	28.39	5.34	0.41	- 0.94	141
	third	29.58	4.72	0.65	- 0.99	153
	fourth	27.83	5.51	- 0.00	- 0.85	119
	fifth	27.42	5.73	0.08	- 0.59	134
	sixth	30.28	4.87	1.95	- 1.37	130
	sum	28.76	5.29	- 0.65	1/00	835
Total	first	28.38	5.60	1.90	- 1.36	310
	second	29.02	5.11	0.38	- 0.97	264
	third	29.45	4.65	0.75	- 0.98	273
	fourth	28.64	5.29	2.00	- 0.93	277
	fifth	28.28	5.54	0.13	- 0.07	242
	sixth	30.02	4.89	1.46	- 1.27	277
	sum	28.96	5.22	- 0.65	1/00	1643

As can be seen in Table 1, the mean intelligence scores, standard deviation, kurtosis, skewness and the number of elementary school male and female students across six grades are known.

Table 2. Kolmogorove-Smirnov for Test of Normality

variable	IQ Grade1	IQ Grade 2	IQ Grade 3	IQ Grade 4	IQ Grade 5	IQ Grade 6
N	310	264	273	277	242	277
Kolmogorove-Smirnov	0.97	1.15	1.18	1.22	1.08	1.33
Sig.	0.29	0.09	0.12	0.07	0.18	0.06

In Table 2, the Kolmogorov-Smirnov test index and sig. value for the first grade intelligence are 0.97 and p=0.29, for the second grade 1.15 and p=0.09, for the third 1.18 and p=0.12, for the fourth 1.22 and p=0.07, for the fifth 1.08 and p=0.18, and for the sixth grade 1.23 and p=0.06. Because Sig. values are more than 0.05, the data distribution is normal.

Table 3. Males' and Females' Intelligence Differences in Different Grades in Rasht Based on Independent Samples Test

Hypothesis	Mean Males	Mean Females	df	t	Sig.
Difference between males & females in grade 1	27.7	28.9	311	1.92	0.56
Difference between males & females in grade 2	29.77	28.4	263	2.18	0.30
Difference between males & females in grade 3	27.29	29.53	272	- 0.45	0.65
Difference between males &	29.18	27.89	273	2.00	0.46

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females in grade 4					
Difference between males & females in grade 5	29.33	27.42	240	2.70	0.008
Difference between males & females in grade 6	29.80	30.21	279	- 0.72	0.47
Total Difference between males & females	29.2	28.8	1641	1.60	0.11

As shown in Table 3, the results of independent-samples t-test reveal that the difference between the males and females mean intelligence scores is 1.92, 2.18, -0.45, 2.00, and -0.72; *t*=1.60 with degrees of freedom *df*=311, 263, 272, 273, 279, 1641, respectively, which is not statistically significant since *p*= 0.56, 0.30, 0.65, 0.46, 0.47 and 0.11 ≥ 0.05. Therefore, there is no significant difference between males and females intelligence scores in grades 1, 2, 3, 4, and 6 and the total number of males and females students. However, the difference between males and females intelligence scores in grade 5 is significant; *t* (240) = 2.70, *p*=0.008.

Table 4. Results of ANOVA for Students' Intelligence in Different Grades

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	78/514	5	102/96	3.85	0.002
Within Groups	25/4391	1631	26/73		

Table 4 shows that F (5, 1631) = 3.85, p< 0/002. Therefore, the results of analysis of variance (ANOVA) reveal that there is a significant difference between elementary school girls' and boys' Raven's colored progressive matrices in different grades in Rasht.

Table 5. The Results of Post Hoc Tests for Different Grades

Group 1	Group 2	Mean Difference	Std. Error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
Grade 1	Grade 2	- 0.70	0.43	0.11	- 1.55	0.15
	Grade 3	- 1.06	0.43	0.01	- 1.90	- 0.21
	Grade 4	0.17	0.43	0.69	- 1.01	0.67
	Grade 5	0.01	0.45	0.98	- 0.88	0.86
	Grade 6	1.67	0.43	0.00	2.50	- 0.83
Grade 2	Grade 1	0.70	0.43	0.11	- 0.15	1.55
	Grade 3	- 0.36	0.43	0.42	- 1.24	0.52
	Grade 4	0.53	0.43	0.24	- 0.35	1.41
	Grade 5	0.69	0.45	0.14	- 0.22	1.60
	Grade 6	- 0.97	0.43	0.03	- 1.84	- 0.09
Grade 3	Grade 1	- 1.06	0.43	0.01	0.21	1.90
	Grade 2	0.36	0.43	0.42	- 0.52	1.24
	Grade 4	0.89	0.43	0.05	0.02	1.76
	Grade 5	1.05	0.45	0.02	0.15	1.95
	Grade 6	- 0.61	0.43	0.17	- 1.48	0.26
Grade 4	Grade 1	0.17	0.43	0.69	- 0.67	1.01
	Grade 2	0.53	0.43	0.24	- 1.41	0.35
	Grade 3	- 0.89	0.43	0.05	- 1.76	- 0.02
	Grade 5	0.16	0.45	0.73	- 0.74	1.06
	Grade 6	- 1.50	0.43	0.00	2.36	- 0.63
Grade 5	Grade 1	0.01	0.43	0.98	- 0.86	0.88
	Grade 2	- 0.69	0.43	0.14	- 1.60	0.22
	Grade 3	- 1.05	0.43	0.02	- 1.95	- 0.15
	Grade 4	- 0.16	0.45	0.73	- 1.06	0.74
	Grade 6	- 1.66	0.43	0.00	- 2.55	- 0.76
Grade 6	Grade 1	1.66	0.43	0.00	0.83	2.50
	Grade 2	0.97	0.43	0.03	0.09	1.84
	Grade 3	0.61	0.43	0.17	- 0.26	1.48
	Grade 4	1.50	0.45	0.01	0.63	2.36
	Grade 5	1.66	0.43	0.00	0.76	2.55

Post-hoc comparisons in Table 5 indicate that difference between intelligence scores of grade 1 and grade 3 (M=-1.06, p<0.01) and grade 6 (M=1.67, p<0.00) is statistically meaningful. Grade 2 scores are statistically meaningful with grade 6 scores (M= - 0.97, p<0.03). Grade 3 scores are statistically meaningful with scores of grade 1 (M= - 1.06, p<0.01), grade 4 (M= 0.89, p<0.05), and grade 5 (M= 1.05, p<0.02). Grade 4 scores are statistically meaningful with scores of grade 3 (M= -0.89, p<0.05) and grade 6 (M= -1.50, p<0.00). Grade 5 scores are also statistically meaningful with scores of grade 3 (M= -1.05, p<0.02) and grade 6 (M= -1.66, p<0.00). Finally, grade 6 scores are statistically

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meaningful with scores of grade 1 (*M*= 1.66, p<0.00), grade 2 (*M*= 0.97, p<0.03), grade 4 (*M*= 1.50, p<0.01) and grade 5 (*M*= 1.66, p<0.00).

Discussion and Conclusion:

The present study was conducted with the aim of comparing the intelligence of elementary school girls and boys in Rasht city. By comparing the results of this research with those of other studies, it can be found that a similar picture of intellectual development is not obtained, that is, there is no difference between boys and girls in intellectual development. Therefore, in the early years of school, intellectual development does not have any significant difference in intelligence scores of boys and girls. Our results show that there is no gender difference in Raven's intelligence in the first, second, third, fourth and sixth grades based on the "average intelligence score" index. These findings are in harmony with Colom and García-López (39), Waschl and Burns (16), and Naderi (35). On the other hand, the results are inconsistent with Halpern et al. (15), Flores et al. (17), Jackson and Rushton (18), Arden and Plomin (19), Reynolds et al. (20), Palejwala and Fine (22), Keith et al. (23), Lutchmaya et al. (24), Zambrana et al. (25), Furnham and Buchanan (36), Sluis et al. (37), and Giofrè et al. (38).

In this research, it has also been shown that there is a significant difference in the mean intelligence scores of girls and boys in the fifth grade (in favor of boys). These findings are in agreement with the research of Halpern et al. (15), Flores et al. (17), Jackson and Rushton (18), Arden and Plomin (19), Reynolds et al. (20), Palejwala and Fine (22), Keith et al. (23), Lutchmaya et al. (24), Zambrana et al. (25), Furnham and Buchanan (36), Sluis et al. (37), and Giofrè et al. (38). However, there is a discrepancy with Colom and García-López (39), Waschl and Burns (16), and Naderi (35). One explanation can be because a large part of the test components of the Raven's progressive matrices focuses on measuring the subject's mental rotation ability, and considering that Lin and Petersen (43) and Voyer, Voyer, and Bryden (44) confirmed that there was a significant male advantage in mental rotation tasks and noted that tasks involving three-dimensional rotations (as opposed to rotations of simpler shapes in the image) produced the largest effect sizes, probably because of females' problem in mentally rotating objects in depth, male students of this grade also outperformed females.

Another explanation could be that the underlying mechanism of the growth pattern of the emergence of gender differences in mental rotation from the biological point of view, especially the role of sexual hormones and gender differences in the structure and function of the brain, attracted much attention. Among the biological variables, endocrine factors such as sex hormones have been considered as important ones (45). Sexual hormones, including androgens, estrogen and progesteroids, can affect a wide range of organs, including the brain. Their most impact occurs in two sensitive periods of growth: the first in prenatal or infancy and the second in the post -birth period. It has been suggested that these sensitive periods in hormonal secretion are related to gender differences in cognitive abilities (45). The effect of age can also be considered to explain these results: according to growth theory, gender differences in intelligence can vary between age groups and are related to the difference in maturity between the two sexes (27). Although several studies

show that there is significant interaction between age and gender (28, 29), most of the empirical findings on this subject can be explained by different (but relevant) approaches that encompass many current frameworks related to gender differences: socio-cultural, evolutionary, and hormonal and brain science approaches (45). Most of these theories confirm the existence of both biological factors (such as physical differences, evolved traits, and hormonal effects) and socio-cultural ones (for example, learning social and cultural role, and stereotypical beliefs). Looking at the differences in gender-related cognitive tasks, socio-cultural theories suggest that gender differences are aroused from social, cultural, psychological and other environmental factors (46). Five decades ago, Waber (47) assumed that gender differences in cognitive abilities can be explained at maturity. He suggested that through the mediating role of the hemisphere specialization, late maturers have better spatial abilities, while early maturers have better verbal abilities, and these findings support better intelligence performance in the fifth grade male students, which have been between the ages of 11 and 12 years and at the beginning of puberty.

Also, there is a significant difference in the total intelligence scores of boys and girls in the pairwise difference between the educational levels. In other words, there was a significant difference between the intelligence scores of the first grade students and the third and sixth grade students. Furthermore, there is a significant difference in the intelligence between the second grade and the sixth grade, the third grade with the first, fourth and fifth grade, the fourth grade with the third and sixth grade, the fifth grade with the third and sixth grade, and the sixth grade with the second, fourth and fifth grade. The researches related to the age difference in the field of intelligence also indicate that the growth curve has a very steep slope in the first 12 years of life. That is, the IQ increases with age until about 18 years old and then, in most cases of adult life, it is relatively stagnant (4).

In general, it can be said that with increasing age and entering a higher educational level, the cognitive ability of students increases, and they can solve more mental problems and answer more questions from Raven's IQ test, which measures general intelligence, correctly. Hence, it can be observed that the IQ scores of the students of lower grades, such as grades 1, 2, and 3, have a significant difference with the IQ scores of higher grades, such as grades 4, 5, and 6, in pairs. This study opens a new dimension in the studies of gender intelligence and academic achievement during the school period. Tracing the change in the structure of intelligence in the process of school education and its effect on the academic success of girls and boys provides the possibility of tracking an important period in the development of intelligence. In addition, the role of social factors especially parents can be considered in the critical period of development to increase children's intelligence.

Limitations

One of the limitations of this research was the cross-sectional nature of the study and differences in individual characteristics, psychological characteristics, cultural and social life differences, which were beyond the control of the researcher. Furthermore, despite a lot of effort, in order to control disturbing variables, the influence of some factors such as the passage of time and the experience of the subjects cannot be ignored.

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It is suggested that the IQ test be conducted frequently for students because this allows teachers and school administrators to identify the abilities and overall progress of students in social studies. It is recommended for parents to be educated about their children's intellectual abilities, so that they can take timely action to increase their intelligence abilities, especially in the primary period. Also, set realistic expectations based on their children's ability and academic performance. In order to achieve more comprehensive and accurate results, the researchers are suggested to carry out the research on a wider level to increase the generalizability of the results. Other intelligence measuring tools such as Wechsler and Stanford Binet are recommended.

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Conflict of Interest

Conducting this research has not resulted in any conflict of interest for the authors, and its results have been reported completely transparent and without bias.

Ethical Considerations

In this research, ethical standards including the principle of respect and confidentiality, preventing the disclosure of the obtained information from subjects with their real names, the authority and freedom of the subjects to participate or leave the training, and obtaining written consent from the subjects, have been observed.

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