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# Psychometric Characteristics Of The Statistical Self-Efficacy Scale Among Trainees At College Of Technology In Abha

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## ABSTRACT

*The current research aims to build a measure of statistical self-efficacy among College of Technology trainees, and to verify its psychometric efficiency. The statistical self-efficacy scale in its final form consists of (50) items. The scale was applied to (152) trainees at College of Technology in Abha, and their average chronological age was 30.26 years with a standard deviation of .75. The validity of the scale was verified using the content validity and construct validity, and the internal consistency of the sub-dimensions and the scale as a whole was verified. The findings of the exploratory factor analysis after orthogonal rotation using the Varimax method and the Kaiser test resulted in the presence of four main factors: Preparation efficacy, which consists of (6) items, application efficacy, which consists of (22) items, the efficacy of reading and analyzing the results, which consists of (17) items, and interpretation efficacy, which consists of (5) items. The results of the confirmatory factor analysis confirmed what was reached through the exploratory factor analysis, as the results showed that the goodness-of-fit indicators for the confirmatory model were within acceptable limits. In addition, standard saturation values were all greater than (.5) and all of them were statistically significant (p<.01). The reliability of the scale was also verified by using Cronbach's Alpha and split-half, whether for the sub-dimensions or for the scale as a whole.*

***Keywords**: statistical self-efficacy scale, College of Technology trainees.*

## 1. INTRODUCTION AND THEORETICAL BACKGROUND:

The concept of self-efficacy is one of the most important concepts in modern psychology, developed by Bandura, who believes that an individual's beliefs in his efficacy appear through cognitive awareness of personal capabilities and multiple experiences, whether direct or indirect. Therefore, self-efficacy can determine the path that it follows in terms of behavioral actions, either in an innovative or stereotypical form. This path can also indicate the extent [1]to which the individual is convinced of the efficacy of the personality and his confidence in his capabilities as required by the situation (Al Mazrou, 2007). Self-efficacy works as self-help and as self-obstacles in facing problems. An individual who has a strong sense of brilliance focuses most of his attention when confronted with a problem on analyzing it in order to arrive at appropriate solutions. However, if doubt arises in his self-efficacy, his thinking will turn inward, away from confronting the problem, and will focus on aspects of weakness, competence, and expectation of failure (Bandura, 1977).

Bandura (1977) defined general self-efficacy as "subjective judgments about an individual's abilities to organize and implement sources of behavior to achieve the goals that

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have been planned". It is defined as "an individual's cognitive judgments about his future ability to organize and carry out the activities necessary to achieve goals". El Sayed Abu Hashem (1994) defined it as "the individual's expectations of his ability to perform a specific task, which means the individual's insight into his capabilities and their good use". Othman (2007) agreed with him that it is "the expectations expressed by the individual about his abilities and capabilities and the activities he performs, and they appear in predicting the necessary effort and perseverance in performing various tasks".

Rahim and Nemer (2013) mentioned what Bandura referred to as four sources of self-efficacy as follows:

First: Performance Accomplishment: This refers to the experiences and expertise that an individual possesses. Success usually raises expectations of efficacy, while repeated failure lowers them. The negative effects of failure usually decrease through repeated successes, which leads to raising self-motivation and enhancing self-efficacy, which leads to generalization to other situations (Bandura, 1977).

Second: Vicarious Experience: It refers to the indirect experiences that an individual can obtain by seeing the performance of others and their practice of difficult activities, which often leads to building high expectations, good or focused observation, a desire to improve, and perseverance with effort despite the weakness of the perceived components of observing others, presenting models can lead to the transfer of information about self-efficacy and the prediction of environmental events (Bandura, 1982).

Third: verbal persuasion: Verbal Persuasion means the information that the individual obtains verbally from others, which may gain him some kind of incentive to perform or act and affects the person's behavior during his attempts to perform the task. There is a reciprocal relationship between verbal persuasion and successful performance in raising the level of personal efficacy and skills possessed by the individual. Others in the individual's environment (teachers, colleagues, peers and parents) can verbally persuade the individual of his abilities to succeed in special tasks, and verbal persuasion may be internal, as it takes positive self-talk (Bandura, 1995).

Fourth: Psychological and Physiological State: It refers to the internal factors that determine whether an individual can achieve his goals or not, taking into consideration some other factors such as the perceived ability of the model, the self, the difficulty of the task, the effort that the individual needs, and the assistance that he may need to perform (Bandura, 1977). Figure 1 shows the different sources of self-efficacy and their relationship to behavior or the final outcome of performance:

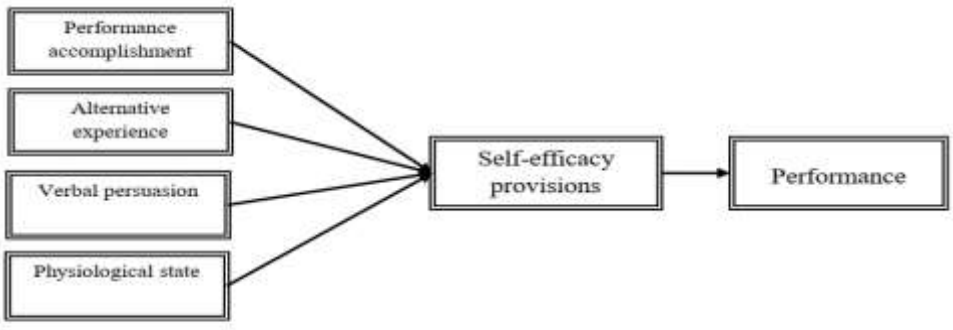


**Figure 1. Sources of self-efficacy according to Bandura (1995)**

The researchers believe that the more these sources are characterized by positivity, accuracy, and credibility, the more the individual has positive self-efficacy. That is, the individual with

high degrees of self-efficacy is the individual who is most aware of his abilities, potential, and skills. In addition, the individual with low degrees of self-efficacy is the individual who is least aware of his abilities and potential. This depends on the nature of those sources and previous experiences that he possesses, upon which he relies to form an understanding of his skills and his abilities to employ them well.

Self-efficacy can also be classified into several types, including. First, national efficacy: It is linked to events that citizens cannot control, such as: the spread of the influence of modern technology, rapid social change in a society..., and it also works to give them ideas and beliefs about themselves as owners of one nationality or one country (Al Mishikhi, 2009). Second, collective efficacy: a group of individuals who believe in their abilities and work in a collective system to achieve the level required of them. Bandura points out that individuals do not live socially isolated, and that many of the problems and difficulties they face require collective effort and social support to bring about any effective change. Individuals' awareness of their collective efficacy affects the actions they undertake and their assessment of the amount of effort required (Al Mashaykhi, 2009). Third, general self-efficacy: This means the individual's ability to perform behavior that achieves positive and desirable results in a specific situation, controlling life pressures that affect individuals' behavior, issuing self-expectations about how they will perform the tasks and activities they undertake, and predicting the effort, activity, and perseverance necessary to achieve the work they want to do (Bandura, 1986). Fourth, private self-efficacy: It means individuals' judgments related to their abilities to perform a specific task in a specific activity, such as special satisfaction, statistics, geometric shapes, and language such as parsing and expression, which contribute to the current study (Al Masry, 2011). Fifth, academic self-efficacy: refers to the individual's belief in his ability to effectively perform the educational task or achieve a specific educational goal. This means the individual's actual ability in various study subjects within the classroom, which is affected by a number of variables such as the size of the classroom, the age of the students, and the level of academic readiness for achievement (Lashab, 2021).

Bandura (1997) identified three dimensions of self-efficacy. First, Magnitude: This dimension, as Bandura points out, is determined by the difficulty of the situation, and this amount is clearly evident when the tasks are arranged from easy to difficult. It is also called the Level of Task Difficulty. This happens when the degree of experience and skill of individuals decreases, and they are unable to face the challenge. Second, Generality: This dimension means the individual's ability to generalize his abilities in similar situations, that is, the transfer of self-efficacy from another's similar situation, but the degree of generality varies and varies from one individual to another. Schwarzer (1999) points out this by saying: The individual's self may be effective in one field and may not be in another field, meaning that the individual may have general confidence in himself, but the degree of confidence may rise in one situation and decrease in another. Third, Strength: Bandura refers to the individual differences between individuals in facing failure situations and the subsequent feeling of frustration. This is due to the difference between individuals in self-efficacy, as some of them have high efficacy and persevere facing poor performance, while others are unable.

Private self-efficacy refers to "individuals' own judgments related to their ability to perform a specific task and activity" (El Sayed Abu-Hashim, 1994), which is reflected in academic self-efficacy, which Fuller (1982) defined as learners' expectations about the results they obtain through personal effort" (Abdel-Sadiq, 2016). It is also defined as "the expectations expressed by the student about his abilities, the degree of confidence in his capabilities, the educational activities he undertakes, and his willingness to exert the necessary effort in the work assigned to him and persevere to achieve goals" (Mitchell, Hopper, Daniels, George & James1994).

Beamer (1993) distinguished between Generalized Self-Efficacy, which relates to an individual's perception of his competence in various areas of life, and Specific Self-Efficacy,

which refers to an individual's perception of his competence in performing specific academic tasks such as mathematics, statistics, or the English language (Osman, 2007).

The current research is concerned with one of the specific forms of self-efficacy, which is statistical self-efficacy, which Finney & Schraw (2003) defined as personal confidence in the ability to complete tasks associated with specific statistical treatments. From their point of view, it also means the individual's confidence in his ability to learn the skills necessary to solve statistical tasks. Abdel Maqsoud (2016) defines statistical self-efficacy as "personal beliefs related to an individual's confidence in his or her ability to acquire information and perform statistical tasks in various situations".

It should be noted that the beginning of the emergence of the concept of statistical self-efficacy dates back to (Finney & Schraw, 2003), who prepared two scales to measure statistical self-efficacy and self-efficacy for learning statistics. Researchers previously relied on mathematical self-efficacy scales to measure the concept despite Bandura's (1977) assertion that the best predictor of performance on a specific task should be directly related to the task. Schneider (2011) pointed out that despite the similarity between the characteristics of mathematical and statistical self-efficacy, they are different in a way that requires separating them when studying and measuring. Therefore, there was a need to have a measure through which statistical self-efficacy can be independently determined.

From the above, the researchers believe that there is a need to develop a scale to measure statistical self-efficacy that focuses on students' beliefs about their abilities and potential to understand and gain statistical information.

## 2. RESEARCH PROBLEM:

The problem of the current research is defined in the following question: What are the psychometric characteristics of the statistical self-efficacy scale for College of Technology trainees?

## 3. RESEARCH OBJECTIVE:

The current research aimed to develop a measure of statistical self-efficacy, verify its psychometric efficiency, and extract some indicators of validity and reliability for it.

## 4. RESEARCH IMPORTANCE:

The importance of the current research lies in the following aspects:

4.1. It seeks to provide a measurement tool that fulfills the scientific conditions necessary to measure the concept of statistical self-efficacy based on the reality of Arab culture and its determinants. Therefore, codifying the scale in the Arab environment may open new horizons of research for researchers in our Arab world, and enrich the Arab library with a tool for measuring an important concept in the field of psychological measurement.

4.2. It addresses one of the important measures that addresses an important topic, which is statistical self-efficacy, the importance of which many studies in the foreign environment have agreed upon through its strong correlations with several variables in mental health and positive psychology, as well as using it to contribute to raising the level of achievement among university students in specially, and school students in general.

4.3. The scarcity of Arab studies - within the limits of researchers' knowledge - that dealt with the subject of measuring statistical self-efficacy.

## 5. RESEARCH TERMINOLOGY

5.1. Statistical Self-efficacy

The researchers define statistical self-efficacy as a concept that focuses on students' beliefs about their abilities and potential to understand and acquire statistical information and their level of confidence in the strength of their motivation to perform statistical tasks in different situations, at a level that helps them persevere and control the difficulties they face and is determined by the score the trainee obtains on the statistical self-efficacy scale.

5.2. College of Technology Trainees

They are individuals whose academic competence allowed them to move to the technical bachelor's level in the College of Technology affiliated with the General Organization for Technical and Vocational Training after obtaining an intermediate technical diploma after secondary school or a certificate that qualifies them for this.

## 6. METHODS

6.1. Population

The research population consists of all trainees from the Abha College of Technology for the bachelor's level (641 trainees).

6.2. Participants

The research sample consisted of (152) trainees from the technical bachelor's program in Abha, and the research tool was applied to them by sending the electronic link to the scale.

6.3. Instruments

Since the concept of statistical self-efficacy is a relatively recent concept in Arab and foreign studies, the current scale was prepared with the aim of providing a psychometric tool derived from the Arab environment, especially the Saudi environment, to suit the objectives of the current research, and take into consideration the nature of the sample individuals and their psychological characteristics.

### 6.3.1. Justifications for preparing a statistical self-efficacy scale for university students:

6.3.1.1. Scarcity of tools that measure statistical self-efficacy in general in the Arab and foreign environments in general, and the Saudi environment in particular.

6.3.1.2. Differences in views on the concept of statistical self-efficacy in foreign and Arab studies. In that some consider it to refer to the concept of the mathematical self.

### 6.3.2. Steps for preparing and building the scale:

The researchers examined previous measures of self-efficacy in general and statistical self-efficacy in particular. The scale was designed to estimate statistical self-efficacy among university students, and its preparation went through a set of steps as follows:

6.3.2.1. Extrapolating the psychological heritage represented in theoretical frameworks and previous studies - as much as possible - closely related to self-efficacy in general, and statistical self-efficacy in particular.

6.3.2.2. Reviewing the published studies and theoretical frameworks that include measures of general self-efficacy, mathematical self-efficacy, and statistical self-efficacy. These include Mathematical Self-Efficacy Scale (Rayan, 2010), Self-Efficacy Scale (Othman, 2007) and Research Self-Efficacy Scale (Arnaout, 2017).

Several foreign scales were also reviewed, including the Current Statistical Self-Efficacy Scale, Self-Efficacy for Learning Statistics Scale (Finny & Schraw, 2003), Statistical Self-Efficacy Scale (Lane, Hall & Lane, 2002), Statistical Knowledge Self-Efficacy Scale (Carmichael & Hay, 2009) Statistical Knowledge Self-Efficacy Scale (Haas & Fellow, 2009) and Mathematical Self-Efficacy Scale (McCutcheon, 2008), table (1) shows this:

**Table 1: Review of published studies and theoretical frameworks that include measures of general self-efficacy, athletic self-efficacy and statistical self-efficacy.**

| | **Scale (Authors and Publication Year)** | **Scale Dimensions** |
|---|---|---|
| 1 | Self-Efficacy Scale (Adel Al Adl, 2001) | Single dimension |
| 2 | Statistical self-scale (Hall, Lane & Lane, 2002) | Single dimension |
| 3 | Statistical self-scale (Finny & Schraw, 2003) | Single dimension |
| 4 | Self-Efficacy Scale (Othman, 2007) | Single dimension |
| 5 | Mathematical Self-scale: (McCutchen, 2008) | Three dimensions<br>1) Emotional<br>2) Intellectual<br>3) Superficial |
| 6 | Statistical self-scale (Carmichael & Hay, 2009) | Single dimension |
| 7 | Statistical Self-scale (Ahmadi, 2016) | Four dimensions:<br>1) Belief in the ability to achieve long-term goals in statistics.<br>2) Belief in the ability to persevere, make effort, and overcome obstacles in absorbing statistical knowledge.<br>3) Belief in the ability to accomplish tasks and undertake activities to improve understanding of statistics.<br>4) Belief in the ability to be flexible with difficulties in understanding statistics. |
| 8 | Research self-efficacy scale (Arnaut, 2017) | Seven dimensions:<br>1) Expectation of success in courses.<br>2) Expecting the ability to choose the research problem.<br>3) Expecting success in presenting the research proposal in the seminar.<br>4) The ability to collect theoretical literature on research topics.<br>5) Efficacy of choosing the appropriate methodological design and choosing the appropriate tools for collecting data.<br>6) Efficiency in collecting, analyzing and interpreting data and presenting suggestions and recommendations.<br>7) Expecting the ability to present the results of the dissertation after completion in public discussion and responses to discussants' queries. |

| | Scale (Authors and Publication Year) | Scale Dimensions |
|---|---|---|
| 9 | Creative self-efficacy scale (Abdul Hafez, Falih, 2017) | Two dimensions:<br>1) Self-efficacy and creative thinking.<br>2) Self-efficacy and creative performance. |

6.3.2.3. Preparing a preliminary version of the scale: In light of the above, a preliminary version of the scale was prepared that consisted of (50) items, and these items were presented to a number of (9) arbitrators in the field of psychology to verify its suitability for the purpose for which it was prepared, as well as its suitability for the age group. The arbitrators approved all items of the scale, with the simple wording of some words modified by more than 80%. Response alternatives were also determined considering the results of an exploratory study that was applied to a sample of (5) adolescent students other than the primary study sample. To check their engagement with the scale and response alternatives. Response alternatives were also determined according to the five-point scale, and they are answered according to the following responses (always, often, sometimes, rarely, never). These responses are given scores (5, 4, 3, 2, 1), and high scores indicate high statistical self-efficacy among the trainees.

### 6.3.3. Psychometric characteristics of the statistical self-efficacy scale

The scale was applied to the study sample to verify the psychometric characteristics of the scale by sending an electronic copy of the scale using Google Forms in its initial form to groups of College of Technology trainees who are studying the statistics course; The validity of the scale was verified as follows:

6.3.3.1. Internal consistency of the scale

The internal consistency of the scale was calculated using the correlation coefficient between the scores of each item and the total score of the scale. This is to delete the scores of items that are not statistically significant before conducting the factor analysis, and table 1 shows the results of this.

**Table 2. Correlation coefficients between each item and the total score of the statistical self-efficacy scale.**

| item | r | item | r | item | r | item | r | item | r |
|---|---|---|---|---|---|---|---|---|---|
| **1** | .722** | **11** | .713** | **21** | .658** | **31** | .649** | **41** | .677** |
| **2** | .737** | **12** | .765** | **22** | .690** | **32** | .655** | **42** | .691** |
| **3** | .771** | **13** | .757** | **23** | .644** | **33** | .633** | **43** | .753** |
| **4** | .727** | **14** | .776** | **24** | .550** | **34** | .720** | **44** | .452** |
| **5** | .654** | **15** | .670** | **25** | .723** | **35** | .746** | **45** | .481** |
| **6** | .693** | **16** | .664** | **26** | .644** | **36** | .666** | **46** | .697** |
| **7** | .780** | **17** | .736** | **27** | .695** | **37** | .587** | **47** | .745** |
| **8** | .741** | **18** | .699** | **28** | .646** | **38** | .700** | **48** | .773** |
| **9** | .758** | **19** | .706** | **29** | .622** | **39** | .598** | **49** | .742** |
| **10** | .758** | **20** | .595** | **30** | .684** | **40** | .647** | **50** | .614** |

Note: r = item-total correlations, **p<.01.

It is clear from the results presented in table 1 that all correlation coefficients are significant at the level of (.01), as they ranged between (.452-.780), and therefore factor analysis will be conducted on all items of the scale.

6.3.3.2. Factor structure of the scale

The two researchers verified the factorial structure of the scale through exploratory factor analysis of the statements of the statistical self-efficacy scale. It was confirmed that the conditions for the exploratory factor analysis were met, and the validity of the matrix of relationships between the items for the factor analysis was revealed, most of which were equal to or greater than (.30). In addition, the Kaisser-Meyer-Oklin (KMO) condition was met to measure the integrity of the sample. Its average should not be less than (.51) in order for the factor analysis to be conducted, as the value of (KOM) in the results of the factor analysis of the scale was (.917), and the statistical significance of the Bartletts Test of (Sphericity) was also significant ($p<.01$).

Thus, the conditions for adopting the results of factor analysis were met, and the scale items were analyzed using the (principal component analysis) method for the components and dimensions of the scale, and then the resulting factors were rotated on axes related to the results of this analysis. The correlation matrix was analyzed using the principal components method (Hottelling), and the factors were rotated orthogonally using Varimax method with a standard Kaiser test to determine the factor structure of the scale. Factor analysis was conducted for (50) items that were saturated with 9 factors before and after rotation, and the following table shows the latent root value (Eigen value) and the percentage of variance explained before and after rotation for the statistical self-efficacy scale.

**Table 3. Results of the factor analysis of the items of the statistical self-efficacy scale (n=152)**

| Factor No. | Saturations before rotation | | | Saturations after rotation | | |
|---|---|---|---|---|---|---|
| | Eigen Value | Variance % | Cumulated % | Eigen Value | Variance % | Cumulated % |
| 1 | 20.417 | 40.834 | 40.834 | 6.688 | 13.375 | 13.375 |
| 2 | 3.069 | 6.137 | 46.971 | 5.825 | 11.650 | 25.025 |
| 3 | 2.233 | 4.467 | 51.438 | 5.057 | 10.115 | 35.139 |
| 4 | 1.572 | 3.145 | 54.583 | 3.619 | 7.237 | 42.376 |
| 5 | 1.398 | 2.797 | 57.379 | 3.052 | 6.105 | 48.481 |
| 6 | 1.278 | 2.555 | 59.935 | 2.736 | 5.473 | 53.954 |
| 7 | 1.143 | 2.286 | 62.221 | 2.468 | 4.936 | 58.890 |
| 8 | 1.049 | 2.098 | 64.319 | 2.222 | 4.444 | 63.334 |
| 9 | 1.001 | 2.002 | 66.320 | 1.493 | 2.987 | 66.320 |

Then the researchers conducted a second-order exploratory factor analysis of the nine factors resulting from the exploratory factor analysis to produce four factors that explain (66.320%) of the variance in the statistical self-efficacy scale. This is a good percentage that indicates the validity of these factors in measuring statistical self-efficacy as a whole by referring the researchers to the content of the statements that satisfied each of the four factors, the four factors were formulated, as follows:

The First Factor: This factor included (6) items, their saturations ranged between (.654-.771), and the percentage of variance was (4.834) of the total variance, with a latent root (2.417), and the items of this factor refer to personal beliefs related to confidence and ability in the correct procedures and practices for preparation and processing in collecting data in various situations, so the researchers proposed naming this factor “preparation efficacy and processing”.

The Second Factor: This factor included (22) items, their saturations ranged between (.550-.780), and the percentage of variance was (6.137) of the total variance, with a latent root (3.069). The items of this factor refer to personal beliefs related to confidence and ability in

correct procedures and practices in choosing statistical programs and methods in various situations. Therefore, the researchers proposed calling this factor "application efficacy".

The Third Factor: This factor included (17) items, their saturations ranged between (.452-.753), and the percentage of variance was (4.467) of the total variance, with a latent root (2.233). The items of this factor refer to personal beliefs related to confidence and ability in correct procedures and practices in reading results and being able to analyze them in various situations. Therefore, the researchers proposed naming this factor "the efficacy of reading and analyzing the results".

The Fourth Factor: This factor included (5) items, their saturations ranged between (.614-.773), and the percentage of variance was (3.145) of the total variance, with a latent root (1.572). The items of this factor refer to personal beliefs related to confidence and ability in correct procedures and practices in interpretation in various situations, so the researchers proposed calling this factor "efficacy of interpretation".

6.3.3.3. Scale Reliability

Cronbach's alpha and split-half methods were used to verify the reliability of the scale, and table 3 shows the values of the extracted reliability coefficients.

**Table 4. Statistical reliability coefficients of the self-efficacy scale using Cronbach's alpha and split-half methods.**

| Variable | | Cronbach's alpha coefficient | Split half using Guttman equation |
|---|---|---|---|
| 1 | Preparation efficacy | .807 | .765 |
| 2 | Application efficacy | .949 | .930 |
| 3 | Efficacy of reading and analyzing the results | .912 | .767 |
| 4 | Interpretation Efficacy | .762 | .684 |
| The scale as a whole | | .960 | .937 |

The results presented in table 3 indicate an increase in all reliability coefficients, whether for the sub-dimensions or for the statistical self-efficacy scale as a whole. It ranged between (.762-.960) for Cronbach's alpha method and ranged between (.684-.937) for the half-division using Guttman method. They all have high reliability values; This demonstrates the statistical reliability of the self-efficacy scale and its sub-dimensions.

6.3.3.4. Validity of the Scale

The validity of the scale was verified using Confirmatory Factor Analysis using JASP, which resulted in all items being saturated on the four basic factors. A first- and second-order confirmatory factor analysis was also conducted, and it resulted in the saturation of the sub-dimensions on one general factor, where the value of ($K^2$) reached (2428.611) with freedom degrees (1171) and is not statistically significant. This confirms the quality of matching the data with the proposed model. Table (6) and figure 2 show the schematic path of the confirmatory factor analysis model for the variables that saturate the latent factor on the statistical self-efficacy.


**Figure 2. One latent factor model for the statistical self-efficacy scale**

It is clear from figure 2 that the value of $\chi 2(1171) = 2428.611$ was statistically non-significant, which indicates a good fit of the data with the proposed model. It is also clear from the values shown in figure 2 that all items in the scale are saturated with the latent factors at a significance level of (.01), which indicates the validity of all items in the scale. There is also a statistically significant positive correlation between all sub-dimensions of the scale, which ranged between (.117-.300), which indicates that all first-order latent factors are saturated with the second-order latent factor, meaning that confirmatory factor analysis provided strong evidence of the validity of the construct.

**Table 5: Statistical saturation of the self-efficacy scale statements with the latent factors of the first and second degrees.**

| First degree latent factors | item | Saturation with latent factor | Standard error | Z value & significance | Composite stability coefficient | Second degree latent factors | | | Composite stability coefficient CR for sub-dimensions |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | | Saturation with latent factor | Standard error | Z value & significance | |
| **Preparation efficacy** | 1 | .300 | .058 | 5.149 | .810 | 2.068 | .376 | 5.506 | .917 |
| | 2 | .269 | .049 | 5.537 | | | | | |
| | 3 | .336 | .059 | 5.658 | | | | | |
| | 4 | .298 | .051 | 5.855 | | | | | |
| | 5 | .267 | .053 | 5.072 | | | | | |
| | 6 | .287 | .047 | 6.086 | | | | | |
| **Application efficacy** | 7 | .220 | .048 | 4.603 | .926 | 3.542 | .804 | 4.406 | |
| | 8 | .211 | .046 | 4.574 | | | | | |
| | 9 | .235 | .052 | 4.528 | | | | | |
| | 10 | .232 | .050 | 4.624 | | | | | |
| | 11 | .203 | .045 | 4.497 | | | | | |
| | 12 | .207 | .045 | 4.625 | | | | | |
| | 13 | .225 | .049 | 4.596 | | | | | |
| | 14 | .209 | .046 | 4.583 | | | | | |
| | 15 | .175 | .039 | 4.458 | | | | | |

| First degree latent factors | Saturation with latent factor item | Standard error | Z value & significance | Composite stability coefficient | Second degree latent factors | | | Composite stability coefficient CR for sub-dimensions |
|---|---|---|---|---|---|---|---|---|
| | | | | | Saturation with latent factor | Standard error | Z value & significance | |
| | 16 .188 .043 4.401 | | | | | | | |
| | 17 .216 .047 4.637 | | | | | | | |
| | 18 .183 .040 4.579 | | | | | | | |
| | 19 .202 .045 4.515 | | | | | | | |
| | 20 .167 .039 4.315 | | | | | | | |
| | 21 .184 .041 4.492 | | | | | | | |
| | 22 .190 .042 4.549 | | | | | | | |
| | 23 .167 .039 4.300 | | | | | | | |
| | 24 .174 .044 3.986 | | | | | | | |
| | 25 .209 .046 4.533 | | | | | | | |
| | 26 .192 .045 4.284 | | | | | | | |
| | 27 .190 .042 4.503 | | | | | | | |
| | 28 .188 .043 4.381 | | | | | | | |
| **Efficacy of reading and analyzing the results** | 29 .254 .053 4.810 | | | .878 | 2.680 | .470 | 5.705 | |
| | 30 .269 .052 5.162 | | | | | | | |
| | 31 .236 .048 4.870 | | | | | | | |
| | 32 .241 .044 5.481 | | | | | | | |
| | 33 .242 .046 5.199 | | | | | | | |
| | 34 .274 .046 5.934 | | | | | | | |
| | 35 .280 .046 6.080 | | | | | | | |
| | 36 .246 .043 5.781 | | | | | | | |

| First degree latent factors | Saturation with latent factor item | Standard error | Z value & significance | Composite stability coefficient | Second degree latent factors | | | Composite stability coefficient CR for sub-dimensions |
|---|---|---|---|---|---|---|---|---|
| | | | | | Saturation with latent factor | Standard error | Z value & significance | |
| | 37 | .220 | .042 | 5.278 | | | | |
| | 38 | .263 | .046 | 5.680 | | | | |
| | 39 | .235 | .044 | 5.361 | | | | |
| | 40 | .230 | .040 | 5.681 | | | | |
| | 41 | .230 | .040 | 5.754 | | | | |
| | 42 | .255 | .043 | 5.876 | | | | |
| | 43 | .297 | .049 | 6.055 | | | | |
| | 44 | .117 | .025 | 4.757 | | | | |
| | 45 | .135 | .028 | 4.908 | | | | |
| **Interpretation efficacy** | 46 | .180 | .053 | 3.428 | .889 | 2.824 | .778 | 3.629 |
| | 47 | .213 | .059 | 3.578 | | | | |
| | 48 | .238 | .064 | 3.710 | | | | |
| | 49 | .244 | .063 | 3.870 | | | | |
| | 50 | .136 | .039 | 3.516 | | | | |

Note: *= p<.01 when tabular "Z" value (2.59) > calculated "Z" value > tabular "Z" value (1.96), and **= p<.01 when where the calculated "Z" values ≥ the tabulated "Z" value (2.59).

It is clear from table 5 that most of the items in the scale are saturated with the latent factors at significance level (p<.01), which proves the validity of all statements in the scale. Likewise, all the first-order latent factors were saturated with the second-order latent factor. It is also evident that the values of the reliability coefficients R2 are high for the paragraphs or dimensions. The values ranged between (.214-.587), which are acceptable values, which provides strong evidence of the validity and reliability of the scale.

6.3.3.5. Final image of the scale

In its final form, the scale consisted of (50) items distributed over four main dimensions. The four dimensions were formulated as follows: The first dimension was called (Preparation

Efficacy) and consisted of (6) items. The second dimension is called (Application Efficacy) and consists of (22) items. The third dimension is called (Efficacy of Reading and Analyzing Results) and consists of (17) items. The fourth dimension is called (Efficacy of Interpretation) and consists of (5) paragraphs. Then the researchers verified the psychometric characteristics of the statistical self-efficacy scale after exploring the factors that make up the scale and naming each factor. Below is a presentation of the verification of internal consistency and reliability indicators using the Cronbach's alpha method, split-half method, and confirmatory validity using JASP statistical program.

## 7. RESEARCH LIMITATIONS:

The current research is determined by its topic, which was "Psychometric Characteristics of the Statistical Self-Efficacy Scale, its sample, which was trainees of College of Technology at Abha in Kingdom of Saudi Arabia, and its location, which was in College of Technology, Abha, Kingdom of Saudi Arabia, and its time in the first semester of the academic year 2023.

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**Appendix (1): Statistical self-efficacy scale in its final form.**

Statistical self-efficacy scale
(Prepared by PhD researcher: Hussein Mohammad Misfer Al Qahtani)

| **Specialization** | **Age Stage:** |
|---|---|
| □ Computer and information technology<br>□ Electrical technology<br>□ Civil and architectural technology (construction)<br>□ Mechanical technology<br>□ Surveying technology<br>□ Administrative technology<br>□ Other | □ From 20 years to less than 30<br>□ From 30 years to less than 40<br>□ From 40 years and above |

**Second: Instructions:**

- The list consists of (50) items that illustrate statistical self-efficacy.
- Read each of them with attention and concentration.
- Put a mark (✓) in front of each word by choosing only one answer from the five answers shown in front of each word, expressing your point of view accurately.
- Not to leave anything unanswered, knowing that your answer will be kept strictly confidential and only the researchers will see it for use in scientific research.

**** Note: (All statements begin with: "I am confident in my ability to...")**

| n | item | It happens to me | | | | |
|---|---|---|---|---|---|---|
| | | Always | Often | Sometimes | Rarely | Never |
| 1 | use spreadsheets and graphs in various computer programs (Word, Excel, etc.) | | | | | |
| 2 | I understand what the data shows | | | | | |
| 3 | point out when conclusions based on surveys are wrong | | | | | |
| 4 | justify how to select a representative sample of students for a college survey | | | | | |
| 5 | determine the appropriate statistical method according to the study hypotheses and the nature of the variables | | | | | |
| 6 | talk to others, especially specialists, when I am stuck on a question in statistics | | | | | |
| 7 | distinguish between the information provided by the three measures of central tendency | | | | | |
| 8 | explain what the standard deviation value means in terms of the variable being measured | | | | | |
| 9 | distinguish between the goals of descriptive versus inferential statistical procedures. | | | | | |
| 10 | explain to a friend how probability (or chance) is calculated | | | | | |
| 11 | determine whether a distribution curve is skewed, given three values of measures of central tendency | | | | | |
| 12 | define the conditions for using different statistical analyses | | | | | |
| 13 | work on my own to apply, what I have learned statistically to different situations | | | | | |
| 14 | understand the relationships between statistical indicators | | | | | |
| 15 | deal with what the numbers actually mean | | | | | |
| 16 | solve problems that use averages | | | | | |
| 17 | determine research hypotheses and compatible statistical methods for several studies and research | | | | | |
| 18 | use logical thinking to solve statistical problems | | | | | |
| 19 | understand the different methodologies used in statistical research | | | | | |

| n | item | It happens to me | | | | |
|---|---|---|---|---|---|---|
| | | **Always** | **Often** | **Sometimes** | **Rarely** | **Never** |
| 20 | use computer hardware and software to display data correctly | | | | | |
| 21 | find the error in the graph if it found. | | | | | |
| 22 | distinguish between the study population and the statistical sample | | | | | |
| 23 | interpret graphs statistically | | | | | |
| 24 | obtain the psychometric characteristics of the scales that will be used in the study | | | | | |
| 25 | accurately interpret the results of the data after processing it statistically | | | | | |
| 26 | understand the T-test for differences between means | | | | | |
| 27 | explain the meaning of the graph in a newspaper or on the Internet | | | | | |
| 28 | determine when to use the mean, median, and mode as measures of central tendency | | | | | |
| 29 | define nonparametric tests corresponding to the t-test and analysis of variance | | | | | |
| 30 | use the statistical package SPSS | | | | | |
| 31 | analyze the structures and shapes of different and diverse data models using (LISREL, AMOS) programs | | | | | |
| 32 | explain what is measured by the numerical value of its standard error | | | | | |
| 33 | distinguish between a type 1 error and a type 2 error in hypothesis testing | | | | | |
| 34 | compare methods for extracting factors and determining their number in exploratory factor analysis | | | | | |
| 35 | interpret the probability value (probability value) | | | | | |
| 36 | define the scale to measure the variable | | | | | |
| 37 | work with others to solve statistical problems and difficulties | | | | | |
| 38 | be interested in new information in statistics in order to develop my scientific and practical competence | | | | | |
| 39 | access various websites for additional help with statistics courses | | | | | |
| 40 | choose the important results | | | | | |

| n | item | It happens to me | | | | |
|---|---|---|---|---|---|---|
| | | **Always** | **Often** | **Sometimes** | **Rarely** | **Never** |
| 41 | keep trying to interpret the results, make decisions, and persevere, no matter how difficult it is | | | | | |
| 42 | try to understand every little thing when studying a topic in statistics | | | | | |
| 43 | conduct sound scientific research from the statistical aspect | | | | | |
| 44 | determine appropriate data collection methods | | | | | |
| 45 | collect the right kind of data | | | | | |
| 46 | get census information from various sources | | | | | |
| 47 | display data in graphs correctly | | | | | |
| 48 | understand statistical tests and methods | | | | | |
| 49 | interpret the results of a statistical procedure in terms of the research question | | | | | |
| 50 | arrange my data correctly in a table | | | | | |