

Students Executive Skills: Effects on Students Conceptual Understanding and Interest Towards Physics during Online Learning

Suan, F.G.¹, Flores, D.², Ybañez, R.³, Jumarito, E.⁴, Alim, N.R.^{5,6}, Vallespin, M.R.^{7*}

^{1,2,3} Student, JH. Cerilles State College, Mati, San Miguel, Zamboanga del Sur

⁴ Faculty, JH. Cerilles State College, Mati, San Miguel, Zamboanga del Sur

⁵ Science and Technology Fellow I, Science and Technology Fellows Program, Department of Science and Technology
Office of the Undersecretary for R&D

⁶ Faculty, Department of Chemistry, College of Science, De La Salle University

^{7*} Faculty, General Education Department, Institute of Education, Far Eastern University-Manila, Manila City, 1008,
Metro Manila, Philippines

Abstract

Dropout rates have risen greatly since the dawning of distance learning. Students' Executive Skills are viewed as less capable of being more actively engaged because online learning encourages distance learning. As a result, most Filipino students struggle to understand Physics concepts, particularly those involving electricity and magnetism, which require higher-order thinking skills. Hence, identifying the students' current acquisition of Executive Skills, Conceptual Understanding, and Interest in Physics during Online Learning is relevant to address the challenges encountered. This research employed a quantitative correlational design using three (3) Adapted survey questionnaires. They are conducted in one of the higher institutions in the province, totaling eighty-eight (n=88) respondents. Analyses showed that students' executive skills and interest levels were "very high," indicating that they adapted well to online modality and showed interest in learning physics. Meanwhile, students' Conceptual Understanding was "very low," proving that the new teaching and learning methods likely made it difficult to grasp Physics concepts. The Pearson Product Moment Correlation (PPMC) test explored the significant correlations among the three theoretical constructs. Results revealed that students' Executive Skills and Interest in Physics are significantly correlated. They are implying that when students are doing well in their Executive skills, it boosts their interest in understanding lessons in Physics. Nonetheless, there is no significant relationship between Executive Skills and Conceptual Understanding levels because even if the students have high Executive Skills, the difficulty of physics subject excel, necessitating thorough teaching. Therefore, it is worth noting that more attention should be given to the methods and techniques to be applied to maintain high levels of executive skills and interest while improving students' conceptual understanding.

Keywords: cognitive skills; metacognition; science education; self-regulation; problem solving; critical thinking; learning strategies; distance education; virtual learning; remote education; academic performance

1. Introduction

Online learning offers new opportunities and unfolds the hidden abilities of both teachers and students. However, the sudden occurrence of COVID-19 forced many countries, including the Philippines, to adopt this technology-based education, as face-to-face interactions are prohibited from stopping the increasing number of infected persons. For this reason, the traditional way of teaching and learning is highly affected. According to Moscoviz & David [1], dropout rates range increased dramatically, from under 1 percent to more than 35 percent, with much higher rates for older students, suggesting that pandemic school closures and other pandemic-related shocks may have curtailed many students. Since online

learning promotes distance education, student's executive skills, which are their ability to plan and organize activities to be able to complete tasks and activities such as problem-solving and assignments at a high level of cognitive functions, are viewed as less capable of being more participated because online learning requires students to use internet-based resources [2].

On the other hand, as Physics is one of the most underlying scientific principles [3], the researchers have seen the purpose of studying Physics as to develop students' reasoning abilities, which are demonstrated by logical thinking skills, systematic thinking, and the ability to solve issues objectively, honestly, and with discipline. However, most Filipino

students need help understanding physics subjects, especially electricity and magnetism, as these require high-order thinking skills [4]. Research shows that students struggle to understand physics concepts and lack conceptual understanding. Furthermore, students' conceptual understanding is generally weak during physics and online learning. Research has reported that even if students perform well in quantitative problem-solving, they need help with conceptual questions [5,6].

2. Methods

The research design, research environment, research respondents, data gathering procedure, and statistical process in analyzing the data.

2.1. Research Design

This study applied a quantitative design using a descriptive correlational technique. The illustrative methods are intended to determine the relationship between the student's Executive Skills, Conceptual Understanding, and Interest in learning Physics online.

2.2. Sampling design

To evaluate the students' Executive Skills, Conceptual Understanding, and Interest in learning Physics online, 88 students, the researchers used a Total Enumeration Sampling Design with 49 first-year and 39 second-year science students.

2.3. Research Environment

This study was conducted in one of the public colleges in the Philippines, located in Mati, San Miguel, Zamboanga del Sur. Researchers surveyed to determine the relationship between Conceptual Understanding, Executive Skills, and students' Interest in Physics during Online Learning, specifically in the School of Teacher Education (STE).

2.4. Research Instrument

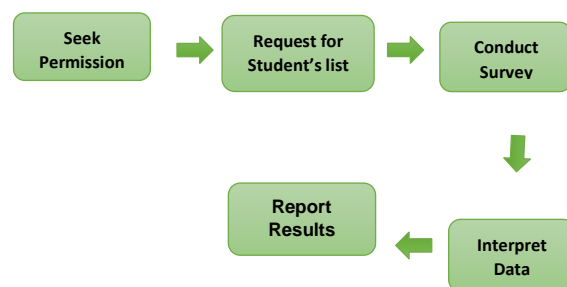
This study adopted the Executive Skills Questionnaire modified by Dawson and Guare [7]. It contains 36 positive questions and a 6 – 6-point Likert Scale (1 = Strongly Disagree to 6 = Strongly agree). The Conceptual Survey of Electricity and Magnetism (CSEM) questionnaire was developed by Maloney et al. [8]. A multiple-choice questionnaire to measure the Conceptual Understanding of Students in Electricity and Magnetism. The Colorado 24 Learning Attitudes about Science Survey (CLASS), modified from Adaams et al. [9], measured the students' Interest in learning

Physics. A 5 – 5-point Likert Scale (1 = strongly disagree to 5 = strongly agree) contains ten positive and two negative questions.

2.5. Research Respondents

The respondents of this study consist of forty-nine (49) enrolled first-year students and thirty-nine (39) second-year education students, with a total of 88 participants. There were eighty-seven (87) students whose ages range from eighteen to twenty-three (18 – 23) years old and only one student with an age range from thirty to thirty-seven (30 – 37) years old.

2.6. Data Gathering Procedure



Seek Permission. Following appropriate research ethics guidelines, the researchers obtained the necessary permissions and endorsement paperwork approved by the STE Department's Dean during the data collection stage. Following the minimal health protocol at the school, the letter was personally delivered to the dean as soon as the letter was signed and authorized.

Request for student's list. The researchers emailed the first-year and second-year science advisers requesting a list of students' names. After this, we counted how many females and males were in each year level.

Conduct survey. Following the approval sheet, participants were requested to fill out surveys sent to them using Google Forms. Before closing the tab in Google, respondents are asked to snap a screenshot sent to any of the researchers as documentation and verification of their involvement in this study. Moreover, the data gathered was strictly confidential and intended only for this study.

Interpret Data. The data was tabulated and evaluated by applying statistical methods for each variable using a Microsoft Excel spreadsheet.

Report Results. The results were presented to show the level of the students' Executive Skills, Conceptual Understanding, and Interest in learning Physics online.

2. 7. Statistical Process

The statistical treatment of the data was composed of two sections. Descriptive statistics (means) were used to analyze and interpret the degree measures of students' Conceptual Understanding, Executive Skills, and Interest in Physics during Online Learning. Inferential statistics Pearson Product Moment

Correlation (PPMC) test was used to explore the significant associations/correlations between the three theoretical constructs. The results of the correlation coefficient were interpreted using the scale of Cohen (1992): -0.3 to +0.3 = weak, -0.5 to -0.3 or +0.3 to +0.5 = moderate relationship, -0.9 to -0.5 or +0.5 to +0.9 = strong relationship, -1.0 to -0.9 or +0.9 to +1.0 = very Strong relationship.

3. Results and Discussion

Table 1. Descriptive levels of Student Executive Skills (n=88)

Items	M	SD	QD
1. I don't jump to conclusions.	4.47	1.22	VH
2. I think before I speak.	5.05	1.22	VH
3. I make sure I have all the facts before I act.	4.83	1.17	VH
4. I have a good memory for facts, dates, and details.	4.26	1.12	VH
5. I am very good at remembering the things I supposed to do.	4.14	1.14	H
6. I rarely need reminders to get things done.	4.39	1.35	VH
7. My emotions rarely stop me from doing what I am supposed to do.	4.44	1.19	VH
8. Little things do not affect my feelings or keep me from doing what I need to do.	4.17	1.32	H
9. When frustrated or angry, I keep my Cool.	4.27	1.34	VH
10. No matter what the task, I believe in getting started as soon as possible.	4.66	1.19	VH
11. Putting things off is usually not a problem for me.	4.32	1.07	VH
12. I rarely wait to the last minute to finish jobs.	4.07	1.33	H
13. I find it easy to stay focused on what I am doing.	4.44	1.15	VH
14. Once I start an assignment or project, I work diligently until it's completed.	4.73	1.20	VH
15. Even when interrupted, I find it easy to get back on track and complete what I was doing.	4.43	1.17	VH
16. When I start my day, I have a clear plan in mind for what I need to do.	4.67	1.25	VH
17. When I have a lot to do, I can easily focus on the most important things.	4.59	1.21	VH
18. I usually break big tasks down into smaller tasks and set deadlines to get everything done.	4.59	1.19	VH
19. I am an organized person.	4.48	1.20	VH
20. It is natural for me to keep my work area neat and organized.	4.67	1.26	VH
21. I am good at coming up with ways to organize my work.	4.64	1.15	VH
22. At the end of the day, I've usually finished what I set out to do.	4.53	1.13	VH
23. I am good at guessing how long it takes to do something.	4.40	1.17	VH
24. I am usually on time for appointments and activities.	4.36	1.28	VH
25. Unexpected events don't upset me.	4.14	1.23	H
26. I easily adjust to changes in plans.	4.30	1.20	VH

27. I consider myself to be flexible and can adjust to change.	4.53	1.21	VH
28. I routinely review my actions and decide how to improve.	4.65	1.21	VH
29. I am able to step back from a situation in order to make fair decisions.	4.57	1.18	VH
30. I am a “big picture” thinker and enjoy the problem solving that goes with that.	4.37	1.16	VH
31. I think of myself as being driven to meet my goals.	4.74	1.19	VH
32. I easily give up immediate pleasures to work on long-term goals.	2.50	1.65	L
33. I believe in setting and achieving high levels of performance.	4.53	1.24	VH
34. I enjoy working in a highly demanding, fast-paced environment.	4.36	1.09	M
35. A certain amount of pressure helps me to do my best.	4.51	1.15	VH
36. Jobs that include a fair degree of uncertainty appeal to me.	4.36	1.21	VH
Overall	4.42	0.93	VH

Note: M = mean, SD = Standard deviation, QD = Qualitative description: 1.00 – 1.79 = Very Low (VL), 1.80 – 2.59 = Low (L), 2.60 – 3.39 = Moderately High (M), 3.40 – 4.19 = High (H), 4.20 – 5.00 = Very High (VH)

The level of Executive Skills based on the results was very high. They indicated an overall mean of 4.42 with a standard deviation of 0.93, which resulted in a very high level of Executive Skills during an online class. Therefore, students did well with the online learning mode. First, students can identify their online learning strengths and weaknesses, which may help them

overcome challenges from this new mode of teaching and learning. Second, they can step back from a situation to make fair decisions and be driven to meet their goals. Third, they usually break big tasks into smaller ones and set deadlines to get everything done. And lastly, they can easily adjust to changes and think of newer plans to accomplish their goals.

Table 2. Descriptive Levels of Students’ Conceptual Understanding in Physics (n=88)

Items	M	SD	QD
1. A hollow metal sphere is electrically neutral (no excess charge). A small amount of negative charge is suddenly placed at one-point P on this metal sphere. If we check on this excess negative charge a few seconds later we will find one of the following responsibilities.	0.43	0.50	VL
2. A hallow sphere made out of electrically insulating material is electrically neutral (No excess charge). A small amount of negative charge is suddenly placed at one-point P on the outside if this sphere. If we check on this excess negative charge few second later, we will find one of the following possibilities.	0.22	0.41	VL
3. The original magnitude of the force on the +Q charge was F; what is the magnitude of the force on the +Q now?	0.48	0.50	VL
4. What is the magnitude of the force on the +4Q charge?	0.51	0.50	VL
5. Now what is the magnitude of the force on the +4Q?	0.45	0.50	VL
6. Which of the narrows is in the direction of the net force on charge B?	0.01	0.11	VL
7. The picture below shows a particle (labelled B) which has a net electric charge of +1 unit. Several centimeters to the left is another particle (labelled A) which has a net charge of -2 units. Choose a pair of force vectors (the narrows) that correctly compare the electric force on A (caused by B) with the electric force on B (Caused by A).	0.38	0.49	VL
8. In the figure below, positive charges q2 and q3 exert on charge q1 a net electric force that points along the +x axis. If a positive charge Q is added at	0.28	0.45	VL

(b,0), what now will happen to the force on q_1 ? (All charges fixed at their location).

9. In the figure below, the electric field at point P is directed upward along the y-axis. If negative charge $-Q$ is added at a point on the positive y-axis, what happens to the field at P? (All of the charges are fixed in position.)	0.25	0.44	VL
10. When the positive charge is released from the rest in the uniform electric field, what will its subsequent motion be?	0.35	0.48	VL
11. What happens to the electric potential energy of the positive charge, after the charge is released from the rest in the uniform electric field?	0.15	0.36	VL
12. A positive charge might be placed at one of two different locations in a region where there is a uniform electric field, as shown below. How do the electric forces on the Charge at positions 1 and 2 compare?	0.23	0.42	VL
13. The figure below shows a hollow conducting metal sphere which was given initially an evenly distributed positive (+) charge on its surface. Then a positive charge $+Q$ was brought up near the sphere as shown. What is the direction of the electric field at the center of the sphere after the positive charge $+Q$ is brought up near the sphere?	0.18	0.39	VL
14. The figure below shows an electric charge q located at the center of a hollow uncharged conducting metal sphere. Outside the sphere is a second charge Q . Both charges are positive. Choose the description below that describes the net electrical forces on each charge in this situation.	0.15	0.36	VL
15. What is the direction of the electric force on a negative charge at point P in the diagram above?	0.24	0.43	VL
16. An electron is placed at a position on the x-axis where the electric potential is $+10$ V. Which idea below best describes the future motion of the electron?	0.26	0.44	VL
17. How does the amount of work needed to move this charge compare for these three cases?	0.13	0.33	VL
18. How does the magnitude of the electric field at B compare for these three cases?	0.22	0.41	VL
19. For case III what is the direction of the electric force exerted by the field on the $+1 \mu\text{C}$ charge object when at A and when at B?	0.28	0.45	VL
20. A positively-charge proton is first placed at rest at position I and then later at position II in a region whose electric potential (voltage) is described by the equipotential lines. Which set of arrows on the left bellow best describes the relative magnitudes and directions of the electric force exerted on the proton when at position I or II?	0.10	0.30	VL
21. What happens to a positive charge that is placed at rest in a uniform magnetic field?	0.17	0.38	VL
22. An electron moves horizontally towards a screen. The electron moves along the path that is shown because of a magnetic force caused by a magnetic field. In what direction does that magnetic field point?	0.18	0.39	VL
23. Wire 1 has a large current I flowing out of the page as shown in the	0.18	0.39	VL

diagram. Wire 2 has a large current I flowing into the page. In what direction does the magnetic field point at position P?			
24. Two parallel wires I and II that are near each other carry currents I and $3I$ both in the same direction. Compare the forces that the two wires exert on each other.	0.20	0.41	VL
25. The figures below represent positively charged particles moving in the same uniform magnetic field. The field is directed from the left to right. All of the particles have the same charge and the same speed v . Rank these situations according to the magnitudes of the force exerted by the field on the moving charge, from greatest to least.	0.22	0.41	VL
26. The diagram shows a wire with a large electric current I coming out of the paper. In what direction would the magnetic field be at position A and B?	0.13	0.33	VL
27. A positively- charged particle (+q) is at rest in the plane between two fixed bar magnets, as shown. The magnet on the left is three times as strong as the magnet on the right. Which choice below best represents the resultant MAGNETIC force exerted by the magnets on the charge?	0.19	0.40	VL
28. Two identical loops of wire carry identical currents i . The loops are located as shown in the diagram. Which arrow best represents the direction of the magnetic field at the point P midway between the loops?	0.35	0.48	VL
29. In which of the above figures will the light blue be glowing?	0.32	0.47	VL
30. A very long straight wire carries a large steady current i . rectangular metal loop, in the same plane as the wire, move with velocity v in the directions in shown. Which loop will have an induced current?	0.24	0.43	VL
31. A neutral metal bar is moving at constant velocity v to the right through a region where there is a uniform magnetic field pointing out of the page. The magnetic field is produced by some large coils which are not shown on the diagram.	0.22	0.41	VL
32. A variable power supply is connected to a coil and an ammeter, and the time dependence of the ammeter reading is shown. A nearby coil is connected to a volunteer.	0.17	0.38	VL
Overall	0.25	0.09	VL

Note: M = mean, SD = Standard deviation, QD = Qualitative description: 1.00 – 1.79 = VeryLow (VL), 1.80 – 2.59 = Low (L), 2.60 – 3.39 = Moderately High (M), 3.40 – 4.19 = High (H), 4.20 – 5.00 = Very High (VH)

The students' descriptive level of conceptual understanding resulted in an overall mean of 0.25 with a very low qualitative description. They need to be more knowledgeable about physics concepts because they require higher thinking skills. The new teaching and learning methods likely made it difficult for the selected responders to grasp the physics teachings online. The result of the study of Guido [4] wherein he

noted that pupils would undoubtedly struggle with the physics curriculum, particularly in electricity and magnetism, because it calls for higher-order cognitive abilities. The degree of conceptual understanding during the online mode could be better, according to the findings and information received from the respondents.

Table 3. Descriptive levels of student's Interest in Physics (n=88)

Items	M	SD	QD
1. I think about the physics I experience in everyday life.	3.67	1.04	H

2. Knowledge in physics consists of many disconnected topics.	3.35	0.95	M
3. I am not satisfied until I understand why something works the way it does.	3.82	0.90	H
4. I study physics to learn knowledge that will be useful in my life outside of school.	3.94	0.94	H
5. I do not spend more than five minutes stuck on a physics problem before giving up or seeking help from someone else.	3.36	0.96	M
6. I enjoy solving physics problems.	3.40	0.95	H
7. Learning physics changes my ideas about how the world works.	3.80	0.90	H
8. Reasoning skills used to understand physics can be helpful to me in my everyday life.	3.78	0.98	H
*9. Spending a lot of time understanding where formulas come from is a waste of time.	3.13	1.18	M
10. To understand physics, I sometimes think about my personal experiences and relate them to the topic being analyzed.	3.64	0.90	H
*11. If I get stuck on a physics problem, there is no chance I'll figure it out on my own.	2.61	0.94	M
12. When studying physics, I relate the important information to what I already know rather than just memorizing it the way it is presented.	3.66	1.00	H
Overall	3.51	0.61	H

Note: M = mean, SD = Standard deviation, QD = Qualitative description: 1.00 – 1.79 = Very Low (VL), 1.80 – 2.59 = Low (L), 2.60 – 3.39 = Moderately High (M), 3.40 – 4.19 = High (H), 4.20 – 5.00 = Very High (VH)

Of the twelve (12) questions provided, nine were scored at a high level, and four were rated at a moderately high level. Based on the data analyzed, the students' interest in physics during online learning resulted in a high level (M = 3.51 and SD = 0.61). The data indicates that some students' online learning did not ultimately affect their Interest in learning Physics. Students are interested in learning Physics because they can relate it to real-life experiences and improve their reasoning skills (Adams et al., 2006).

Conceptual understanding and Executive skills exhibited a weak correlation ($r=0.03$, $p=0.784$), whereas interest in physics and executive skills exhibited a moderate correlation ($r=0.580$, $p<0.05$). Therefore, there is no significant relationship between executive skills and the students' conceptual

understanding. According to Vosniadou et al. [10], students with low Executive Skills struggle with Conceptual Understanding tasks, especially those requiring Conceptual Concepts. There is a 0.034 correlation coefficient and a 0.756 p-value between Interest in Physics and Conceptual Understanding. Therefore, it reveals that only interest in Physics and Executive Skills have a significant relationship because their p-value is less than 0.05. The strong correlation between the two variables helps the students' ability to take physics lessons online.

Table 4: Correlation matrix among executive skills, conceptual understanding, and interest in Physics. Executive Skills

	Executive Skills	ConceptualUnderstanding	Interest towards Physics
Executive Skills	-		

	0.03	
Conceptual Understanding	0.784	-
	.580*	0.034
Interest towards Physics	0.00	0.756

Note: Cell contains Correlation coefficient (above) and p-values (below), * Correlation is significant at the 0.05 level (2-tailed). *r* is interpreted using Cohen's Scale: -0.3 to +0.3 = weak, -0.5 to -0.3 or +0.3 to +0.5 = moderate relationship, -0.9 to -0.5 or +0.5 to +0.9 = strong relationship, -1.0 to -0.9 or +0.9 to +1.0 = very Strong relationship.

4. Conclusion

Based on the results of this study, the students had very high executive skills in learning physics online. Students did well with 40 in the online learning mode. It did not affect their feelings or keep them from learning. They certainly get back on track and complete their task even if interrupted because they are flexible and easily adjust to plan changes. Consequently, students' conceptual understanding of online physics learning was very low. Conceptual Understanding in this study focused explicitly on Electricity and Magnetism to measure students' creative thinking skills in solving E&M problems. Therefore, the degree of Conceptual Understanding during the online mode is relatively poor.

Furthermore, students' Interest in Physics during online learning was at a high level because they enjoy solving and learning physics problems. As a result, it indicates that some students' online learning only partially affected their interest in learning physics. In the context of this research, we found no significant relationship between the student's level of executive skills and the student's conceptual understanding of physics during online learning.

On the other hand, a significant relationship was found between the students' level of executive skills and their level of interest in physics during online learning. The results of this study reveal that they have a strong relationship, and that the students' Interests will improve if their Executive Skills are recognized. Therefore, Executive Skills only affect the students' Interest in learning Physics online.

5. Recommendations

1. Teachers are encouraged to maintain effective teaching methods that capture the students' Interests and improve their Executive Skills when learning Physics online. Continuously giving intrinsic motivation will encourage students to use executive skills in learning. They can also alter how instruction is delivered to lessen the effects of

weak skills, such as by putting strategic plans and routines in place.

2. Students are inspired to change from being avid participants of knowledge to being active participants in activities that involve analysis and evaluation for the development of their Executive Skills, as well as in conceptual understanding and also an Interest in learning Physics to engage in active learning such as writing essays and reflection.
3. Teachers are encouraged to assess students' prior knowledge, misconceptions, and areas where they have difficulties and implement effective teaching methods to increase their Conceptual Understanding, knowing that learning Physics is a difficult subject and students have low levels of the said construct, particularly when done online.

Future studies may consider what needs to be changed in this study and identify a potential approach to provide a satisfactory result that will benefit future researchers.

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