# Computing Students' Academic Performance Analysis Before and Amidst Pandemic Using Data Analytics

**By**

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## Abstract

Computing students are among those greatly affected by the mode of learning transition due to the Covid-19 pandemic. To this writing, there are no formal studies conducted yet to describe and visualize the effect of this transition on the computing students' academic performance in particular. In light of this reason, this study was initiated to effectively use data analytics to describe and visualize the effect of the mode of learning transition on the computing students' academic performance. Anchored to the objectives of the study, a mixed-method approach where quantitative data, 2,997 final grades of BSIT students of Camarines Sur Polytechnic Colleges were collected and a qualitative method was applied to describe the perceived factors affecting academic performance, retention, and dropout rate. RStudio was used to analyze and visualize the computing students' academic performance within three (3) semesters both before and amidst the Covid-19 pandemic. Data analytics revealed that there is no significant difference in the academic performance of the students before and amidst the pandemic (p-value= 0.5798). However, in terms of retention and dropout rate, it was revealed that there is a significant difference before and amidst the pandemic (p-value=1.553e-0). Implementation of thematic analysis further revealed the perceived factors that affect the academic performance, retention, and dropout rate. Identified themes revealed that resources, self-factor, learning environment, and financial factors are the top factors that affect computing students' academic performance, retention, and dropout rate. Therefore, an appropriate and prompt intervention in consideration of these revealed factors is vital.

**Index Terms—** academic performance, computing students, data analytics, distance learning, drop-out rate, retention rate, thematic analysis

## Introduction

Educational institutions must always leap in the pursuit of quality education. Anchored to this fact, Higher Educational Institutions (HEIs) in the Philippines continuously struggle to ensure that their students receive the best quality education possible [1]. However, during the surge of the Covid-19 pandemic, all levels of the education system in the Philippines were affected. All the HEIs in the country were mandated to shift from face-to-face learning to distance or flexible learning. This method of learning offers an alternative way to reduce contact between students or between students and teachers. However, in the Philippines, many students do not have access to online education due to a lack of resources as a result of the economic and digital divide [9]. Several studies show that this new education set-up impacts the mental health of students as it brought anxiety and worst, depression [12].

Computing Students (students enrolled in Information Technology Education programs) are among those greatly affected by this transition in the mode of learning. These transitions could affect also their academic performance since the ITE programs are originally designed for face-to-face learning since this includes hands-on activities that most cannot be delivered virtually especially if the students don't have the necessary resources and equipment [7].

Analysis of the academic performance is a vital input to the HEIs in devising interventions to ensure that quality education is achieved despite the shift in the learning modes brought about by the pandemic. Aside from that, analysis of students' academic performance is also a criterion in program accreditation and evaluation [11]. For state colleges and universities in the Philippines, the Accrediting Agency of Chartered Colleges and Universities in the Philippines (AACCUP), Inc. encourages and even requires compliance with periodic analysis of students' academic performance to gain meaningful insights including the retention rates.

There are various studies on the analysis of the academic performance of engineering and medical students [9][11] but only a few focuses on computing students. Also, analysis and comparison of the academic performance of the computing students before and amidst the pandemic to determine the pandemic impact on the academic performance of the computing students were not covered. Most of the analyses were conducted for different purposes such as to determine the relationship between computing students' initial and final academic performance; prediction for future work performance and future career success, and predict the impact of social media usage on academic performance [16][6][1].

Analysis of the academic performance of computing students with a large population is a bit challenging since this works with large and complex data sets, so integration of emerging technology such as Data Analytics can be of great help. Institutions have used data analytics for functional support of enrollment management and general student progress over the last decade but less frequently for assessing student learning outcomes and individual student success. For a change, it is now timely to consider data analytics in assessing the academic performance of students. The emerging approaches to data processing and analysis enable to create an effective learning mechanism, new insights, and meaningful information that can benefit students, teachers, and the entire education system [14].

Among the widely used tool for data analytics is R Studio. R is widely used since it is an open-source for statistical computing and a lot of learning materials for this tool are available online. Also, the R tool has its strength as a data analysis tool. For example, it contains nearly 12000 statistical, graphical and analytical packages [18]. Qualitative data can be a subject also for data analytics. One of the commonly used analysis techniques for qualitative data is thematic analysis. Thematic analysis is a technique for identifying, analyzing, and interpreting patterns of 'themes' from texts or transcripts [2]. Various tools are available for this purpose, and NVIVO is among the most commonly used tool because of its dynamic functionalities. It is a "premier software for qualitative data analysis" [Utama, 2020, p.1] and has been used by qualitative researchers in various fields to analyze data from interviews, surveys, field notes, web pages, and even journal articles.

It is in light of these reasons that this study is being initiated. This study was conducted to effectively use data analytics to present and visualize the effect of the mode of learning transition on the computing students' academic performance. Specifically, this study aims to: determine and visualize the academic performance of the computing students in Professional

Courses before and amidst the pandemic in terms of overall performance, retention rate, and drop-out rate; determine if there is a significant difference in the academic performance of the computing students in professional courses before and amidst the pandemic in terms of overall performance, retention rate and drop-out rate; and to analyze the perceived factors by the computing students and faculty members that affects the overall academic performance, retention rate and dropout rate amidst the pandemic. Further, the meaningful insights that will be gained as a result of data analytics will serve as input for recommendations to the school administration for some plan of actions or interventions that can be implemented in the teaching-learning process. Finally, as a computing educator, it is the earnest desire of the researcher to contribute something in achieving the goal of the Information Technology Education system as a whole.

# Methodology

### Procedure

Anchored to the objectives of this study, the researcher adopted the mixed-method approach specifically the explanatory sequential design was employed where quantitative data, final grades of BSIT students of Camarines Sur Polytechnic Colleges (CSPC) were collected and a qualitative method was applied to explain the quantitative findings in depth.

For data analytics, the procedure was guided by the Data Analytics Process [19] as shown in Fig. 1.



**Fig. 1** *Data Analytics Process*

Understand the Problem: In this step, the researcher defines the problem, frames objectives, crafts a preliminary hypothesis to be tested, and assesses the availability of the data sources [8]. Academic performance is too general so during this time, this was refined to the visualization only of the overall academic performance, drop-out rate, and retention rate. The possible sources of data to do analysis were assessed also. These resources include the data, the analytics tools, and other relevant literature.

Data Collection: This is the step where the collection of data commences. Class records were retrieved from the dean's office and from the handling faculty members with the due approval of the dean. The coverage of the collected class records was from the second semester of AY 2018-2019 to first semester of AY 2021-2022, only for Professional Courses. The collected final grades were plotted in a spreadsheet according to professional courses per semester and academic year. A structured interview was also conducted with the computing students and faculty members to gather the perceived factors that potentially affect the overall performance of the computing students amidst the pandemic.

Data Cleaning: In this step, data were preprocessed and conditioned in preparation analysis [8]. The consistency of the final grades in terms of its decimal places as well as the typographical errors was fixed. The dataset was double-checked also if there are missing or null values. Unnecessary data were also removed.

Data Exploration and Analysis: This is the step where the actual data analysis commences. Data visualization and statistical technique tool, specifically R, was used. The dataset was analyzed according to the objective of this study which is to describe and visualize the overall academic performance, retention rate, and drop-out rate of computing students before and amidst the pandemic. A thematic analysis using the NVIVO software tool was also conducted to analyze the potential factors that affect the academic performance, drop-out rate, and retention rate amidst the pandemic based on the perception of the computing students and faculty members.

Interpret the Results: In this step, interpretation of the analysis result commences. By this time, the result of the analysis validates whether or not the outcome meets the expectations and whether or not the hypothesis will be accepted or rejected. Meaningful insights gained in this step will serve as input for teaching-learning intervention decision-making.

*Materials*

Data: Final grades of BSIT students (first year to third year), three (3) semesters before the pandemic, and there (3) semesters during the pandemic across all the offered professional courses were collected and analyzed. Further, responses or transcripts from the structured interview conducted with the students and faculty members were collected and analyzed.

Data Analytics Tool: R is an open-source data analytics tool used to determine and visualize the academic performance of computing students across the professional courses before and amidst the pandemic in terms of overall performance, drop-out, and retention rate. The thematic analysis utilized NVIVO software tool.

*Methods*

Analysis of Existing Records: The available class records archived at the office of the dean served as the existing records and secondary data collected for the analysis. A letter of approval from the dean was secured by the researcher and assured the confidentiality of the gathered data.

Structured Interview: A structured interview was conducted to collect the perception of the computing students and faculty members on the potential factors that affect the academic performance, retention rate, and drop-out rate. There are 109 BSIT students and eleven (11) core BSIT faculty members who participated in the interview.

*Analysis Section*

Descriptive Analytics: this type of analysis was used to describe the academic performance of computing students before and amidst the pandemic through weighted mean in terms of overall performance, and percentage technique in terms of drop-out, and retention rate. The interpretation of the result of the academic performance follows the scale presented in Table I.

**Table I.** *Academic Performance Scaling and Interpretation*

| Grade | Verbal Interpretation |
|---|---|
| 95.00-100.00 | Outstanding |
| 90.00-94.99 | Very Satisfactory |
| 85.00-89.99 | Satisfactory |
| 80.00-84.99 | Fair |
| 75.00-79.99 | Poor |

Further, the retention rate was computed by adopting the following formula [20]:

$$RR = [(TE-DRP)/TE] *100$$

where:

RR is the Retention Rate

TE is the Total enrolled students in the course

DRP is the Number of students who were officially and forced to drop from the course.

Inferential Analytics: this type of analysis was used to determine if there is a significant difference in the academic performance, retention rate, and dropout rate of computing students before and amidst the pandemic. For this purpose, an independent sample t-test was used. The hypothesis tested is as follows:

Ho: There is no significant difference in the academic performance of the computing students in professional courses before and amidst the pandemic in terms of overall performance, retention rate, and drop-out rate.

Thematic Analysis: this type of analysis was used to determine the perceived factors by students and faculty members that affect the overall academic performance, retention rate, and dropout rate amidst the pandemic.

# Results and Discussion

This section presents a comprehensive discussion of the revealed results after a thorough analysis of the gathered data. The presentation and discussion of results were ordered according to the sequence of the presented specific objectives of the study.

***To determine and visualize the academic performance of the computing students in the Professional Courses before and amidst the pandemic in terms of overall performance, retention rate, and drop-out rate.***

The overall performance of the computing students for three (3) semesters before the pandemic and three (3) semesters during the pandemic across all the offered professional courses was presented in Table II. To supplement the presentation of results, Fig. 2 visualized the overall academic performance.

**Table II.** *Overall Performance of Computing Students*

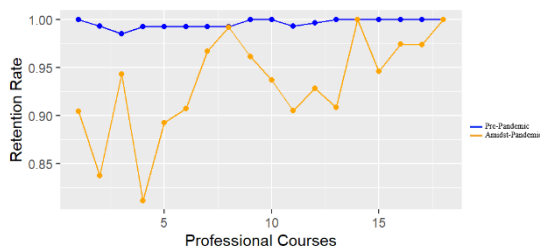| Professional/Core Courses | Before Pandemic | | Amidst Pandemic | |
|---|---|---|---|---|
| | Overall Performance | Interpretation of Performance | Overall Performance | Interpretation of Performance |
| Introduction to Computing | 87.3413 | Satisfactory | 91.2381 | Very Satisfactory |
| Computer Programming 1 | 83.1428 | Fair | 86.1540 | Satisfactory |
| Computer Programming 2 | 87.9262 | Satisfactory | 88.8318 | Satisfactory |
| Introduction to Human-Computer Interaction | 89.8753 | Satisfactory | 87.3927 | Satisfactory |
| Discrete Mathematics | 91.5047 | Very Satisfactory | 90.9554 | Very Satisfactory |
| Web Systems and Technologies 1 | 89.9903 | Satisfactory | 91.1251 | Very Satisfactory |
| Data Structures and Algorithms | 84.5918 | Fair | 84.5072 | Fair |
| Information Management 1 | 87.5424 | Satisfactory | 84.7118 | Fair |
| Object-Oriented Programming | 83.0114 | Fair | 87.2872 | Satisfactory |
| Web Systems and Technologies 2 | 86.6118 | Satisfactory | 87.7064 | Satisfactory |
| Mobile Technology 1 | 82.7306 | Fair | 87.6459 | Satisfactory |
| Multimedia Systems | 93.6062 | Very Satisfactory | 91.2704 | Very Satisfactory |
| Networking 1 | 90.1760 | Very Satisfactory | 90.9356 | Very Satisfactory |
| Integrative Programming and Technologies 1 | 88.3923 | Satisfactory | 87.8223 | Satisfactory |
| Ecommerce Technology 1 | 87.1811 | Satisfactory | 89.1757 | Satisfactory |
| Probability and Statistics in Information Technology | 91.9819 | Very Satisfactory | 91.7995 | Very Satisfactory |
| Platform Technologies | 87.8279 | Satisfactory | 87.0741 | Satisfactory |
| Mobile Technology 2 | 89.3748 | Satisfactory | 86.3980 | Satisfactory |
| **Overall Rating** | **87.9338** | **Satisfactory** | **88.4462** | **Satisfactory** |
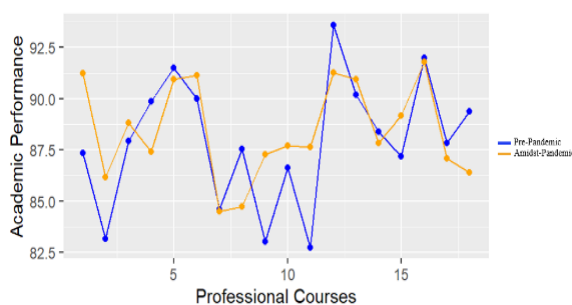
**Fig. 2** *Overall Performance Visualization*

As shown, overall, the academic performance is Satisfactory with an average Final Grade of 87.9338 and 88.4462 respectively. The Satisfactory rating can be interpreted that overall, the BSIT students were able to meet or satisfy the requirements of the Professional course enrolled both before the pandemic and amidst the pandemic. It is interesting to note in the result that the overall performance amidst the pandemic is at least one (1) point higher than the overall performance before the pandemic. Due to some difficulties in the flexible learning arrangement amidst the pandemic, this result is not expected. However, the possible factor that affects this result is the CSPC's implementation of the policy on the extent of leniency to the students amidst the pandemic where the grading system was amended for it to become more student-friendly [21,22]. This is consistent with the guidance provided by EAPRO-UNICEF on assessing and monitoring learning during the Covid-19 crisis which emphasizes "keeping the stakes of assessments low" [ EAPRO-UNICEF, 2020, p.3-4] which means whenever possible high-stake assessment should be postponed during crisis. With this, students were given as much as possible considerations so that their academic performance will not suffer due to pandemic crisis.

The retention rate for three (3) semesters before the pandemic and three (3) semesters during the pandemic across all the offered professional courses was presented in Table III. Moreover, Fig. 3 visualized the revealed retention rate.

**Table III.** *Retention Rate of Computing Students*

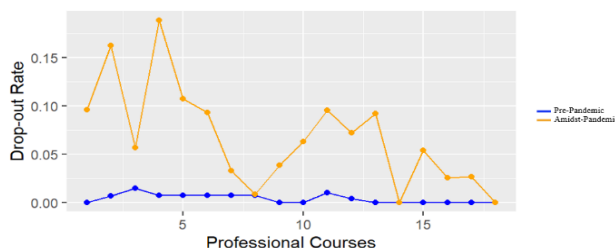| Professional/Core Courses | Before Pandemic | Amidst Pandemic |
|---|---|---|
| Introduction to Computing | 100% | 90% |
| Computer Programming 1 | 99% | 84% |
| Computer Programming 2 | 99% | 94% |
| Introduction to Human-Computer Interaction | 99% | 81% |
| Discrete Mathematics | 99% | 89% |
| Web Systems and Technologies 1 | 99% | 91% |
| Data Structures and Algorithms | 99% | 97% |
| Information Management 1 | 99% | 99% |
| Object-Oriented Programming | 100% | 96% |
| Web Systems and Technologies 2 | 100% | 94% |
| Mobile Technology 1 | 99% | 90% |
| Multimedia Systems | 100% | 93% |
| Networking 1 | 100% | 91% |
| Integrative Programming and Technologies 1 | 100% | 100% |
| Ecommerce Technology 1 | 100% | 95% |
| Probability and Statistics in Information Technology | 100% | 97% |
| Platform Technologies | 100% | 97% |
| Mobile Technology 2 | 100% | 100% |
| **Overall Rating** | **100%** | **93%** |

**Fig. 3** *Retention Rate Visualization*

As shown, overall, the retention rate is 100 % and 93% before and amidst the pandemic respectively. This result can be interpreted in terms of retention rate across Professional courses, there is a significant decline of 7% of students who were able to complete the enrolled professional course within the semester. It is clear and evident in the result that the retention rate amidst the pandemic is significantly lower than the retention rate before the pandemic. Due to some difficulties in the flexible learning arrangement amidst the pandemic, this result is expected. The possible specific factors that affect this result are presented in the succeeding sections. This result is consistent with the key findings in the report released by the US College Board entitled "College Enrollment and Retention in the Era of COVID-19" which revealed that as a result of pandemic, there is a decline of approximately 5% in the retention rates at community colleges [5]. This result affirms that Covid-19 has a significant effect on education, specifically on the retention rate of students. With this in mind, the computing education administration shall prepare appropriate and timely interventions that could help in maintaining a higher retention rate despite the difficulties encountered in flexible learning.

The dropout rate for three (3) semesters before the pandemic and three (3) semesters during the pandemic across all the offered professional courses was presented in Table IV. Moreover, Fig. 4 visualized the revealed drop-out rate.

**Table IV.** *Dropout Rate of Computing Students*

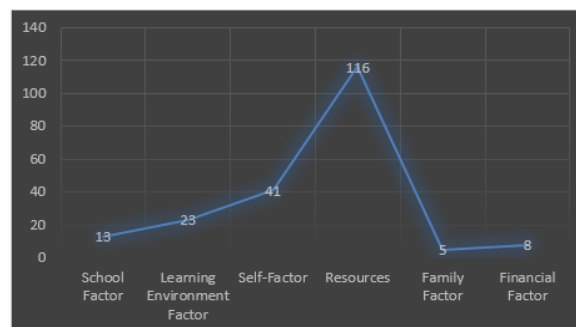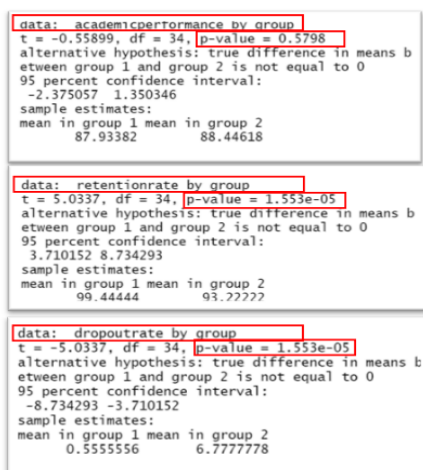| Professional/Core Courses | Before Pandemic | Amidst Pandemic |
|---|---|---|
| Introduction to Computing | 0% | 10% |
| Computer Programming 1 | 1% | 16% |
| Computer Programming 2 | 1% | 6% |
| Introduction to Human-Computer Interaction | 1% | 19% |
| Discrete Mathematics | 1% | 11% |
| Web Systems and Technologies 1 | 1% | 9% |
| Data Structures and Algorithms | 1% | 3% |
| Information Management 1 | 1% | 1% |
| Object-Oriented Programming | 0% | 4% |
| Web Systems and Technologies 2 | 0% | 6% |
| Mobile Technology 1 | 1% | 10% |
| Multimedia Systems | 0% | 7% |
| Networking 1 | 0% | 9% |
| Integrative Programming and Technologies 1 | 0% | 0% |
| Ecommerce Technology 1 | 0% | 5% |
| Probability and Statistics in Information Technology | 0% | 3% |
| Platform Technologies | 0% | 3% |
| Mobile Technology 2 | 0% | 0% |
| **Overall Rating** | **0%** | **7%** |



**Fig. 4.** *Dropout Rate Visualization*

As shown, overall, the dropout rate is 0% and 7% before and amidst the pandemic respectively. This result can be interpreted that in terms of the dropout rate across Professional courses, there is a significant increase of 7% of students who did not complete the enrolled course within the semester. It is also evident in the result that the dropout rate amidst the pandemic is significantly higher than the dropout rate before the pandemic. Due to some difficulties in the flexible learning arrangement amidst the pandemic, this result is expected. The possible specific factors that affect this result are presented in the succeeding sections. This result affirms the fact presented in the article "Educational Challenges and Opportunities of the Coronavirus (COVID-19) Pandemic" that an increased student dropout rate is among those challenges amidst the Covid-19 crisis in the field of education [15]. With this in mind, the computing education administration shall prepare appropriate and timely interventions that could help in maintaining a lower dropout rate despite the difficulties encountered in flexible learning.

***To determine if there is a significant difference in the academic performance of the computing students in professional courses before and amidst the pandemic in terms of overall performance, retention rate, and drop-out rate.***

The summary of academic performance, retention rate, and dropout rate were loaded to RStudio and an independent sample t-test was executed. The result for the significant difference test is revealed in Fig. 5.



```
data:  academicperformance by group
t = -0.55899, df = 34, p-value = 0.5798
alternative hypothesis: true difference in means b
etween group 1 and group 2 is not equal to 0
95 percent confidence interval:
 -2.375057  1.350346
sample estimates:
mean in group 1 mean in group 2
      87.93382        88.44618
```

```
data:  retentionrate by group
t = 5.0337, df = 34, p-value = 1.553e-05
alternative hypothesis: true difference in means b
etween group 1 and group 2 is not equal to 0
95 percent confidence interval:
 3.710152 8.734293
sample estimates:
mean in group 1 mean in group 2
      99.44444        93.22222
```

```
data:  dropoutrate by group
t = -5.0337, df = 34, p-value = 1.553e-05
alternative hypothesis: true difference in means b
etween group 1 and group 2 is not equal to 0
95 percent confidence interval:
 -8.734293 -3.710152
sample estimates:
mean in group 1 mean in group 2
     0.5555556       6.7777778
```



**Fig. 5** *Significant Difference Test Result*

The result revealed no significant difference in the academic performance before and amidst the pandemic as evident in the p-value of 0.5798. The result is the opposite of what is being expected. This finding is consistent with the comparative analysis conducted by Ghada Refaat and El Said [2021] on the academic performance of higher education students in a developing country which reveals that there was no significant difference in the students'

grades before and amidst the pandemic. Further, the study revealed that the unexpected and swift transition to online distance learning during the pandemic did not result in a poor learning experience, as anticipated [13].

On the other hand, results revealed that there is a significant difference in the retention and dropout rate as evident in the p-value of 1.553e-05. Due to the shift in the mode of learning, the result is expected. It is noticeable in the result that the retention rate is significantly lower and the dropout rate is significantly higher amidst the pandemic. This result is consistent with the view of Edeh Michael Onyema [2020] that the shift to flexible learning due to the Covid-19 pandemic may result in to increase in the dropout rate and a decrease in retention rate due to students' lack of interest and resources to continue their education. With this in mind, the computing education administration shall prepare appropriate and timely intervention that could help in maintaining a lower dropout rate and higher retention rate despite the difficulties encountered in flexible learning for it may lead to a more serious problem. As mentioned by Onyema [2020], if not well managed, dropouts may lead to idleness of students which contributes to "negative peer influences and youth involvement in crimes" [p.112].

***To analyze the perceived factors that affect the overall academic performance, retention rate, and dropout rate of computing students amidst the pandemic.***

The result of the thematic analysis conducted with the gathered data from the interview was summarized through Table V and Fig. 6 in terms of the generated themes for the factors that affect the overall academic performance amidst the pandemic.

**Table V.** *Generated Themes for the Factors that Affect the Overall Academic Performance Amidst Pandemic*

| Themes | Frequency (no. of times the theme was mentioned by the participants) |
|---|---|
| **School Factor** | **13** |
| *Teacher Factor* | *1* |
| *Learning Tasks Provided* | *3* |
| *Teaching Modality and Strategy* | *9* |
| **Learning Environment Factor** | **23** |
| *Peer Interaction* | *2* |
| *Student-Teacher Interaction* | *3* |
| *Distraction* | |
| *Social Media* | *2* |
| *Household Related Distraction* | *16* |
| **Self-Factor** | **41** |
| *Acquired Skills* | *1* |
| *Other Commitments* | |
| *Part-Time Job* | *3* |
| *Emotional Factor* | *3* |
| *Physical Health* | *5* |
| *Learning Ability* | *6* |
| *Attitude and Learning Motivation* | *7* |
| *Time Management* | *7* |
| *Mental Health* | *9* |
| **Resources** | **116** |
| *Course Materials or Resources* | *1* |
| *Power Outages* | *2* |
| *Equipment or Gadget* | *42* |
| *Internet Connectivity* | *71* |
| **Family Factor** | **5** |
| **Financial Factor** | **8** |

**Fig. 6** *Visualization of the Frequency of Generated Themes (Overall Performance of Students)*

As revealed in Table 5 and Fig. 6, the theme with the highest frequency (116) is the Resources. This can be interpreted that the majority or almost all of the computing students and faculty members who responded to the interview perceived that the availability of the resources affects their overall academic performance. Further, sub-themes under Resources show that majority perceived that internet connectivity (71) and equipment or gadget (42) affects their overall academic performance. This only suggests that the internet connectivity and the learning equipment or gadget on hand is really vital during flexible learning for it affect

the overall academic performance of computing students. This result is expected due to the fact the teaching-learning process in the field of computing requires hands-on and actual application where internet connectivity and equipment or gadget at least a laptop or computer unit[7]. However, due to some limitations, not all computing students have equal access to these resources. On the other hand, the Family Factor is with the lowest frequency (5) among the themes. It can be said that factors such as family problems and family status slightly affect the overall academic performance of computing students as perceived. For a more detailed view, each theme is discussed as follows according to the frequency the theme was mentioned by the participants:

### Resources

This theme is the highest in terms of the frequency of being mentioned by the participants. These pertain to the availability and status of internet connectivity and equipment or gadget as well as other course materials even the power outages. "No laptop", "No stable internet connection", "frequent power outages in our place" and "lack of information and instruction on the provided course material" are only a few of the sample responses under this theme.

### Self-Factor

This theme is the second highest in terms of frequency of being mentioned by the participants. This includes the following subthemes: acquired skills; other commitments (e.g., part-time job); emotional factor; physical health; learning ability; attitude and learning motivation; time management; and mental health. "Our limited acquired skills"; "my laziness and lack of motivation"; "Unmotivated because of pandemic"; "I will freak out and got nervous also my heart beat so fast like I'm in a race"; "I wasn't able to fully do and understand hands on activities"; "This may be challenging for any student who is a slow learner and struggles to grasp the material"; "I wasn't able to fully do and understand hands on activities"; "as a BSIT student, sometimes I cannot understand the lessons, especially in the programming subject"; "I'm prone to overthinking the worst-case situation, which exacerbates my poor track record"; "other responsibilities", "When the pandemic first broke out, my fear about getting a COVID-19 and infecting my family limited me to doing the same tasks I did at school"; "lack of proper rest/sleep"; "I find it quite challenging to synchronize things together"; "how hard it is to manage the time". These are only a few of the sample responses under this theme.

### Learning Environment Factor

This theme is the third highest in terms of frequency of being mentioned by the participants. This includes the following subthemes: peer interaction; student-teacher interaction and distraction (e.g., social media and household-related distraction). "lack of interaction between teacher and classmates especially in group activities"; "as the set-up is like homeschooling, there are also too much "utos" that it hinders me from doing my tasks (like when I'm thinking and almost grasping the correct word then suddenly there's that "utos")"; "task at home that needs to be accomplished first before the task at school"; "the distractions of social media". These are only a few of the sample responses under this theme.

### School Factor

This theme is the fourth in terms of frequency of being mentioned by the participants. This includes the following subthemes: Teacher Factor; learning task provided; teaching modality and strategy. "Too much activities to be accomplished"; "some teacher are not regularly teaching"; "The online adaptation of classes as a whole makes the learning process different, hard, and not fun nor motivational"; "teachers failed to discuss in depth the topic". These are only a few of the sample responses under this theme.

### Financial Factor

This theme is the fifth in terms of frequency of being mentioned by the participants. No subthemes were identified for this theme. "food insecurity, unemployment (of the guardians/parents) that leads on not having the capacity of buying their necessities, etc."; "lacking of finance"; "With gas price hikes present, going from the town proper takes a lot of toll on time and money". These are only a few of the sample responses under this theme.

### Family Factor

This theme is the lowest in terms of frequency of being mentioned by the participants. No subthemes were identified from this theme. "Some of the possible factors are the environment of each and every student in their houses"; "family matters"; "family status"; "family problems". These are only a few of the sample responses under this theme.

Further, the result of the thematic analysis conducted with the gathered data from the interview was summarized in Table VI and Fig. 7 in terms of the generated themes for the factors that affect the retention and dropout rate amidst the pandemic.

**Table VI.** *Generated Themes for the Factors that Affect the Retention and Dropout Rate Amidst Pandemic*

| Themes | Frequency (no. of times the theme was mentioned by the participants) |
|---|---|
| **Resources** | **84** |
| *Equipment or Gadget* | *40* |
| *Internet Connectivity* | *44* |
| **Self-Factor** | **79** |
| *Unexpected Pregnancy* | *1* |
| *Course Requirement Compliance* | *1* |
| *Life Priorities* | *4* |
| *Self-motivation* | *11* |
| *Mental Health* | *12* |
| *Time Management* | *14* |
| *Attitude Towards Distance Learning* | *16* |
| *Learning Ability* | *20* |
| **Learning Environment** | **16** |
| *Student-Teacher Interaction* | *3* |
| *Peer Interaction* | *5* |
| *Distraction* | *8* |
| **School Factor** | **10** |
| *Teaching Learning Modality* | *5* |
| *Teacher Factor* | *5* |
| **Family Factor** | **6** |
| **Financial Factor** | **27** |
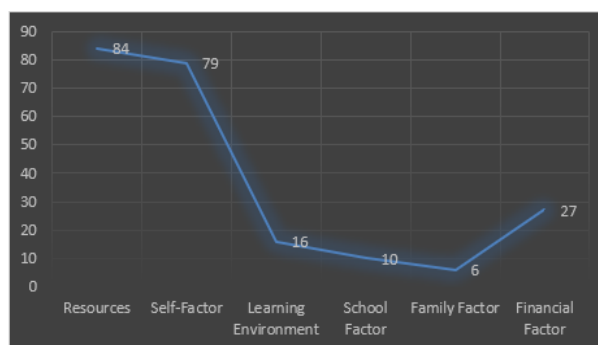


**Fig. 7** *Visualization of the Frequency of Generated Themes (Retention and Dropout Rate)*

As revealed in Table VI and Fig. 7, the theme with highest frequency (84) is the Resources. This can be interpreted that majority or almost all of the computing students and faculty members who responded the interview perceived that the availability of the resources affects their retention and dropout rate among computing students. Further, sub-themes under Resources show that majority perceived that internet connectivity (44) and equipment or gadget (40) affects their overall academic performance. This only suggests that the internet connectivity and the learning equipment or gadget on hand are really vital during flexible learning for the lack of these can lead to an increase in the dropout rate and low retention rate.

This result is expected due to the fact the teaching-learning process in the field of computing requires hands-on and actual application where internet connectivity and equipment or gadget at least a laptop or computer unit[7]. However, due to some limitations, not all computing students have equal access to these resources. Lack of these resources, opt or even forced the computing students to drop the enrolled course. This agrees with the revealed result of the study of Acknowled Gments[2021] that "regardless of demographic or academic background, technology inadequacy creates an academic struggle for students and threatens their academic success"[p.10]. On the other hand, the Family Factor is with the lowest frequency (6) among the themes. It can be said that factors such as family problems and family status slightly affect the retention and dropout rate among computing students as perceived. For a more detailed view, each theme is discussed as follows according to the frequency the theme was mentioned by the participants:

### Resources

This theme is the highest in terms of the frequency of being mentioned by the participants. These pertains to the availability and status of internet connectivity and equipment or gadget. "Not having the proper equipment and gadget will affect the dropout rate in my course. Having only a mobile phone wasn't enough"; "one of these is the lack of resources/gadgets that they can use in online learning that's why they deciding to stop for a while, and waiting to be back the face-to-face classes"; "I think having difficulties in coping up with the lessons and requirements because of unstable internet connection and lack of resources". These are only a few of the sample responses under this theme.

### Self-Factor

This theme is the second highest in terms of frequency of being mentioned by the participants. This includes the following subthemes: unexpected pregnancy; course requirement compliance; life priorities; self-motivation; mental health; time management; attitude towards distance learning and learning ability. "I'm also experiencing laziness to not do the activities. So, I find ways to entertain myself and to have motivation but the urge of being lazy is powerful these days and if I can't really understand what to do with the given activity"; "some were forced to drop due to unexpected pregnancy"; "The possible factors or reasons that affect the dropout and retention rate in courses is the Compliance of Task and Late Submissions"; "because also they want to help first their family on the financial crisis so they chose to look for work and prioritize it than their academics". "some chose to drop the course because they were not able to cope up mentally the pressures, and worst some commits suicide"; "Losing the interest to study because of an online class and the capacity of knowledge that are gaining are insufficient"; "Time management between household works and academic works that may result into late submission of activities". These are only a few of the sample responses under this theme.

### Financial Factor

This theme is the third highest in terms of frequency of being mentioned by the participants. There were no subthemes identified in this theme. "life amidst pandemic is so hard that's why there are many who chose to drop the course and forced to look for a job instead of pursuing the study"; "increasing price of goods makes the students forced to work to support their expenses"; "Some of the students chose to have jobs to support their families and to survive the pandemic". These are only a few of the sample responses under this theme.

### Learning Environment

This theme is fourth in terms of frequency that it is being mentioned by the participants. This includes the following subthemes: distraction; peer interaction and student-teacher interaction. "our family business and my responsibilities at home are what's keeping me behind

from doing my activities on track"; "many distractions online"; "when I did not understand the lesson or when I did not attend the online class, I feel so isolated and feel helpless for I found no one to seek help for"; "as well as lack of interaction between students and instructors". These are only a few of the sample responses under this theme.

### School Factor

This theme is the fifth in terms of frequency that is being mentioned by the participants. This includes the following subthemes: teaching-learning modality and teacher factor. One of the reasons I may consider is our faculty's inattention and inconsiderate for their students. "Students who are struggling in class have the greatest rate of dropping out due to their lack of development in all areas. Professors should lend a helping hand to their students who are in need. They should be more approachable so that students may approach them without hesitation. More professors that are tough and give students a hard time are the ones who aren't approachable at all"; "sometimes the teachers failed to explain the lesson in depth, and failed to impart the lesson in a way that it can be easily understood"; "it is sad to note that there are instructors who did not discuss the lesson but gives activity"; "High expectation of teachers but lack of instruction is given". These are only a few of the sample responses under this theme.

### Family Factor

This theme is the last in terms of frequency that it is being mentioned by the participants. There is no subthemes identified in this theme. "family problem"; "lack of freedom"; "supportive family members". These are only a few of the sample responses under this theme.

## Conclusion

Computing students are not exempted on the challenges brought about by the transition in the mode of learning due to the Covid-19 pandemic. Therefore, the effect of this on the academic performance of the computing students is hereby explored in this study. Implementation of data analytics on the gathered data revealed an unexpected fact that there is no significant difference on the academic performance of the computing students in their enrolled professional course before and amidst the pandemic. In fact, it was also noticeable in the result that the academic performance amidst the pandemic is slightly better than that before the pandemic. Therefore, despite the difficulties the academic success among computing students was still achieved amidst the pandemic. However, in terms of retention and dropout rate, the comparative analysis revealed that there is a significant difference in the retention rate amidst the pandemic for it is significantly lower than before the pandemic and the dropout rate is significantly higher than before the pandemic. Thus, the pandemic significantly impacts the point of view of students on whether to pursue or not their studies. Implementation of thematic analysis further revealed the perceived factors that affect the academic performance, retention, and dropout rate. Identified themes revealed that resources, self-factor, learning environment, and financial factors are the top factors that affect computing students' academic performance, retention, and dropout rate. Therefore, an appropriate and prompt intervention in consideration of these revealed factors is vital.

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