

Cognitive Anomalies and Their Relationship to Formal Thinking among University of Baghdad Students

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Abstract

The present study seeks to explore cognitive anomalies and formal thinking, and to examine how both relate to the level of academic achievement among students in the Kindergarten Department. The research focused specifically on third-year students in the Kindergarten Department, College of Basic Education at Al-Mustansiriya University during the 2021–2022 academic year.

Adopting a descriptive correlational design, the study targeted a research population of 81 third-stage students from the department. To achieve its objectives, the researcher developed three instruments: a formal thinking test comprising 40 items, a cognitive anomalies scale consisting of 56 items, and an achievement level scale containing 25 items. The psychometric properties of these tools were carefully verified, including indices of difficulty, discrimination power, and reliability. Data analysis was conducted using the Statistical Package for the Social Sciences (SPSS).

The findings indicate that third-stage students demonstrate measurable levels of formal thinking, cognitive anomalies, and academic achievement. These results may be attributed to students' active pursuit of knowledge, their engagement with modern communication technologies, and the influence of a social environment that often shapes ideas as fixed assumptions. Additionally, students' active participation in research and learning processes appears to contribute to improved achievement outcomes.

Based on these results, the researcher concludes that third-stage students possess adequate levels of formal thinking, cognitive balance, and academic achievement, supported by the acquisition of relevant knowledge, concepts, and learning strategies. The study recommends that university professors in colleges of basic education place greater emphasis on designing subject questions that assess formal thinking skills, with the aim of enhancing students' performance in this area. Besides, the researcher proposes conducting a comparative study examining cognitive anomalies among students in public and private colleges.

Keywords: Formal Thinking, Cognitive Anomalies, Achievement Level, and Kindergarten.

Chapter One: Introduction

First: The Research Problem

Cognitive dissonance is one of the significant topics that have attracted the attention of researchers across various fields up to the present time. Cognitive dissonance theory assumes that a student experiences conflict between their ideas and behavior when they encounter new knowledge that does not align with their previously held beliefs and opinions. This inconsistency leads to discomfort and psychological anxiety resulting from the presence of these conflicting conditions, which in turn motivates the individual to reduce the dissonance in one way or another.

The process of thinking is also considered one of the essential processes in students' lives, particularly formal thinking skills at the university level. These skills represent a fundamental component necessary for success in many academic, professional, and social domains. Since current curricula are insufficient in achieving this goal, universities need to pay greater attention to developing formal thinking among students. This has been emphasized by the findings of several studies highlighting the importance of formal thinking, including the study by Al-Jarjari (2003) and the study by Laibi (2011). Formal thinking is regarded as one of the key factors in achieving successful performance, and its absence may lead to weak performance. Accordingly, the research problem is represented by the following question:

-What is the relationship between cognitive dissonance and formal thinking among students at the University of Baghdad?

Second: The Importance of the Research

Thinking is a familiar concept to people; however, it remains one of the most complex and difficult concepts to define. In its general sense, thinking refers to the search for meaning, whether that meaning already exists and we attempt to discover and reveal it, or whether we derive meaning from matters in which it does not appear obvious, or even reconstruct and reorganize it from existing fragments (Al-Mousawi, 2021: 32).

Moreover, the ability to think is one of the indispensable skills for all members of contemporary society. Individuals have the right to develop and enhance this skill within their community in order to play an active role in it. Schools are considered the most suitable institutions for training students in thinking skills. If qualified teachers are properly trained and encouraged to foster thinking, then developing thinking through school curricula becomes both feasible and cost-effective. Through the support and encouragement provided to teachers, facilities, materials, and opportunities can be made available to improve the quality of instruction (Dakhel, 2021: 123).

Bruner considers it a form of symbolic representation, which is the most abstract and advanced level among the modes of representation he proposed. This stage involves the use of words and symbols to describe a particular experience. At this level, students' mental abilities develop to represent their external world through logical, abstract, and conceptual thinking, as well as processing that relies on active experimentation. Objects, people, or events are represented by the child through their inherent characteristics, which are then abstracted.

Formal thinking, therefore, is a mental process aimed at deriving conclusions and extracting abstract meanings and relationships through hypothetical reasoning, symbolism, generalization, and the ability to formulate and verify hypotheses. Formal thinking occurs when an individual encounters a problem for which there is no ready-made solution or experimental method, prompting them to search for underlying causes and explanations. It is based on theoretical evidence and proofs and is described as intentional, goal-directed thinking that requires significant intellectual effort (Al-Jubouri et al., 2021: 85).

Formal thinking skills are considered essential components of the scientific method in problem-solving. When a student faces a problem or question requiring an answer and finds no suitable solution within their prior experiences, their mental activity increases. The student then attempts to solve the problem by formulating hypotheses, gathering information, and establishing new relationships from previously stored experiences in their mind (Jandal, 2021: 65).

This implies that a person seeks consistency between their behavior and their cognitive mental processes, striving to ensure that their observable behavior toward a situation aligns with the thinking processes that preceded it and led to a particular attitude, whether one of love and preference or dislike and avoidance. This condition is not limited to individuals in workplace or administrative settings; rather, it extends to students in their various roles, whether as learners, teachers, administrators, or leaders, and so on. A student who possesses a coherent cognitive framework does not usually encounter situations that are difficult to integrate into that framework as part of their cognitive structure. Accordingly, their mental representations remain stable and coherent (Qatami, 2012: 45).

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Therefore, cognitive dissonance holds great importance in relation to seeking and avoiding information, especially when it comes to selective exposure and selective attention. There is evidence that people pay attention to messages that do not support their attitudes if they believe these messages are easy to refute. They also avoid exposure to information that supports their own position if it is weak. (Nasr, 2015: 102)

The state of cognitive dissonance is one that every student should experience, as it is essential in building or making decisions based on newly acquired information. For example, a student who must choose between continuing studies in one of the general academic tracks (scientific or literary) or pursuing a vocational track inevitably has to abandon one alternative. However, after making the decision, the student may perceive some positive qualities in the rejected option due to cognitive dissonance. To eliminate or reduce this conflict, the individual is compelled either to convince themselves that the rejected alternative is unattractive and that the characteristics of the chosen option were not strongly influential in the decision, or to justify their choice by presenting a set of supporting factors, such as exaggerating the positive qualities of the selected alternative. In this way, the person emerges from the state of cognitive dissonance and regains psychological balance, moving forward to implement the decision while allowing for the possibility of modification and correction through a process of reorientation. (Festinger, 2017: 17).

Therefore, studying cognitive dissonance is almost essential for understanding students' cognitive motives in particular. A student experiencing cognitive dissonance is in a state of motivation; that is, they remain driven in their behavior to express their attitudes toward the object they are facing or thinking about. This motivational state keeps them cognitively and mentally preoccupied, even when it does not appear so outwardly. In reality, however, they are internally aroused, unsettled, and unable to regain balance until the state of dissonance is resolved or reduced. (Qatami, 2012: 45).

Joel Cooper (2007) explained that students are naturally more inclined toward consistency between their beliefs and their behavior, and that consistency among cognitive elements is more cognitive than logical in nature. Everything that appears consistent among cognitive elements in the student's mind represents harmony, whereas anything that does not represents dissonance. The relationship between these elements can be described as follows: a harmonious relationship occurs when one of the two elements or ideas includes something about the other, meaning that the first idea implicitly indicates the second. Conversely, dissonance arises when one cognitive element contradicts another; that is, when a student holds two ideas that are opposite to each other. (Cooper, 2007: 34). As such, the importance of the research can be summarized as follows:

- The importance of the university stage, which is considered one of the most significant educational institutions concerned with preparing future teachers. This is achieved by equipping them with experiences, skills, and knowledge according to scientific foundations, enabling them to assume the responsibility entrusted to them, namely, educating promising future generations.
- The importance of teaching formal thinking skills, as this enables students to deal effectively with various forms of knowledge and information, and then make

appropriate decisions after careful study, examination, and analysis. As a result, their decisions are more likely to be sound when facing the many problems that occupy students' time and attention throughout their academic years.

- The importance of identifying the relationship between cognitive dissonance and formal thinking among students at University of Baghdad.

Third: Research Objectives

The research aims to:

- Identify the level of cognitive dissonance among university students.
- Determine the significance of differences in cognitive dissonance according to the gender variable (male–female) among university students.
- Identify the level of formal thinking among university students.
- Determine the significance of differences in formal thinking according to the gender variable (male–female) among university students.
- Identify the correlational relationship between cognitive dissonance and formal thinking among university students.

Fourth: (Scope of the Research)

The current research is limited to students of University of Baghdad for the academic year (2024–2025), including both males and females.

Fifth: Definition of Terms

1. Cognitive Dissonance was defined by:

- Abdel Fattah and Jaber (2005) as: "The desire for logic, consistency, coherence, and non-contradiction. When related information and ideas are consistent, what we call a problem does not arise; rather, cognitive harmony or cognitive balance occurs. However, when these ideas and pieces of information conflict with one another, a state of cognitive dissonance arises, which drives the learner to seek to reduce this dissonance and achieve harmony." (Abdel Fattah & Jaber, 2005: 74)
- Lahouidek (2014) as: "An internal emotional state that occupies the individual's mind and thinking when two ideas or issues of equal importance conflict, ultimately leading to a state of internal cognitive consistency." (Lahouidek, 2014: 43)

The researcher's operational definition: Cognitive dissonance is defined as a state of psychological and cognitive instability or imbalance experienced by students of the University of Baghdad (males and females) when they are exposed simultaneously to a set of conflicting ideas and information, resulting in a state of cognitive dissonance. This state is inferred through their responses to the items of the measurement scale.

2. Formal Thinking was defined by:

- Abu Jado and Mohammed (2010) as: "The mental ability that enables an individual to solve complex problems through the use of abstractions and generalizations that integrate specific elements." (Abu Jado & Mohammed, 2010: 35)

- Al-Tamimi and Zaid (2019) as: "A mental activity that includes a number of thinking skills, such as logical reasoning, inference, and problem-solving." (Al-Tamimi & Zaid, 2019: 4)

The researcher's operational definition: Formal thinking is defined as a set of mental processes possessed by students of the University of Baghdad (males and females) that enable them to solve the problems they encounter using logical operations. It is inferred through their responses to the items of the formal thinking test prepared for this purpose.

Chapter Two

Theoretical Framework and Previous Studies

Theoretical Aspects

In the second chapter, the researcher seeks to clarify the theoretical aspects upon which the current study is based, with the aim of explaining the theoretical foundations and premises underlying the research variables.

First Axis: Cognitive Dissonance

The theory of cognitive dissonance is considered one of the cognitive theories that explain individual motivation from a rational, cognitive perspective. Numerous theories have interpreted human motivation: some have focused on biological aspects, others on environmental aspects such as material and social factors, and still others on psychological aspects, including cognitive and emotional dimensions (Festinger & Carlsmith, 2015: p. 81).

Cognitive dissonance is regarded as one of the motives for learning and among the most important forces driving the development of students' knowledge. It motivates students to seek new knowledge in order to interpret existing knowledge. The need for mental or cognitive consistency means that when cognitive components, such as information, ideas, and perceptions, conflict with one another, they often stimulate behavior. In such cases, the student experiences discomfort and, at the same time, feels motivated to reduce cognitive dissonance (Abdel Fattah & Jaber, 2005: 76).

Cognitive dissonance explains students' attitudes, knowledge, and behavioral activities. Students develop their ideas and knowledge either through themselves or through the surrounding environment. These cognitions include opinions, ideas, attitudes, and beliefs about themselves, their behaviors, and their environment.

In the 1950s, Leon Festinger published his theory of cognitive dissonance. The essence of this theory is that ideas function as motives and can arouse motivation so strongly that they may even surpass very basic incentives. Cognitive (or intellectual) dissonance refers to a state of conflict and contradiction between what an individual believes and what they actually do.

For example, based on extensive scientific research, one may believe that student teachers, upon graduation, experience cognitive dissonance due to lack of experience, differing surrounding conditions, and professional environments that contrast with what they learned in their practicum programs. This is a situation in which an idea conflicts with behavior, creating psychological discomfort. When cognitive elements, such as information, ideas, and perceptions, conflict with one another, the individual feels uneasy due to a state of tension.

This tension stimulates and directs behavior toward reducing it by restoring balance and harmony among cognitive elements. This may occur through seeking new information, changing behavior, or modifying attitudes (Qatami, 2012: 65). As such, the degree of cognitive dissonance depends on several factors, including:

- The importance of the decision made.
- The relative attractiveness of the rejected alternatives compared to the chosen alternative.
- The degree of similarity or overlap between the selected alternatives.

Cognitive dissonance may also occur when an individual is compelled to conform to the opinion of a group without a corresponding or prior change in their personal beliefs. Forced compliance often results from the rewards or punishments that the group is able to impose on the individual. So, whether the dissonance experienced is moderate or intense, it must be reduced. This reduction can occur through the following methods:

- Convincing one that the decision was correct by seeking information that justifies the decision.
- Submitting to authority or group pressure, whereby the individual adopts compliance as a behavioral strategy, even if it conflicts with their own beliefs and ideas.(Abd Ali, 2019: 61)

Second: Formal Thinking

The theory of Jean Piaget (1896–1980) is considered one of the most prominent and earliest theories addressing the subject of human cognitive development. It has received wide attention from researchers in various fields, particularly in general psychology and developmental psychology.

This theory seeks to provide a comprehensive and in-depth explanation of the process of human cognitive development. Piaget proposed that the cognitive processes individuals use to understand information differ according to the developmental stages they pass through. He attributed these differences to several key factors, most notably maturation, acquired experiences, social interactions, and the achievement of cognitive balance.

Piaget emphasized that these factors collectively play a fundamental role in intellectual transition and growth from one cognitive stage to another. Ultimately, this progression leads to the development of abstract thinking abilities and more advanced methods of information processing (Abu Ghazal, 2006: 133).

Cognitive development in individual's progresses according to a predetermined sequence, as the completion of each stage is believed to depend on the successful achievement of the preceding stages. Although Jean Piaget acknowledged the role of heredity in intellectual development, he also recognized the influence of the social and physical environment in determining the age at which mental abilities emerge and develop (Davidoff, 1983: 288).

Piaget examined cognitive development through the method of “mental construction,” which focuses on the type and quality of thinking individuals possess at different developmental stages. In addition, he considered mental functions, those processes involved when interacting with external environmental stimuli, as an essential component of this development (Abu Jado, 2000: 103).

Piaget viewed cognitive development from two fundamental perspectives: mental structures and mental functions. Mental structure refers to the level of thinking an individual is capable of achieving at a particular stage of life, whereas mental function relates to the mechanisms an individual uses when interacting with their environment. Accordingly, Piaget believed that mental functions are innate and consistent among humans, meaning they are inherited. In contrast, mental structures are what develop and evolve with age (Al-Awamleh & Mazahreh, 2003: 47).

Formal Thinking involves identifying relationships among the elements of a subject and emerges in an individual only when they have acquired a sufficient repertoire of concepts. This provides the learner with new and developing mental capabilities, allowing their thinking to move beyond the limits of concrete reality into the realm of mental representations, principles, and theories (Badeer, 2008: 114).

Jerome Bruner considered formal thinking as symbolic representation, which is the most abstract and advanced stage of representational development. It involves the use of words and symbols to describe particular experiences (Qatami, 2005: 110). At this stage, the learner's mental abilities evolve to represent the external world through logical thinking, conceptual abstraction, and processing that relies on active experimentation. Objects, people, or events are represented by their characteristics, which are abstracted into symbols that signify them (Al-Rimawi, 2008: 94).

Language is the primary system of symbolic representation through which an individual can encode experiences. A learner reaches this stage when various symbolic systems, such as language, logic, and mathematics, replace actions and sensory perceptions (Abu Jado, 2014: 131–132).

Formal thinking is a mental process aimed at deducing outcomes, extracting abstract meanings of things, and identifying relationships using hypothetical reasoning through symbols, generalizations, and the ability to formulate and test assumptions (Saeed, 2008: 30).

Formal thinking occurs when an individual encounters a problem for which there is no ready solution or experimental method. It is exercised to understand the causes and underlying reasons behind phenomena, relying on theoretical evidence and proofs. It is characterized as purposeful and directed thinking that requires considerable cognitive effort (Al-Tamimi & Zaid, 2019: 43).

Second Axis: Previous Studies

First: Al-'Adamat and Adnan (2017)

Study Title: "Cognitive Dissonance and Its Relationship to Thinking Styles and Sources of Social Support among Yarmouk University Students". This study was conducted in Jordan at Yarmouk University. It aimed to examine the level of cognitive dissonance and its relationship to thinking styles and sources of social support. The researchers selected a sample of 775 students from Yarmouk University. They used three scales:

1. A scale to measure cognitive dissonance
2. A scale to measure social support

3. A scale to measure thinking styles

The following statistical methods were employed:

Cronbach's alpha for reliability, Two-way analysis of variance, Percentages, and Discrimination coefficient formula

Study Results:

The results indicated differences in levels of cognitive dissonance across academic years. All dimensions of the cognitive dissonance scale among Yarmouk University students were at a moderate level, except for the dimension of emotional control, which differed from the others (Al-'Adamat & Adnan, 2017: 15–27).

Second: Study (Al-Aibi, 2011)

'Formal Thinking and Its Relationship with the Big Five Personality Traits among Preparatory Stage Students'. The research aims to identify formal thinking and its relationship with the Big Five personality traits among preparatory stage students. The sample consisted of 400 students from the fifth preparatory grade, selected using stratified random sampling with proportional distribution from the Karkh Education Directorates (First, Second, and Third), comprising 207 males and 193 females, with 226 students from the scientific branch and 174 students from the literary branch.

Two instruments were used in the research. The first was the Formal Thinking Test, which was developed by the researcher. Its psychometric properties were verified, including face validity, construct validity, item difficulty, and discriminative power. Reliability was assessed using the test-retest method, yielding a correlation coefficient of 0.78, the split-half method with a corrected correlation of 0.79, and Cronbach's alpha of 0.81. The final version of the test consisted of 24 items.

Chapter Three

Research Population:

The current research population consisted of students from the colleges of University of Baghdad, including both genders (male and female) for the academic year 2024–2025.

Research Sample:

The researcher selected her research sample using the random sampling method. The sample consisted of 140 students, chosen from four colleges at University of Baghdad, namely: Ibn Rushd College of Education, College of Arts, College of Engineering, and College of Science, as shown in Table (1).

Table (1): Research sample distributed according to the variables of college and gender. Here's the English translation of your table in a clear format:

No.	College	Gender	Total
		Male	Female

No.	College	Gender	Total
1	Ibn Rushd College of Education	18	20
2	College of Arts	17	21
3	College of Engineering	14	16
4	College of Science	17	17
Total		66	74

Research Instruments:

To measure the variables of the current study, the researcher adopted the Cognitive Dissonance Scale developed by Shawkat. The scale consisted of 33 items, each with five response options: *Always applies to me*, *Applies to me*, *Applies to a moderate degree*, *Does not apply to me*, *Never applies to me*, scored (1, 2, 3, 4, 5) respectively.

The Formal Thinking Test was adopted from the test developed by Al-Aibi. The test consisted of 24 items, scored as (1, 0), where a score of 1 is given for a correct answer representing formal thinking, and 0 for an incorrect answer that does not reflect formal thinking. To determine the validity of the items, the research instruments were presented to a group of referees specializing in educational and psychological sciences. The purpose was to assess the suitability of the items. Based on the referees' feedback, items with at least 80% agreement were retained. Accordingly, all items in both instruments were kept without any deletions by the referees.

Statistical Analysis of the Research Instruments (Cognitive Dissonance and Formal Thinking):

The two instruments were applied to 140 students, and this sample was used for item analysis as well as for the results of the current study. The extreme groups method was employed as a procedure for item analysis, as follows:

Extreme Groups: To conduct the analysis using this method, the following steps were taken:

1. Determine the total score for each questionnaire on both instruments.
2. Arrange the questionnaires from the highest to the lowest score for each instrument.
3. Identify the top 27% of questionnaires with the highest scores and the bottom 27% with the lowest scores. These represent two groups with the largest possible size and maximum differentiation. Each group consisted of 38 questionnaires per instrument.

Then, an independent samples t-test was applied to test the difference between the mean scores of the high-score group and the low-score group for the Cognitive Dissonance Scale. For the Formal Thinking Test, since its items were dichotomous, the discriminative power of the items was calculated.

All items in the Cognitive Dissonance Scale were found to be discriminative at the 0.05 significance level, and all items in the Formal Thinking Test were also discriminative at the 0.05 significance level, based on Ebel's criterion, which sets the discriminative power threshold at 0.30 or higher. Tables (2 and 3) illustrate this.

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Table (2): Discriminative Power of the Items of the Cognitive Dissonance Scale

No.	High Mean	Group	High SD	Group	Low Mean	Group	Low SD	Group	t- value	Significance (0.05)
1	4.9		0.071		3.8		3.13		11.82	Sig
2	4.5		0.39		3.9		1.9		7.59	Sig
3	4.48		3.72		3.56		3.55		6.57	Sig
4	3.14		1.36		2.56		2.64		5.57	Sig
5	3.3		1.2		3.03		1.8		14.11	Sig
6	4.4		0.64		4		1.08		5.88	Sig
7	4.25		0.77		3.6		1.5		8.33	Sig
8	4.5		0.64		4		0.84		7.9	Sig
9	4.7		51.0		3.3		1.75		17.9	Sig
10	4.4		0.35		3.8		9.7		5.45	Sig
11	2.5		1.74		2.9		1.68		4.16	Sig
12	4.9		0.071		4.3		3.13		6.45	Sig
13	4.2		1.25		7.3		0.39		7.46	Sig
14	4.25		0.81		3.48		0.913		15.4	Sig
15	4.4		0.8		3.5		1.64		11.25	Sig
16	4.4		0.6		3.6		0.55		14.28	Sig
17	3.3		1.9		2.7		1.44		6.31	Sig
18	2.3		1.9		2.03		0.65		3.37	Sig
19	4.7		0.74		4.03		1.11		9.43	Sig
20	4.8		0.4		4.03		1.11		19.25	Sig
21	4.8		0.48		4.3		0.83		8.47	Sig
22	4.5		1.79		4.07		1.22		4.77	Sig

No.	High Mean	Group	High SD	Group	Low Mean	Group	Low SD	Group	t- value	Significance (0.05)
23	3.85		1.59		3.29		2.98		5.09	Sig
24	3.37		1.85		2.48		1.79		8.98	Sig
25	4.2		1.25		3.67		1.07		7.60	Sig
26	4.5		0.625		3.6		1.01		13.63	Sig
27	4.3		0.64		4		1.08		5.13	Sig
28	4.2		0.77		3.6		1.5		8.32	Sig
29	4.5		0.64		4		0.84		7.55	Sig
30	4.4		51.0		3.3		1.75		9.9	Sig
31	4.4		0.35		3.8		9.7		5.45	Sig
32	4.5		1.74		2.9		1.68		4.16	Sig
33	4.9		0.071		4.3		3.13		6.45	Sig

Table (3): The Discriminative Power of the Formal Thinking Items

Item Number	Discriminative Power	Significance
1	0.36	Sig
2	0.36	Sig
3	0.42	Sig
4	0.36	Sig
5	0.34	Sig
6	0.49	Sig
7	0.36	Sig
8	0.45	Sig
9	0.39	Sig
10	0.38	Sig
11	0.41	Sig

Item Number	Discriminative Power	Significance
12	0.36	Sig
13	0.44	Sig
14	0.38	Sig
15	0.38	Sig
16	0.40	Sig
17	0.41	Sig
18	0.38	Sig
19	0.37	Sig
20	0.32	Sig
21	0.44	Sig
22	0.47	Sig
23	0.45	Sig
24	0.48	Sig

The Relationship between Item Scores and the Total Scale Score:

Pearson's correlation coefficient was used to determine the correlation between the score of each item on the scale and the total score. All correlation coefficients were statistically significant for the Cognitive Dissonance Scale. For the Formal Thinking Test, since it is dichotomous, the point-biserial correlation coefficient was used. All items were statistically significant when compared with the tabulated value of (0.159) at a significance level of (0.05) and with (138) degrees of freedom. Tables (4) and (5) illustrate this.

Table (4): Correlation Coefficients of the Cognitive Dissonance Scale Items

Item	Correlation Coefficient	Item	Correlation Coefficient	Item	Correlation Coefficient
1	0.306	12	0.210	23	0.229
2	0.262	13	0.112	24	0.365

Item	Correlation Coefficient	Item	Correlation Coefficient	Item	Correlation Coefficient
3	0.365	14	0.267	25	0.251
4	0.255	15	0.265	26	0.332
5	0.226	16	0.185	27	0.256
6	0.221	17	0.225	28	0.367
7	0.265	18	0.183	29	0.377
8	0.255	19	0.378	30	0.371
9	0.304	20	0.219	31	0.211
10	0.459	21	0.465	32	0.310
11	0.208	22	0.395	33	0.288

Table (5): Correlation Coefficients of the Formal Thinking Test Items

Item	Correlation Coefficient	Item	Correlation Coefficient	Item	Correlation Coefficient
1	0.277	11	0.255	21	0.307
2	0.234	12	0.275	22	0.276
3	0.338	13	0.320	23	0.280
4	0.231	14	0.222	24	0.294
5	0.173	15	0.297	—	—
6	0.264	16	0.295	—	—
7	0.265	17	0.218	—	—
8	0.358	18	0.292	—	—
9	0.333	19	0.331	—	—
10	0.226	20	0.224	—	—

Validity:

Validity is one of the fundamental psychometric properties of educational and psychological tests and measures. The researcher extracted two indicators of validity for the two instruments: face validity and discriminant validity.

Face Validity: Face validity for the Cognitive Dissonance Scale and the Formal Thinking Test was established after presenting them to a panel of experts in the field of educational and psychological sciences.

Discriminant Validity: Discriminant validity was verified through the statistical analysis of the items of both instruments. The purpose of this procedure was to retain the good (discriminating) items and eliminate the non-discriminating ones. The extreme groups method was used as a procedure for item analysis in this type of validity. In addition, internal consistency was calculated (i.e., the correlation between each item score and the total score).

Reliability:

Reliability for the Cognitive Dissonance Scale was calculated using Cronbach's Alpha. The reliability coefficient obtained by this method was (0.84). For the Formal Thinking Test, reliability was calculated using the Kuder–Richardson Formula 20 (KR-20), as it is the most commonly used method for estimating the internal consistency of instruments with dichotomous items (Melhem, 2000: 265). The reliability coefficient reached (0.81).

Statistical Methods:

The following statistical methods were used:

1. Independent samples t-test.
2. Pearson correlation coefficient.
3. Cronbach's Alpha formula.
4. One-sample t-test.
5. Point-biserial correlation coefficient.
6. Discriminative power equation.
7. Kuder–Richardson Formula 20 (KR-20).

Chapter Four

Presentation and Interpretation of the Results

First Objective: Identifying Cognitive Dissonance among University Students

The results of the statistical analysis showed that the sample's mean score was (113.05) with a standard deviation of (13.75), while the hypothetical mean of the test was (99). Using a one-sample t-test, the calculated t-value was (12.9). When compared with the tabulated value of (1.96), it was found to be statistically significant at the (0.05) level with (139) degrees of freedom.

This indicates that the research sample exhibits cognitive dissonance, as shown in Table (6).

Table (6)

The t-test Value for the Difference between the Sample's Arithmetic Mean and the Hypothetical Mean in Cognitive Dissonance

Table (6); *The t-test Value for the Difference Between the Sample Mean and the Hypothetical Mean in Cognitive Dissonance*

Sample Size	Arithmetic Mean	Standard Deviation	Hypothetical Mean	t-value (Calculated)	t-value (Tabulated)	Significance Level (0.05)
140	113.05	13.75	99	9.12	1.96	Significant

Second Objective: Identifying the Significance of Differences in Cognitive Dissonance According to Gender (Male–Female) Among University Students

To achieve this objective, the mean scores were calculated. The mean score for males was (111.61) with a standard deviation of (13.33), while the mean score for females was (115.09) with a standard deviation of (10.66).

Using an independent samples t-test, the calculated t-value was (3.69). When compared with the tabulated value of (1.96), it was found that there is a significant difference between males and females in cognitive dissonance, favoring females, at the (0.05) level with (138) degrees of freedom. Table (7) illustrates these results.

Table (7)

Results of the Independent Samples t-Test Between the Mean Scores of Males and Females in Cognitive Dissonance

Gender	Sample Size	Arithmetic Mean	Standard Deviation	t-value (Calculated)	t-value (Tabulated)	Significance (0.05)
Male	66	111.61	13.33	3.69	1.96	Significant in favor of females
Female	74	115.09	10.66	—	—	—

Third Objective: Identifying Formal Thinking Among University Students

The results of the statistical analysis showed that the sample's mean score in formal thinking was (17.30) with a standard deviation of (11.56), while the hypothetical mean of the scale was (12). Using a one-sample t-test, the calculated t-value was (9.9). When compared with the tabulated value of (1.96), it was found to be statistically significant at the (0.05) level with (139) degrees of freedom.

This indicates that the research sample possesses formal thinking. Table (8) illustrates these results.

Table (8)

One-Sample t-Test Result for the Difference between the Sample Mean and the Hypothetical Mean in Formal Thinking

Sample Size	Arithmetic Mean	Standard Deviation	Hypothetical Mean	t-value (Calculated)	t-value (Tabulated)	Significance (0.05)
140	17.30	11.56	12	9.9	1.96	Significant

Fourth Objective: Identifying the Significance of Differences in Formal Thinking According to Gender (Male–Female) Among University Students

To achieve this objective, the mean scores of males and females were calculated. The mean score for males was (17.51) with a standard deviation of (10.43), while the mean score for females was (17.09) with a standard deviation of (11.12). Using an independent samples t-test, the calculated t-value was (0.51). When compared with the tabulated value of (1.96), it was found that there is no significant difference between males and females in formal thinking at the (0.05) level with (138) degrees of freedom.

Table (9)

Results of the Independent Samples t-Test Between the Mean Scores of Males and Females in Formal Thinking |

Gender	Sample Size	Arithmetic Mean	Standard Deviation	t-value (Calculated)	t-value (Tabulated)	Significance (0.05)
Male	66	17.51	10.43	0.51	1.96	Not- sig
Female	74	17.09	11.12	—	—	—

Fifth Objective: Identifying the Correlation between Cognitive Dissonance and Formal Thinking among University Students

After analyzing the results using Pearson's correlation coefficient, it was found that there is no significant correlation between cognitive dissonance and formal thinking for the sample as a whole. The correlation coefficient was (0.101), which is smaller than the tabulated Pearson correlation value of (0.159) at the (0.05) significance level with (138) degrees of freedom.

Fourth: Recommendations

- Integrate thinking skills programs, especially formal thinking skills, into university curricula and activities to equip students with formal thinking abilities. This will enable them to understand lessons better and deal effectively with everyday life problems.
- Encourage instructors in colleges of basic education to use modern teaching methods and avoid rote teaching or imposing ideas and solutions on students. This will allow students to experience cognitive dissonance and actively seek solutions to conflicting ideas, thereby reducing dissonance and increasing knowledge while avoiding mental rigidity.
- University professors in colleges of basic education can be encouraged to include questions in their courses that assess formal thinking skills to improve students' performance in these skills.

Fifth: Suggestions for Future Research

- Conduct a similar study with other samples in Iraqi universities and compare the results with the current study.
- Conduct a similar study at different educational levels, such as middle and high school stages, and compare the results with those of this study.
- Conduct a comparative study of cognitive dissonance between students in public and private colleges.

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