European Journal of Education Studies
ISSN: 2501 - 1111
ISSN-L: 2501 - 1111
Available on-line at: www.oapub.org/edu

doi: 10.5281/zenodo.1434241 Volume 5 | Issue 2 | 2018

ANALYSIS OF THE RELATIONSHIP BETWEEN UNDERGRADUATE STUDENTS' PHYSICS SUCCESSES AND THEIR ABILITIES

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Abstract:
The purpose of this study was to identify the effects of student abilities on their learning processes and to determine what kind of students in terms of their abilities were more successful during physics teaching. In this direction, 156 students who took basic physics course in Atatürk University, Faculty of Education, in Departments of Physics, Science, Computer, and Mathematics teaching were included to the research scope. "Self-assessment inventory" that was developed by Kuzgun in 1988 was used to measure students' abilities. The letter grades and raw scores that were received by students at the end of academic year were considered to determine students' academic successes. Students' academic successes were consisted of two exams. First one was a midterm exam that was organized in the middle of the terms and the other was final exam that was organized at the end of the term. The questions that were used in exams were prepared by researcher and reliability of tests was found as α=0,69. Descriptive analysis and correlation test were used for data analysis. As a result, it was found that student abilities affected academic successes and students who had numerical abilities had higher levels of physics successes.

Keywords: ability, academic success, education, physics

1. Introduction

Ability could be defined as "power of being able to learn something, benefit from a particular skill or knowledge teaching". Humankind is born as having different levels of power of being able to learn or do many things. This is commonly called as "potential energy (capacity)". The potential power is developed by being used as people get older. Therefore, people progressively become able to do more complex works in life's different periods. In other words, people use their own capacity and become ready to learn new things as they interact with environment and engage in various learning experiences. Thus, ability is a combination of behaviors that enables us

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to predict which extent people can benefit from a learning process as analyzing their abilities that they have developed until a certain age.

Furthermore, ability includes information and skills that people obtain until a certain age in addition to their potential powers that are carried with their genetics. For example, if a 5-year old child who currently starts going to a school learns the multiplication table and is able to solve basic mathematical problems with four operations, it means that this child shows a mathematical skill which is beyond her age. We can say that the child in our example can learn mathematic related subjects easier and faster. Furthermore, if this child did not previously receive any kinds of special care and support in this manner, we would be able to conclude that this power was about her inheritance and her mathematical thinking capacity was beyond normal levels. However, we need to compare her mathematical successes with her peers' successes in order to reach this conclusion. We can only decide whether this child is special, retarded or "normal".

Power of learning is also known as "general ability" and reflects the necessary power to learn a subject. Some people are able to do easy and basic works while some others are able do very artificial or very complex works easily and well, therefore it is a known phenomenon that there are differences among people in terms of this power that we call as "ability level". However, people differentiate in terms of ability types as much as ability levels.

1.1 Academic Ability

Education in primary schools, high schools and universities require learning of artificial concepts that are represented with symbols such as words, numbers and graphs. The ability type that is required to become successful in this type of education is called as "academic ability". Academic ability is an ability which is required to be able to obtain information and skills that are taught in corporate education providing schools, and "intelligence" is generally used to state this ability (Randahl, 1991).

Academic ability is composed of three main parts as verbal, numerical and perceptual abilities (Randahl, 1991).

1.2 Verbal Ability

This ability represents the power of being able to learn vocabulary (words), use these words appropriately, and understand and narrate the concepts that are stated with these words. Comprehending the meanings in a written article is related to this ability. Verbal ability is consisted of two parts as verbal fluency and verbal reasoning.

1.2.1 Verbal Fluency

This ability that represents the power of being able to obtain a rich vocabulary, explain feelings and thoughts with different sentences in a fluent style can be observed in letters and essays that children compose. Writers, orators and presenters are people whose fluently speaking and writing abilities are highly developed. Fluently speaking ability is

generally come with writing ability although there are cases one ability is developed more than the other.

1.2.2 Verbal Reasoning

This ability represents the power of learning the concepts that are stated with words, understanding the written text or a speech and expressing thoughts clearly. Verbal ability is, indeed, the power of being able to solve the similarities and differences between concepts that are stated with words. There is a necessity for this ability to be able to work in social science related fields.

1.3 Numerical Ability

This ability is a widely-known ability as the power of being able to see the relationship between numbers and solve the number related problems. This ability is also consisted of two parts:

1.3.1 Calculation

Calculation ability which can be defined as ability of the power of being able to solve problems with four operations in mind, realize the problem in an operation is a type of ability which might be needed in trade and accountancy fields.

1.3.2 Numerical Reasoning Ability

This ability is a kind of theoretic and symbolic thinking power and can be defined as the power of being able to see complex relationships and solve mathematical problems. Numerical ability is a kind of ability which is necessary for success in disciplines such as mathematic and statistics and main sciences and technical areas such as physics and chemistry.

There is a close connection between verbal and numerical reasoning abilities as both of them represent reasoning power in theoretical subjects.

1.3.3 Perceptual Reasoning Power

This ability is defined as the power of being able to see the relationships between geometrical figures. It is consisted of two parts:

1.4 Ability to See Perceptual Relationships

This ability, which represents the power of being able to perceive drawings and geometrical figures with their details, realizing the similarities and differences between figures in terms of types, sizes etc., is necessary for success in technical and industrial areas.

1.5 Ability to See Spatial Relationships

This ability, which represents the power of being able to imagine the last shape when a material is rotated or moved in space or a figure in a paper, imagine a figure as in three-dimension, imagine a building by looking merely at a plan or a drawing, is necessary

for success in architecture, machine and civil engineering, technical and industrial areas.

In addition to these abilities that consist academic ability's main elements, it could be beneficial to consider below stated abilities in profession selection (Holland, 1997).

1.6 Color Perception

Ability to recognize colors, see fine differences between them and create convenient color combinations is a required ability in studies related to medicine, biology and agricultural etc. and mainly in art fields, and professions such as airplane piloting and being a driver.

1.7 Memory

Memory that is the power of being able to memorize names, numbers and a commanded directive and keep them in memory in a long period of time is required in areas such as medicine, law and history and professions such as secretary.

1.8 Attention

Attention that is defined as the power of being able to recognize the events and materials around with their details and see many things in short amount of time, see errors in a text quickly is necessary in all kinds of work field, however professions such as secretary and treasureship are especially depended on attention.

Being able to attentively focus on a point is special kind of attention and mainly required in studies in areas such as astronomy and meteorology.

1.9 Mechanical Ability

This ability is the power of being able to understand the working process of a tool or a machine, build, handle and repair tools and machines by reading their schemes and is required for success in all kinds of technical professions.

1.10 Finger Skills

The power of being able to do fine works and work in small works by using fingers quickly is an ability which is required in operating in technical works and handcrafting.

1.11 Eyes-hands Cooperation

Eyes-hands cooperation which is defined as the power of being able to use eyes and hands quickly in coordination, for example reeving a wire from a small hole, is an ability that is required in all kinds of mechanical and technical works and handcrafting.

In addition to these abilities, we can mention artistries which are widely known as special abilities.

1.12 Musical Ability

The power of being able to recognize voices with their fine frequencies, learn melodies quickly, play with an instrument and compose works.

1.12 Fine Arts Ability

The power of being able to create art works such as picture, caricature, sculpture and handicraft.

Educators should have sufficient information about student abilities. Children can have a happy future and successful career if especially their abilities are discovered in primary school level and they are provided an education in accordance with their abilities (Hansen, 1984). The purpose of this study was to determine personal abilities of the students who were included to study scope with a standardized assessment tool and determine the relationship between abilities and academic successes by utilizing these profiles.

2. Method

Screening method from quantitative approaches was used in the research. The obtained data was analyzed by using SPSS 20 statistical package program for social sciences. Self-assessment inventory that was consisted of 230 items and developed by Kuzgun (1988) was used to determine student abilities. This inventory that was created to identify abilities, interests and values was consisted of questions that reflected cases about abilities, interests and values. Each question focused on how frequently an activity was made or how much attention was generally given to a particular thing. Participants were requested to attentively give answers by reading questions. In answer sheet, A represented "Never", B "Rarely", C "Often", and D "Always". Sometimes A represented "Not Important", B "Not Much Important", C "Important", and D "Very Important". Shortly, A stood for that an attitude or attention was not obtained or obtained in the lowest level while D stood for that an attitude or attention was obtained in the highest level.

The obtained data was evaluated in accordance with the unique way to the assessment and separate profile paper was created for each student. Academic success scores of each student were determined at the end of the term (midterm and final) and analyses were conducted as transferring the data to SPSS program.

Students' academic success scores were obtained from General Physics course that the researcher thought. In the research, two tests that were composed of 20 multiple choice questions were created for midterm and final exams, moreover these tests' reliability was found as Cronbach Alpha Co-efficiency 0,69. Participants were composed of students from four different majors (Physics, Sciences, Computer and Mathematics).

3. Findings

Correlation analysis was conducted between the data of students' SAI (Self-Assessment Inventory) and academic successes. Firstly, student profiles were created with SAI that was applied to each student as considering the scores which were equal to and greater than 75%. Those who remained between 25% and 75% were considered as students who had difficulty on decision making so that they were not considered in profile creation. Profiles were created for 156 students in total. Distribution of these profiles that represented student abilities in terms of major distribution were presented in Table 1. Research data was considered in significance level of 0,05. Data analyses were obtained from SPSS package program as mean values.

Table 1: Mean values of students' SAI abilities in terms of major distribution

	Physics	**Sciences**	**Computer**	**Mathematics**
Numerical Ability	65,46	64,45	66,77	75,51
Perceptual-Spatial Ability	72,33	65,34	70,83	67,09
Verbal Ability	55,27	66,18	56,64	52,55

In the analysis of Tablo-1, it could be seen that mathematics students took the first place in numerical ability with 75,5, physics students took the first place in perceptual-spatial ability with 72,3 and Science students took the first place in verbal ability with 66,1. It could be derived from the table that perceptual-spatial ability, numerical ability and perceptual-spatial ability was more dominant compared to other ability types for physics department, mathematics department and computer department, respectively. For Science department, all abilities had similar values.

The dominant ability could be found by analyzing SAI ability mean values for the students who were included to the study.

Table 2: Mean values of all students' abilities

SAI Abilities	**Mean Value**	**The Number of Students**
Numerical Ability	68,05	156
Perceptual-Spatial Ability	68,89	156
Verbal Ability	57,66	156

According to the results in Table-2, it could be seen that perceptual-spatial ability took the first place, numerical ability took the second place with a little difference, and verbal ability became the lowest ability. This result is normal. These departments accept students with their science and mathematics scores.

Students' academic successes were evaluated based on 100 as full score. The scores that were obtained from midterm exam were evaluated based on 100 as full score and their contribution to average grade was 40%. The scores that were obtained from final exam were also evaluated based on 100 as full score and their contribution to average grade was 60%. With these calculations, raw grades based on 100 that were

equal to and greater than 50 were considered successful and students who took less than 50 were considered unsuccessful.

Table 3: Distribution of students' physics success in terms of their abilities

Abilities	**Physics Academic Successes**		**The Number of Students**
	Successful	**Unsuccessful**	
Numerical Ability	54	7	61
Perceptual-Spatial Ability	56	8	64
Verbal Ability	20	11	31
Total	130	26	156

As seen in Table-3, there was an important relationship between the identified abilities in SAI and academic successes. Academic success rate of students who had Numerical Ability and Perceptual-Spatial Ability was high while success rate of students with verbal ability was observed as low.

According to the data in this table, correlation co-efficiency was found the highest in perceptual-spatial ability and academic success (0,81), and followed with numerical ability and academic success (0,79) and lastly verbal ability and academic success (0,63). A same directed relationship was observed between each of the ability and academic success.

3. Conclusion

In this study, finding answer to the question of "what kind of students in terms of their abilities are more successful in learning physics?" was aimed. As seen in Table 3, academic success of the students who had perceptual-spatial and numerical abilities were very similar to each other and the related students were more successful than the students who had verbal abilities. This condition brings forward perceptual-spatial and numerical abilities in physics learning.

Another question was how the abilities of students in the departments that were included to the study were distributed. As seen in Table 1, ability mean values of physics department students were the highest in perceptual-spatial with 72,33; mathematics department in numerical ability with 75,51, computer department in perceptual-spatial ability with 70,83 and science department in verbal ability with 66,18. This condition shows the differences in student abilities in terms of departments.

It is obvious that people who are aware of their own abilities have higher level of success rates in life. Individuals love the activities that they are able to do and they enjoy engaging in them. Requesting or commanding people to work on something that they do not have particular abilities for bring both unsuccessfulness and unhappiness (Glasson, 1989). Individuals who are aware of their own abilities are very good at using their potential powers. Therefore, these people have successes on making a discovery and breaking a record.

There are many incidents that are encountered in daily life and people who use their abilities in different areas discover their own potential powers incidentally. For example, a child who engages in trade because of his father's profession can discover his ability to run while foot-racing with his friends. If he can develop his particular ability, in other words if he can progress on his potential power, success will come afterwards.

The subject of ability is frequently researched in learning. It is very difficult for a student who has numerical ability to study a department which mainly includes social subjects. Opposite condition is also valid. Because he will not be able to use his ability and his probability to be unhappy is high. Although ability is a characteristics coming from birth, could it be obtained by working on it later?

It is known that there are many factors affecting a student's success. In addition to factors such as environment, age, readiness level, family socio-economic condition etc., the effect of student abilities on success was proved with this study.

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