

## The level of mind habits among students majoring in mathematics at Al-Balqa Applied University and its relationship to some variables

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### Abstract

The study aimed to reveal the level of mind habits among students majoring in mathematics at Al-Balqa Applied University and its relationship to some variables. The researcher used the descriptive analytical method and developed the habits of mind scale prepared by Al-Qahtani, which consists of 50 items, and applied it to a study sample consisting of 143 male and female students who were randomly selected from different academic levels in the mathematics department at the university. The results of the study showed that the mind habits of students majoring in mathematics at Al-Balqa Applied University was at a moderate positive degree, and there were statistically significant differences in the habits of mind among students majoring in mathematics at Al-Balqa Applied University concerning the gender variable, in favour of females, and there were significant statistical differences concerning the academic level variable, in favour of the master's students. In addition, in light of the results of the study, the researcher presented a set of recommendations.

Keywords: Mind habits, university students, cross-sectional, Jordan;

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## 1. Introduction

The mind is a thinking machine, and whether used or not, its function is to think. The hypothesis behind the thinking machine is that the individual is born and has a general readiness to think (McPeck, 2016). The fuel of the mind machine is experiences with which the individual interacts, and so his/her process, speed and organisation of situations and problems develop (Joranger, 2018). The task of the directed environment requires that the individual be trained to increase the investment of his/her mental energies and employ all the surrounding circumstances, capabilities, materials and tools for the capabilities of his/her body, mind and senses to implement the mind and reach advanced mind habits (Al-kreimeen et al., 2022).

When the mind glows, the march of human civilisation begins and its flame goes out, but when its lustre fades, civilisation begins to crumble, fall and collapse (Samawi et al., 2020). Building the nation's civilisation requires appealing to the mind and drawing inspiration in its goal, because the mind is the beginning and expert of human civilisation (Swanson, 2022).

Regarding the importance of the habits of the mind, there are a set of different strategies and ways to develop them for learners, including providing a supportive environment for a process of discussion and thinking among them (Lucas & Hanson, 2016), using thinking maps and images, describing them, expressing using symbols that make them think about what they are doing, self-awareness and reflecting on their thinking, actions and behaviours, and evaluating themselves, their attitudes and behaviours, and striving to improve it for the better (Buran & Filyukov, 2015).

Learners form their mental habits related to higher order thinking skills and develop their cognitive strategies, when they are forced or placed in situations that force them to interpret ideas, raise questions, respond to challenges (Amponsah et al., 2019) and seek solutions to the problems they face, and thus they consider this a recognition of their intelligence and sufficient abilities to accomplish what they were assigned (Pei et al., 2018).

Habits of the mind are defined as the correct behaviour patterns that the individual prefers to use when facing a situation (Verplanken et al., 2018), problem or question that is not being answered at the present time, by employing mental skills and enhancing his/her knowledge production methods by benefiting from previous experiences to reach the correct solution (Wendel, 2020).

Mind habits is a pattern of intelligent behaviours that lead the educated individual to some actions resulting from his/her response to different types of problems that need research, reflection and contemplation (Koura & Zahran, 2017).

The set of characteristics that characterise the habits of mind, as reported by Kallick and Zmuda (2017), are as follows:

- Inclination or what is called the presence of desire: The tendency and desire to implement various intellectual behavioural patterns.
- Value: Choosing a specific pattern from a set of patterns of intellectual behaviour that is more productive instead of choosing other patterns that are less productive.
- Sensitivity: Recognising the existence of a specific opportunity or situation that is more appropriate for thinking, as well as choosing the appropriate time to implement it.
- Commitment: Working to develop performance by using different behavioural patterns that support and enhance the thinking process itself, as well as by seeking to reflect on and improve its performance.

- **Capability:** Possessing basic skills and abilities through which an individual can apply the various patterns of intellectual behaviour.
  - **Policy:** The use of rationality in all practices, actions and decisions, working to raise their level, and make them a general policy that should not be overlooked at work.

With regard to the theoretical approaches that deal with habits of mind, the most important is the Costa and Kallick (2000) model, which includes 16 mental habits represented by perseverance, data collection using all senses, impulse control, visualisation, creativity and innovation, listening with understanding and empathy (Claxton et al., 2016), responding with amazement and questioning, metacognitive thinking, taking responsibility for taking risks, being accurate, having a good sense of humour, questioning and posing problems, reciprocal or group thinking, thinking flexibly, applying previous knowledge in new situations, thinking and communicating clearly and accurately and permanent readiness for continuous learning (Vollrath, 2016).

Hogan et al. (2015) reported that mental habits might include the following:

- 1- Thinking process maps, including the skills of asking questions, metacognition, multiple senses and emotional skills.
- 2- Brainstorming habits include creativity, flexibility, curiosity and expanding experience.
- 3- Graphic organisers include perseverance, organisation, control and accuracy.

The productive habits of the mind are one of the important domains in education, and work based on these habits makes the individual effective and efficient and allows high-level thinking (Luna Scott, 2015). Habits of the mind should be the focus of teaching and learning. There is no point in students learning content if they do not learn to strive for accuracy and correctness, avoid impulsivity and work on the edge of their competence and not at its centre (Winner et al., 2020).

For this reason, educators have been interested in providing educational strategies to put the learner in long-term intellectual environments by training him/her on basic thinking skills and mastering them so that it becomes possible to effectively confront higher levels of thinking (Luckin et al., 2016), resulting in mental processes that are used in the development of a product or decision-making, which leads to the formation of mental habits that we seek (Doyle, 2018).

From this point of view, there are 16 habits that the productive mind performs and are affected by the brain's control of certain intelligences of an individual, as they differ from one individual to another, and also differ in their acquisition and refinement in light of the study material being learned. Mathematics, for example, acquires productive mental habits that are different from what is gained in languages, social sciences, natural sciences etc. (Al-Qahtani, 2017).

Thus, attention to the preparation, training and development of university students is a must to advance the educational process by developing skills, knowledge and values that guarantee the quality of this building, hence the idea of the current study, which aims to identify the level of mind habits among students majoring in mathematics at Al-Balqa Applied University and its relationship some variables.

### 1.1. Previous studies

Abu Rayyash and Al-Jundi (2018) conducted a study that aimed to reveal the level of mind habits among the source teacher in light of the variables of the type of school (public/private), the number of years of experience and gender. The study sample consisted of 289 male and female teachers working

in learning resource rooms in Jordanian schools. To achieve the objectives of the study, the researchers built a scale for 16 mental habits, and used the descriptive survey method. The results indicated that the teacher's possession of the habits of questioning and problem-solving, finding humour and controlling recklessness was at a high level, where the levels of the source teacher's possession of these habits ranged between 33.05 and 33.69; the levels of the source teacher's possession of the rest of the habits ranged between medium and large; and the lowest degree was for the habit of creation, visualisation and innovation. It also indicated that there were no statistically significant differences in the mind habits of the source teacher concerning the variables of school type, number of years of experience and gender.

Al-Sabbagh (2015) conducted a study aiming to identify the habits of the mind of mathematics students at the University of Jordan and Al-Balqa Applied University, and to examine whether these habits statistically differ according to gender, university and academic level, and to find out whether there is a correlation between the habits of mind and attitudes towards mathematics. To answer the study questions, two questionnaires were designed: the first to measure the habits of mind and the second to measure students' attitudes towards mathematics. A cluster random sample of 438 students specialising in mathematics was used for the first semester of the year 2013–2014. The results of the study showed the existence of some habits of mind, especially the application of knowledge. The least of which was metacognitive thinking. The results of the three-way analysis of variance also showed that the habits of mind of the study sample varied in a statistically significant degree depending on the achievement level variable; some bilateral interactions; and the interaction between the achievement level, gender and university level. The results of the *t*-test showed statistical significance in the habits of mind among the students concerning the level of achievement. Also, there was no statistically significant relationship between the habits of mind and students' attitudes towards mathematics.

Wirsema (2009) conducted a study to identify the intended mental processing and the student's thinking as monolithic habits of mind. The researcher used the descriptive approach, and the study sample consisted of eight students who participated in university courses from Kansas State in Luanda. To achieve the objectives of the study, the researcher prepared an observation card and interview. The results of the study indicated that questioning is the best way to develop habits of mind among the participating students. In addition, teaching students alone to ask and answer these questions develops mental processing operations, which leads to the development of habits of mind for them.

Gordon's (2011) study aimed to know the mathematical habits of mind, increase students' thinking and used the descriptive analytical approach on a sample of 210 male and female high school students in the United States of America. To collect data, the researcher prepared a questionnaire about the habits of mind. The results of the study indicated that there was a decrease in the level of mind habits among students participating in the study, and that discussion was the best strategy to improve the habits of mind about the mathematical strategies used in various mathematical problems.

Al-Khafaf (2016) conducted a study that aimed at identifying the habits of mind of kindergarten teachers according to the variable of age, length of service and social status. The research sample consisted of 100 teachers from the Rusafa Education Directorate. The results showed that kindergarten teachers had mental habits with a mean score higher than the hypothetical average of the scale, and that the difference in the degrees of mental habits according to the variable of age and length of service was statistically significant, while there were no differences in the degrees of mental habits according to the variable of social status.

Al-Qahtani's (2017) study aimed to identify the level of practicing the habits of the productive mind and its relationship to some variables among students of the Faculty of Education at the University of Shaqra. The research sample consisted of 222 male and female students. The researcher followed the descriptive approach. The study concluded that the students of the College of Education practice the 16 habits of mind at a rate of 70.93%. There was no relationship between the level of practice of the students of the College of Education at Shaqra University for those habits and their cumulative average and there were no differences in the level of practicing the habits of productive mind of the students of the Faculty of Education at Shaqra University regarding the variable of specialisation in high school (scientific and literary).

After reviewing the previous studies that examined the issue of the level of mind habits, the importance of knowing their levels among university students and the difference of the current study from previous studies in terms of the study sample and its tools that were developed to suit the reality of universities in Jordan was noted.

### *1.2. Statement of the problem*

The university educational field is one of the most vital and important fields of life. It is the vital system that interacts with its environment and affects and is permanently affected by it, and so it derives its inputs and returns to it its outputs. The educational reality, according to what was conducted from previous studies, confirms that most students lack the use of habits in various educational and practical activities in mathematics. In addition to that, they memorise scientific concepts and terms without understanding or comprehending them as required. Therefore, modern education methods call for making habits of mind a priority in the different stages of education.

All habits of the mind can be found by the student in all the work that he/she practices and performs, and his/her possession of these habits has an impact on his/her method of acquiring information and integrating knowledge, so it may be difficult to use them automatically if the student does not train on them and has the opportunity to use them.

Mathematics is one of the most important scientific subjects that a university student studies, and it needs to activate various new roles and strategies that simulate creative thinking and the thinking skills of students to increase their knowledge and information and expand their awareness so that they can understand, apply, comprehend and conclude what they learn to reach the desired result.

Therefore, this study measures the level of mind habits of students majoring in mathematics at Al-Balqa Applied University and its relationship to some variables. In light of the foregoing, the problem of the study is to answer the following questions:

1. What is the level of mind habits of mathematics students at Al-Balqa Applied University?
2. Are there statistically significant differences at the level of the function ( $\alpha \leq 0.05$ ) in the level of mind habits among students majoring in mathematics at Al-Balqa Applied University concerning the variables of gender and educational stage?

### *1.3. Research objectives*

The study aimed at measuring the level of mind habits among students majoring in mathematics at Al-Balqa Applied University and its relationship to some variables, as well as measuring the differences in the level of mind habits among students majoring in mathematics at Al-Balqa Applied University concerning the variable of gender and academic level, in addition to identifying the

variables that can contribute to its strengthening and make some recommendations in light of the results that have been reached.

#### *1.4. Research significance*

- 1- Preparing a list of mental habits that should be developed among university students, especially students specialising in mathematics, which may benefit those in higher education institutions in preparing and developing programmes that include these habits and seek to develop and improve them.
- 2- Preparing the study tools represented in the habits of mind scale, with the aim of training mathematics students to self-evaluate their performance according to the habits of mind, which is reflected in their academic and personal performance.
- 3- Recognising the level of mind habits of students majoring in mathematics at Al-Balqa Applied University, which may contribute to directing the attention of the teaching staff in scientific faculties and making the learning process more positive and effective by providing the appropriate atmosphere and scientific activities.
- 4- The results of the study may be useful in enriching the scientific knowledge related to the level of mind habits among students majoring in mathematics in Jordanian universities.
- 5- Providing some recommendations and suggestions in light of the results of the current study.

#### *1.5. Conceptual and operational definitions*

Habits of the mind is the desire or inclination of the individual towards a certain position he/she takes and considers that its implementation is more useful than others, with an emphasis on the effective administration of behaviour and the continuation of its practice (Diez, 2007). It is defined procedurally as the degree that the respondent obtains on the scale used in the current study.

#### *1.6. Research limits*

- 1- Human limits: The study sample was limited to students majoring in mathematics at Al-Balqa Applied University.
- 2- Topical limits: The level of mind habits of mathematics students at Al-Balqa Applied University and their relationship to some variables.
- 3- Locative limits: The study was implemented at Al-Balqa Applied University, Al-Balqa Governorate, Jordan.
- 4- Temporal limits: The current study was implemented in the first semester of the 2021/2022 school year.

#### *1.7. Research limitations*

It includes the psychometric characteristics of the study tool, the method of selecting the study sample and the research methodology used.

## **2. Methodology**

The descriptive analytical approach by studying the phenomenon in reality and paying attention to its description and expression in an accurate quantitative and qualitative description was used. In addition to that, this approach seeks to investigate and analyse the manifestations of the phenomenon.

## 2.1. Research population

The population of this study consisted of all the students of the mathematics department at Al-Balqa Applied University/Centre in Al-Balqa Governorate ( $n = 245$ ), of whom 200 are at the bachelor's level and 45 are at the master's level, according to the statistics of Al-Balqa Applied University for the academic year 2021/2022.

## 2.2. Research sample

The study sample consisted of 150 male and female students; they were chosen randomly; and after distributing the study tool to them, the number of retrieved and valid questionnaires for analysis was 143 questionnaires (95%). Table 1 shows the distribution of students in light of the study variables.

Table 1  
*Distribution of the Study Participants Based on Gender and Academic Staff*

Variable	Categories	F	%
Gender	Male	69	48
	Female	74	52
Academic level	Bachelor	120	82
	Master	23	18
<b>Total</b>		143	100

## 2.3. Data collection instrument

### 2.3.1. Mind habits scale

Abu Latifa (2019) and Al-Qahtani's (2017) scales were developed and improved to measure the level of mind habits among university students and it consists of 30 items distributed into 16 dimensions:

- 1- Perseverance: items 1–6.
- 2- Controlling recklessness: items 7–12.
- 3- Thinking flexibly: items 13–18.
- 4- Thinking and communicating clearly and accurately: items 19–24.
- 5- Applying knowledge to new situations: items 25–30.

The data collection tool was a self-report questionnaire that the students responded to on a 5-point Likert scale: Strongly Agree (5), Agree (4), Neutral (3), Disagree (2) and Strongly Disagree (1). The study used the following equation to extract the range for each of the three levels:  $(\text{Upper score} - \text{lower score}) / 3$ , i.e.,  $5 - 1 / 3 = 1.33$ ; therefore:

- Low level: 1–2.33.
- Intermediate level: 2.34–3.67.
- High level: 3.68–5



As for validity, the researcher verified the validity of the content by presenting the questionnaire to a number of refereed professors specialised in the methods of teaching mathematics and educational sciences, and asked their opinions about the appropriateness of its domains and statements, the integrity of its language, its representation and suitability for the category to which the study sample belongs. Based on their observations, the statements were modified linguistically, and to extract coefficients of validity of the internal consistency of the scale, the correlation coefficients of the scale items with the total degree and the domains belonging to it were calculated (Table 2).

Table 2  
*Correlation Coefficients Between the Questionnaire Statements and the Total Score*

No.	Correlatio n with scale	Correlatio n with domain	No.	Correlatio n with scale	Correlatio n with domain	No.	Correlatio n with scale	Correlatio n with domain
1.	0.352*	0.398*	11.	0.418*	0.584*	21.	0.423*	0.621**
2.	0.510**	0.767*	12.	0.420**	0.593**	22.	0.417**	0.472**
3.	0.442*	0.672**	13.	0.326**	0.419*	23.	0.424*	0.523**
4.	0.382*	0.439**	14.	0.410*	0.524**	24.	0.331*	0.555**
5.	0.510**	0.521**	15.	0.360*	0.534**	25.	0.498**	0.533**
6.	0.420**	0.513**	16.	0.533**	0.730**	26.	0.505**	0.680*
7.	0.502**	0.530**	17.	0.521**	0.612**	27.	0.383*	0.489**
8.	0.367*	0.603**	18.	0.486**	0.671*	28.	0.520**	0.561**
9.	0.703**	0.745*	19.	0.410*	0.524**	29.	0.739**	0.761**
10.	0.444**	0.555**	20.	0.380*	0.534**	30.	0.540**	0.875*

\*Statistically significant at  $\alpha \leq 0.05$ ; \*\*Statistically significant at  $\alpha \leq 0.01$ .

It is clear from Table 2 that the correlation coefficients of the statements with the total score and the domains belonging to it were statistically significant at significance levels ( $\alpha \leq 0.05$  and  $\alpha \leq 0.01$ , respectively), and the scale had high validity and appropriateness for the purposes of the current study. Therefore, none of the items was deleted, which indicates that the domains of the scale are suitable for measuring the level of mind habits of students majoring in mathematics at Al-Balqa Applied University.

As for reliability, it was ensured by the test–re-test method and the reliability coefficient by the method of internal consistency according to Cronbach’s alpha equation on a pilot sample of 20 male and female students from outside the original study sample. The results presented in Table 3 show the reliability coefficients of the study questionnaire and it is clear from the reliability coefficients that these values were considered appropriate for the purposes of this study.

Table 3  
*Internal Consistency Coefficients and Test–Re-test Coefficients for the Study Questionnaire*

Domain	Test-retest	Cronbach’s alpha
Perseverance	0.86	0.92
Controlling recklessness	0.83	0.91
Thinking and communicating clearly and accurately	0.80	0.85
Thinking flexibly	0.82	0.87
Applying knowledge to new situations	0.85	0.91



**Total score** 0.84  
0.89

### 3. Results and discussion

#### 1. What is the level of mind habits of mathematics students at Al-Balqa Applied University?

To answer the question, the mean scores and standard deviations of the scale items and domains were extracted (Table 4).

**Table 4**  
*Means and Standard Deviation of the Mind Habits Scale's Domains*

No.	Domain	M	SD	Level
1	Perseverance	2.87	0.580	Moderate
2	Controlling recklessness	3.17	0.632	Moderate
3	Thinking and communicating clearly and accurately	2.38	0.425	Moderate
4	Thinking flexibly	2.56	0.606	Moderate
5	Applying knowledge to new situations	2.58	0.578	Moderate
<b>Total mind habits scale</b>		2.65	0.464	Moderate

Table 4 shows that all domains of the mind habits scale among students majoring in mathematics at Al-Balqa Applied University were at a moderate level. The overall scale showed that the domain of controlling recklessness was in the first place, with the highest mean score of 3.17 and a moderate level, followed by the perseverance domain in the second rank, with a mean score of 2.87; and in the last rank was the domain of thinking and communicating clearly and accurately, with a mean score of 2.38. Finally, the overall mean score of the scale was 2.65 and a standard deviation of 0.464.

The researcher attributes the previous results to the fact that employing the habits of mind according to its domains in varying proportions among students majoring in mathematics is affected by the proportions of variation and difference in the characteristics, tendencies and desires of the educated students themselves. If the desire, tendencies and ability to employ them are available, the faculty members at the university push to increase their integration in their different teaching styles because of the students' activity and perseverance, their orientations to try to apply what is new to the education arena and their quest for renewal and development away from traditional learning patterns.

Students also develop and improve their cognitive strategies and form their mind habits when they are forced or placed in situations that compel them to ask questions, respond to challenges, provide logical justifications and search for information. When students are assigned to do so, they bear the responsibility to accomplish it; their view of themselves improves; they develop a concept of the importance of developing their habits of mind, making them observe their thinking; are aware of the relationships between them; and increase their ability to link new information with previous information in their knowledge structure to achieve understanding and comprehension; thus, they succeed in specialisation. The study findings are in accordance with the findings reported by Al-Qahtani (2017), Al-Khaffaf (2016), Gordon (2011) and Wiersemak.(2009)

- Are there statistically significant differences at the significance level ( $\alpha \leq 0.05$ ) in the level of mind habits among students majoring in mathematics at Al-Balqa Applied University concerning the variables of gender and educational stage?

To answer this question, the mean scores and standard deviations of the study sample were calculated according to the gender and the academic stage variables (Table 5).

Table 5

*Means and Standard Deviations Concerning Gender and Academic Level*

Variables	Categories	<i>n</i>	<i>M</i>	SD	Rank
Gender	Male	69	2.45	0.53	2
	Female	74	2.67	0.49	1
Academic level	Bachelor	120	2.32	0.59	2
	Master	23	2.65	0.43	1

It is noted from Table 5 that there are apparent differences between the mean scores of the variables of gender and academic level, where the female category constituted the highest percentage of the study sample, with a mean score 2.67, while the mean score for the male category was 2.45. With regard to the variable of the academic level, the highest mean score for the master's degree was 2.65, while the mean score for the bachelor's level was 2.32.

To verify the statistical significance of the differences between the mean scores according to the variables of gender and academic level, a two-way analysis of variance (ANOVA) was conducted (Table 6).

Table 6

*Two-Way ANOVA for the Differences in the Level of Mind Habits Among the Study Participants Concerning Gender and Academic Level Variables*

Source	Sum of squares	df	Mean squares	<i>F</i>	Sig.
Gender	0.3261	1	0.535	4.194	**0.003
Academic level	1.578	1	0.761	5.159	**0.002
Interaction	0.035	2	0.017	0.123	0.887
Error	45.263	341	0.145		
Total	47.039	346			

\*\*Statistically significant at significance level ( $\alpha \leq 0.05$ ).

It is evident from Table 6 that there are statistically significant differences in the level of total habits of mind concerning the gender variable, in favour of the female category, where the calculated *F*-value was 4.194 with a significance level of 0.003, which is statistically significant at a significance level of significance (0.05).

The researcher attributes the previous result to the activity and perseverance of females and their tendencies to try to apply what is new in the education arena, and their quest for innovation and development away from stereotypes and traditional methods, more than males. Female students majoring in mathematics in general are more interested and serious than males in dealing with educational situations, and they have a greater commitment and desire to apply everything that is new. Therefore, they have cognitive experiences to implement any new practices in education, such as habits of mind and to employ them effectively, which positively affect their behaviour.

The results of the study also showed that there were statistically significant differences in the level of total habits of mind concerning the variable of the academic level, in favour of the category of master's students, where the calculated  $F$ -value was 5.159 with a level of significance of 0.002, which is statistically significant at the level of significance (0.05).

The researcher attributes this result to the fact that master's students have greater opportunities to increase training in the skills of habits of mind through the activities and duties included in this stage of study. Therefore, they think more deeply because they have passed the bachelor's stage and have deeper knowledge and experiences, whether at the level of specialisation or at the personal level, in addition to the courses offered to students at the master's stage provide a greater opportunity for creativity, imagination and communication with others through research and exploration away from indoctrination in the education process, and the use of all senses and struggle for accuracy and others in learning the courses offered to them, which makes the degree of their practice of those habits on a greater level than undergraduate students, thus gaining a new sense of themselves as active thinkers.

### 3.1. Recommendations

In light of the study results, the researcher recommends the following:

- 1- Replacing or modifying the traditional teaching methods used in teaching mathematics courses at the university, by focusing on developing thinking skills with its various characteristics that support the improvement and development of mind habits such as accurate thinking, flexible thinking, reciprocal thinking, thinking and communication, and imagination and creativity.
- 2- The necessity of clearly integrating the skills of habits of mind in curricula, methods, and course plans for mathematics majors to help students improve their abilities and change their practices around the learning and teaching process to create a generation of thinkers.
- 3- Employing the habits of mind by enrollment of students of mathematics specialisation to many workshops and training courses that help them practice thinking patterns and university educational and learning activities that activate the habits of mind.

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