



Technological Challenges of an Engineering Department Amidst Pandemic

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Authors' contributions

This work was carried out in collaboration between both authors. Both authors read and approved the final manuscript.

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ABSTRACT

Technology management is more important than ever due to the quick development of technology across all fields of specialization. The study is grounded on the challenges faced by lecturers and students of the engineering department and highlighted the mechanisms used in finding the solutions. The study made use of a qualitative research design to gather in-depth insights about the problem and generate new ideas for research. The respondents of the study include the department head and lecturers of the department. The study used maxQDA software in the analysis of responses to develop a model based on the existing practices of an engineering division. This model includes mechanisms to address the technological challenges like regular meetings and collaborative meetings with teachers and students. These practices address the technological challenges on management, teaching, and learning. The school must embody key characteristics to face all challenges and must start with collaboration among the teachers and students before

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extruding to collaboration with external stakeholders like alumni and local government units. This study further showed the effect of poor internet connectivity, thus school administrators should look into the need providing internet connection in the campus for teachers needs in providing effective instructions. The results further showed the challenge in adapting new technologies like software and online platform intended for learning of students. The head of the division must be supportive of the teaching needs of the staff which results in good relations and collaboration of subordinates and students. Lastly, lecturers must be compassionate to teaching to address the learning needs of students and consider methods like video clips, tutorial sessions, and consultation.

Keywords: Engineering education; technological challenges in new normal education; challenges of students and teachers amidst pandemic.

1. INTRODUCTION

Technology management is becoming more significant nowadays because of the fast-moving growth of technology in the different fields of specialization. Managing a technology helps an organization get ready for the demands for higher performance to meet customer needs. If there is no strategic technology planning to fulfill the requirements of business operations, there may be problems in the supply chain of a particular institution.

According to a recent study of fast-growing companies in Ontario, identifying strategic partners, getting employee buy-in, and managing cash flow during expansion are the three most problems for CEOs. The Queen's Centre for Enterprise Development (QCED) study found difficulties for fast-growing businesses. Each of these issues has a unique effect on how these businesses develop and manage information technology, which is essential to their expansion [1].

Multinational corporations that have purchased multiple businesses in several nations must handle distinct R&D cultures and strategies. A cross-disciplinary, international environment is produced by the emerging knowledge-based economy, which permeates businesses, universities, research institutions, and nations. It's obvious that managing technology in this new environment is extremely difficult [2].

The management of many colleges and universities had to take a close look at their current IT infrastructure in 2020 as a result of significant disruptions and major glitches that affected daily operations. This forced management to consider what could be done to better accommodate faculty and students [3].

Universities are dealing with a variety of problems as a result of poor technological management, including the inadequate planning of technology that could be useful during pandemic interruptions. Universities were compelled to develop strategies that rely on the usage of technology designed for the delivery of instruction. There were many platforms and channels for delivery available on the market, but choosing the online mode of delivery was hampered by problems with internet connectivity, power supply, and the availability of computer supplies and materials. The study's findings on the challenges of hybrid teaching during a pandemic revealed that the engineering division was aware of these difficulties: inadequate support for online students, platform-related technical problems, a lack of devices for online learning, a lack of readiness, and reluctance among lecturers, and unstable internet connections [4].

Engineering Department in State Universities and Colleges is one of the units that is surely affected by technological issues. In the absence of technological advancement, faculty members struggle in providing learning experiences suited to the needs of the learners in the advent of pandemic. Especially nowadays, wherein technological management is really integrated in the development process of the institutions in order to produce quality graduates that the university could be proud of, faculty members really need to be well versed with the new trend of technology. As cited by Johnson, A. M., et. al., (2016), if a teacher's school does not possess adequate computers and fast internet connection, the implementation of educational technology is not feasible. Another one is inadequate training related to technology. If teachers are not provided effective professional development on new technologies, they will not be capable of using it to its full potential [5].

These very reasons are the driving forces for this study, which aims to understand how an engineering department approaches the use of technology in the classroom in the face of pandemic-related challenges.

1.1 Research Problems

This study determined the technological challenges of an engineering department amidst pandemic. Specifically, it sought to answer the following questions:

1. What were the technological management challenges encountered by the teachers?
2. How did the teachers and students respond to these challenges?
3. What are the mechanisms used in achieving the solutions to the technological challenges faced?

1.2 Objectives of the Study

This study aimed to understand how an engineering department in a Higher Educational Institution transforms its practices to attune to Technological Management during the time of Pandemic. Specifically, it aimed to:

1. Identify technological management challenges encountered by the teachers.
2. Examine the solutions employed by teachers and students to respond to the challenges.
3. Explore the mechanism used in achieving the solutions to the challenges faced.

2. METHODOLOGY

2.1 Research Design

The study made use of a qualitative research design to gather in-depth insights about the problem and generate new ideas for research. Specifically, a grounded theory was implemented as a research tool that will help the researchers develop a theory that will help to explain the main concern of our study and how it will be resolved or processed [6]. In this study, a phenomenon from people's experience is aimed at developing a theory on the technological challenges based on the experiences of lecturers.

The study used an interview guide with three major concerns and a series of open-ended

questions. The instrument was a validated questionnaire from the unpublished research conducted by Nebrida, et al. [7] on the challenges of a School in Teaching and Learning. However, theoretical sampling was adopted as prescribed for the grounded theory.

The respondents of the study include the department head and lecturers of the department. The researchers assured that all necessary activities in the conduct of the study were properly undertaken such as sending communication letters, consent forms, scheduled interviews, and confidentiality. The data were then transcribed and reviewed for accuracy.

2.2 Data Gathering

The data was gathered with an initial interview from all the participants. Before conducting the interview, a letter of request to the head of the division and the teachers who emerged in the process was made citing the details of the research. A letter of informed consent was given to the participants before conducting the interview. After each interview session, the raw data were transcribed and analyzed with the use of maxQDA software. In using this software, analysis begins with coding to sort and organize data. The second step is axial coding to analyze the questions based on the initial coding made. Lastly, selective coding helps to narrow down the selected code to develop the theory.

3. RESULTS

The findings obtained from the responses of emerging participants from the initial interview with the department head are presented according to the study's statement of the problem, which was able to identify the challenges encountered by lecturers and students and how these challenges are responded to and articulate the solution to the identified technological problems amidst pandemic.

3.1 Technological Challenges of the Department Head

The discussion below shows how the department head describes the experiences on the technological challenges and general solutions used.

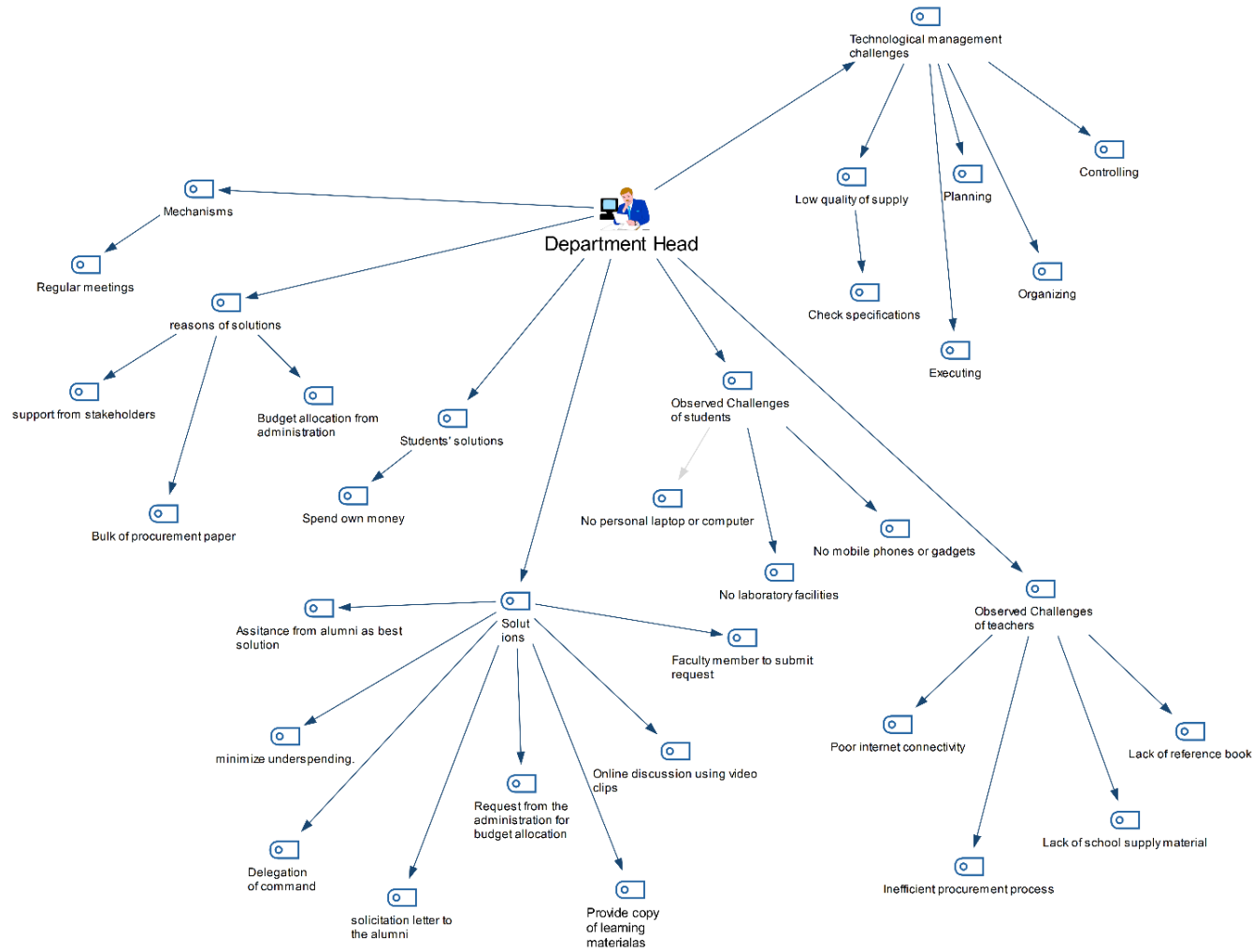


Fig. 1. Technological challenges of department head

Technological management challenges of the department head: The department head recognizes the challenges of technology during the time of pandemic as follows.

Planning: Due to the poor internet connection, communicating with co-workers and students using an online flat form seems to be challenging. Lack of necessary resources, such as a projector, laptop, computers, laboratory equipment, and the like, are also a challenge.

Executing: Due to the department's two primary courses and a shortage of teachers, scheduling tasks is challenging.

Organizing: It is challenging to appoint someone to carry out the tasks and responsibilities because the department is short on faculty.

Controlling: The office must follow the lengthy procurement procedures in terms of resources. Bidding, the Project Procurement Management Plan (PPMP), and similar procedures are examples of such processes.

“Communicating with my subordinates and students using online flat form seems to be difficult due to low internet connection (Interview with Department head, Pos. 18-22)

Observed Challenges of Teachers: The department head recognizes the challenges faced by teachers such as poor internet connectivity, inefficient procurement process, lack of reference textbooks, and lack of school supply materials.

Observed Challenges of Students: The challenges of students as observed by the department head are lack or no mobile phones or gadgets and laptops or personal computer, and insufficient laboratory facilities.

In the study of Nebrida et.al (2022), demonstrated that the school is aware of issues such as the inadequate number of staff members, responsibility for the school's assets, the current principal's position, the new normal situation, the limitations of school activities, transportation problems, problems with onsite monitoring, and choice of modality [7].

General Solutions: The department head addresses the challenges with proper delegation of command, request of budget allocation from the administration, providing students with

learning materials, solicitation to the alumni, and online discussion using video clips.

Nebrida et al. (2022), cited that the division implemented strategies like providing laptops, group learning, online learning tools, gamification, audiovisual learning, tutorial videos, using both personal and institutional resources, and repetition for mastery [7].

Support from stakeholders: The department head stressed the significant support from the stakeholders especially the financial assistance coming from the alumni which is considered to be the best solution.

Regular meeting: The department head stressed the significance of having regular meetings as one mechanism in coming up with the solutions to the challenges addressed by the department.

3.2 Challenges of Teacher 1

The discussion below shows how the lecturer 1 describes the experiences on the technological challenges and general solutions used.

Technological Challenge as a teacher: The teacher stressed out the difficulty of the distribution of learning materials because of poor internet connection.

Observed Challenges of Students: The teacher observed that students were facing difficulty due to lack of resources like mobile phones and internet gadgets, and the poor internet connectivity.

General Solutions: The teacher stressed out that limited students on face to face synchronous classes was the best solution on these challenges amidst pandemic. The modular mode of instruction was also instrumental in addressing these challenges. For students, hard copy modules were the solution instead of online.

Collaboration with external stakeholders: The need of collaboration with the external stakeholders provides municipal links in the distribution of hard copy of modules to the students. According to Agbetorwoka et.al (2019), to ensure successful inclusive education, it is advised that instructors work together with all stakeholders to develop efficient and successful education of students [8].

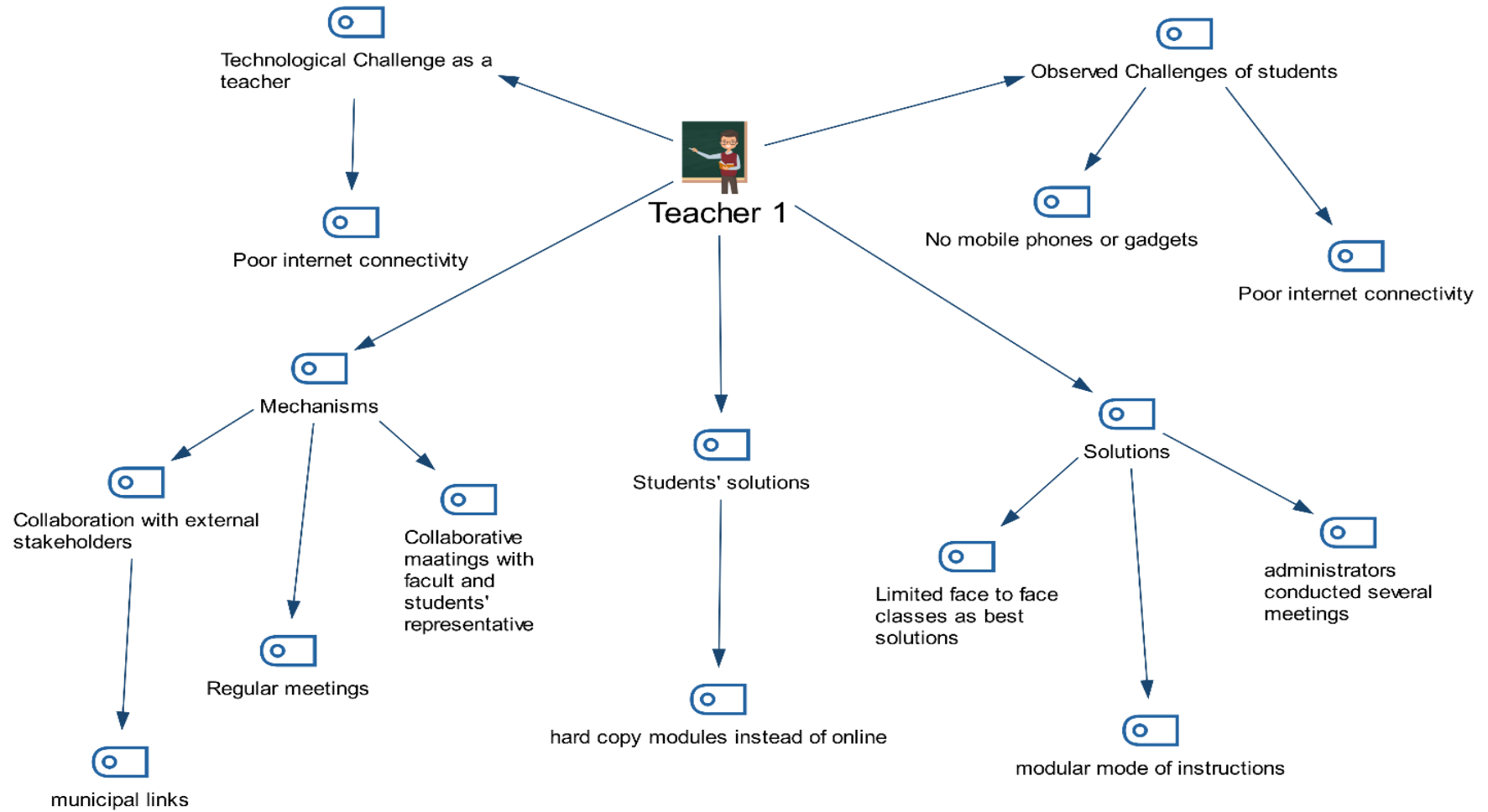


Fig. 2. Technological challenges of teacher 1

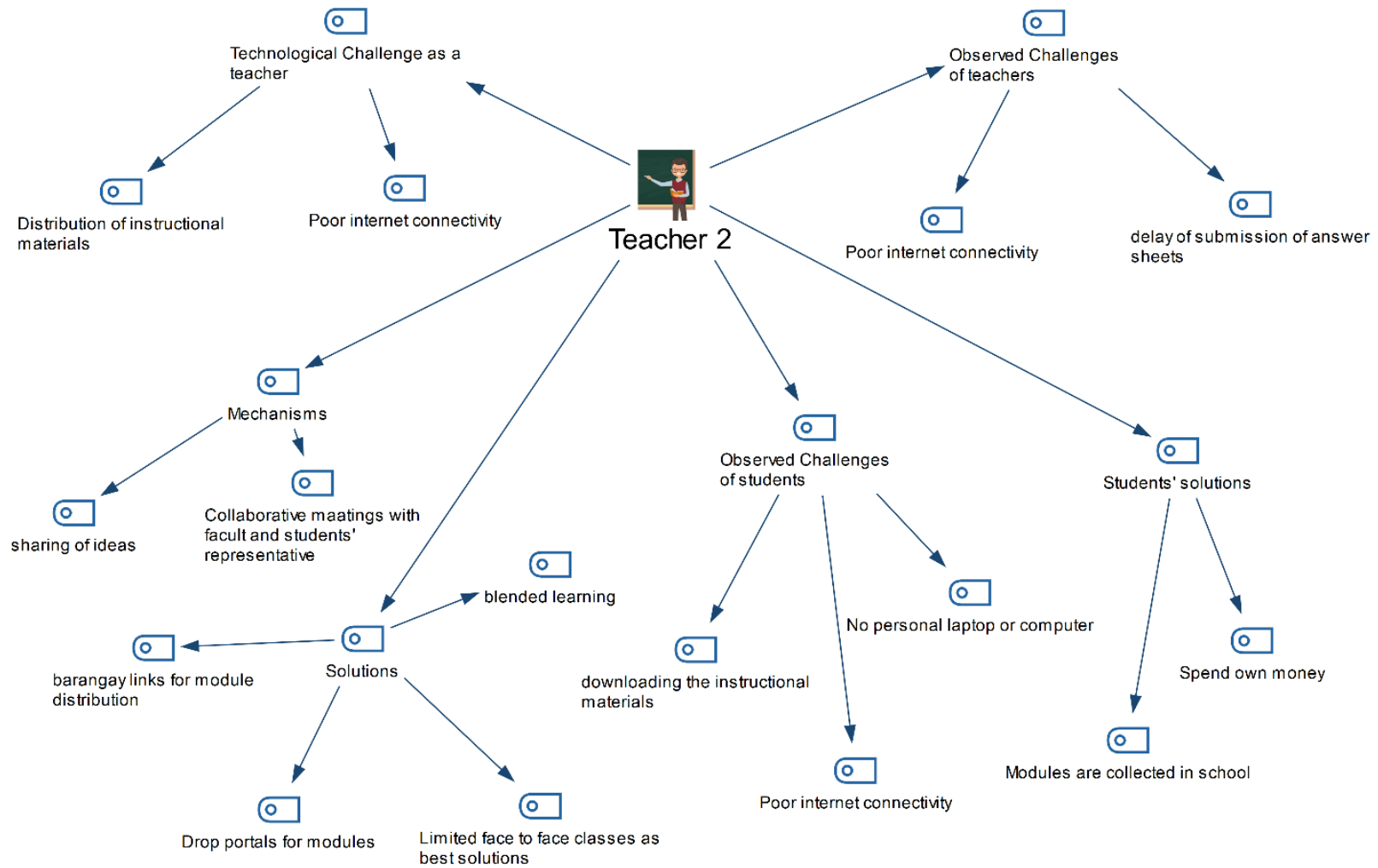


Fig. 3. Technological challenges of teacher 2

Mechanisms: The department head stressed the significance of having regular meetings and collaborative meetings with faculty members and students' representatives in addressing the need of students' effective learning.

3.3 Challenges of Teacher 2

The discussion below shows how the lecturer 2 describes the experiences on the technological challenges and general solutions used.

Technological Challenge as a teacher: The teacher stressed the challenges of distribution of learning materials and poor internet connection, and the delay of submission of students' output.

Observed Challenges of Students: The teacher observed that students were challenged with the need of resources like laptop or personal computer, and downloading instructional materials because of poor internet connectivity.

General Solutions: The teacher cited the need of barangay links as drop portals for module distribution as solution to the challenges faced in addressing the learners' needs. In addition, blended learning was utilized in learning modality by which limited face to face synchronous as the best solution to students learning.

Mechanisms: The teacher stressed the significance of collaboration with faculty members thru sharing of ideas in addressing the challenges amidst pandemic. According to the study of Olvido et.al (2021), teachers modified their lesson plans when there was a lockdown at the school. Due to poor or nonexistent internet connectivity, the majority of students found it challenging to complete the required learning activities. The requirement for flexible learning delivery, the function of technology, and the teaching and learning environment were discerned from the qualitative replies [9].

3.4 Challenges of Teacher 3

The discussion below shows how the lecturer 3 describes the experiences on the technological challenges and general solutions used.

Technological Challenge as a teacher: The teacher stressed the challenges of poor internet connection.

Technological Challenge as students: The teacher observed the challenges of students on

insufficient memory of their devices and poor internet connection.

General Solutions: The teacher cited the solutions to challenges faced amidst pandemic such as identification of barangay links for module distribution, and having chat groups for consultation and tutorial of students and coordination with fellow teachers. Due to the insufficiency of mobile phone's storage, the assignment of one student in securing files and storing in external hard drive is identified to be an alternative solution. Most importantly, being compassionate to the needs of students is vital to students' success in learning.

Mechanisms: The teacher stressed the significance of collaboration with faculty members and students in addressing the challenges amidst pandemic.

3.5 Challenges of Teacher 4

The discussion below shows how the lecturer 4 describes the experiences on the technological challenges and general solutions used.

Technological Challenge as a teacher: The teacher stressed the challenges of adaptation to new software and online platforms, and poor internet connectivity. Because of the poor internet connectivity, the learners as well as the educators find it hard to use software and online platforms. In addition, some of the students' output were not delivered to their subject teacher and projects such as video presentations are also a problem for the students in submitting it to their instructors online.

Technological Challenge as students: The teacher observed the challenges of students on the difficulty of students who don't have gadgets like mobile phone, computer, that will be use to access the learning materials. Also, the internet connection is one of their problems especially for those students who are living in the far-flung areas.

General Solutions: The teacher cited the solutions such sending of learning materials when internet connection is good during midnight, and administrators' assistance in delivering modules. For students, they keep finding place for a good internet connection and devised ways to submit their project using external hard drive and CDs.

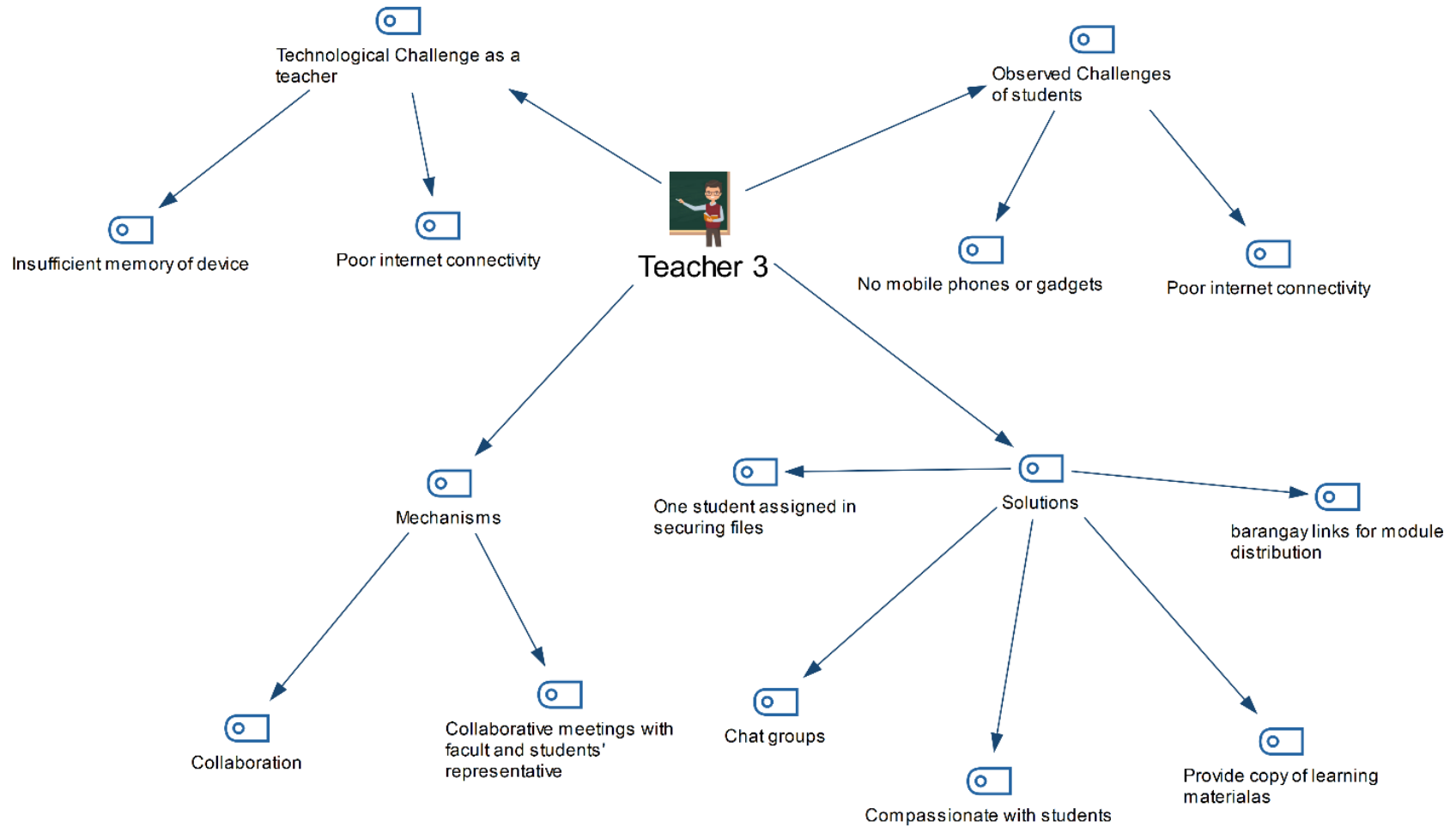


Fig. 4. Technological challenges of teacher 3

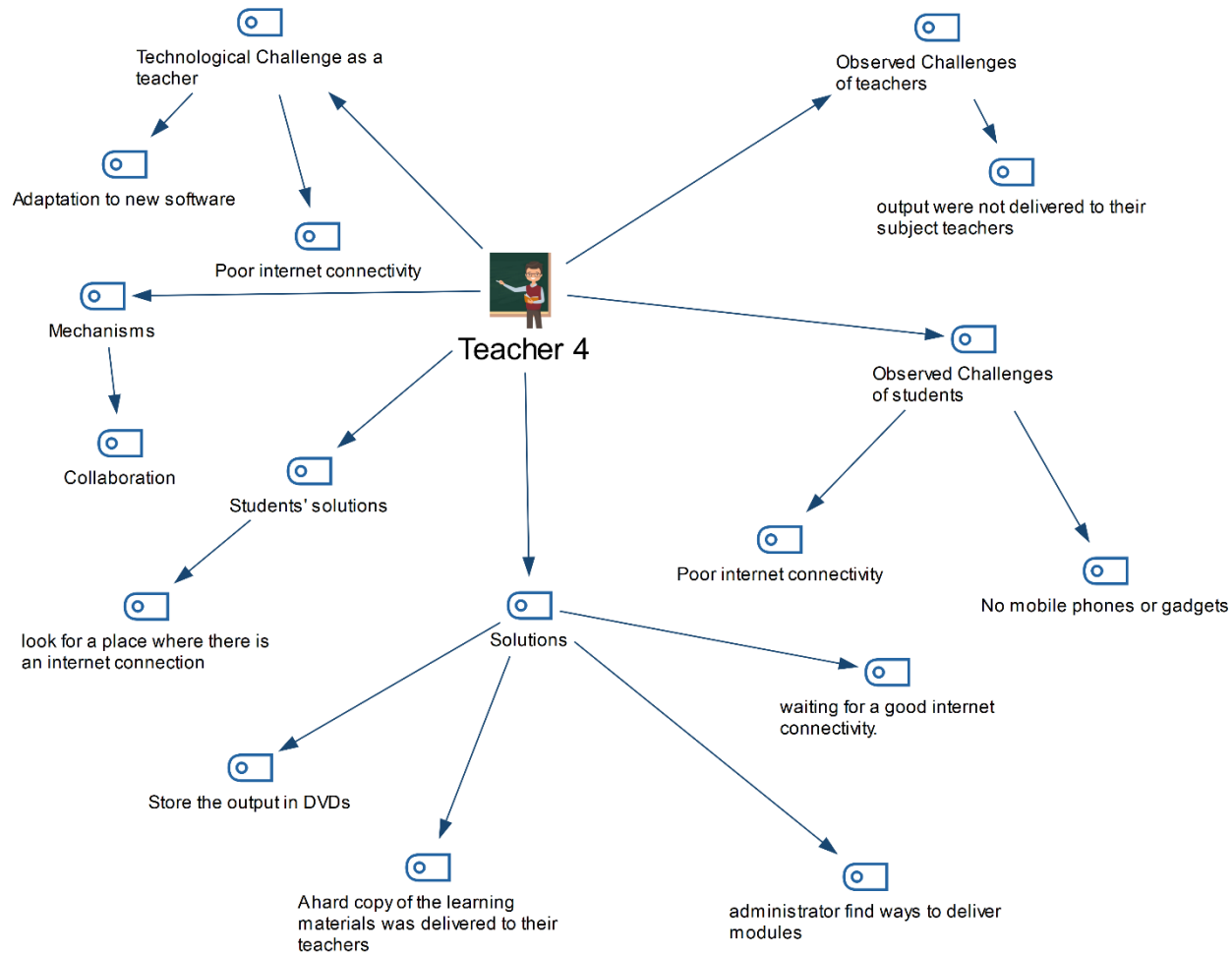


Fig. 5. Technological challenges of teacher 4

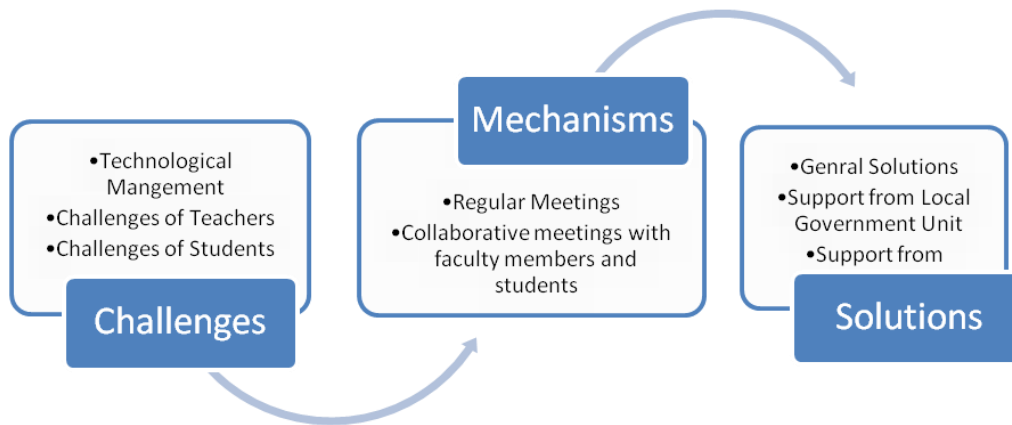


Fig. 6. Model of technological management amidst pandemic

Mechanisms: The teacher stressed the significance of collaboration with faculty members and students in addressing the challenges amidst pandemic.

In the study of Nolasco (2021), the college instructors encountered creating modules to comply with the government's order that classes be conducted virtually make it more difficult for educational systems to support these teachers by giving them access to enough materials, tools, and technologies; proper training; and a form of expressive emotional reinforcement [10].

4. DISCUSSION

The study revealed the various problems faced by both teachers and pupils, as well as the technological challenges the division faced that had an impact on the management of the department head. Responses to these challenges include general solutions, alumni support, and stakeholders' collaboration. To come up with solutions, a mechanism is used, such as faculty collaboration meetings with students and regular faculty meetings. Fig. 6 showed the model that was developed in managing technological challenges, as well as the mechanisms that were used to obtain the solutions.

In the study of Karakose et al. (2021), It has been discovered that school administrators embrace digital transformation and technology-based professional development in schools as a means of fostering a digital learning culture [11].

Technological management challenges of the department head: The engineering department

recognizes the challenges of technology during the time of pandemic as follows.

1. Planning. Planning is difficult since using an online flat form to communicate teachers and students appears to be difficult during a pandemic owing to a slow internet connection.
2. Executing. Due to the department's two primary courses and a shortage of teachers, scheduling tasks is challenging.
3. Organizing. Due to the department's lack of faculty, it is difficult to appoint someone to carry out the duties and obligations.
4. Controlling. The office struggled with the difficulty of drawn-out resource acquisition processes. Such procedures include bidding and the Project Procurement Management Plan (PPMP).

In the study by Bayo (2019), technology can boost participation and interaction with distant workers and can widen the potential pool of participants who are working and cooperating on projects together through shared data bases, on internal intranets, and the internet [12].

Challenges of teachers: The department stressed out the difficulties of teachers, such as slow internet connectivity, an ineffective purchasing process, a lack of reference books and school supplies, difficulty in distributing instructional materials, delays in submitting student work, and adaptation to new software and online platforms. Some students' assignments weren't submitted to their subject teacher, and students have trouble completing online assignments like video presentations. Moustakas and Denise (2022) cited that teachers

were reported having trouble inspiring their students, particularly when there was no visual connection [13].

Observed challenges of students: The department has cited that students' difficulties include a lack of or an absence of personal computers, mobile phones, or other technology, a lack of laboratory facility, a lack of adequate internet connectivity for downloading course materials, and a lack of memory on their devices. The home learning setting posed the biggest challenge for the students, whereas technical knowledge and competency posed the least difficulty [14].

General solutions: The department responds to management issues by properly delegating authority and requesting the administration for budgetary support. The best way to combine synchronous face-to-face classes with limited students was to use a modular approach to instruction, which was essential for addressing problems with lecture content. Instead of submitting requirements online, students were advised to submit and store files via external hard drives, CDs, and hard copy modules.

Support from alumni: The department emphasized the important contributions from all stakeholders, particularly the financial support from alumni, considered to be the ideal solution.

Support from local government unit: Barangay and municipal links for module distribution, chat groups for student consultation and tutorials, and collaboration with other teachers were also mentioned as additional solutions. Most importantly, kids' success in learning depends on teachers' compassion for their needs.

According to Wiesner and Lan (2008), complex technology solutions will be needed to address the difficulties that global societies face. A significant increase in knowledge is anticipated, which could result in new technology to address global issues [15].

4.1 Mechanisms

To address the challenges faced by the school, it is important to note the mechanisms utilized in providing solutions to respective problems.

Regular meeting: The significance of collaboration with faculty members thru sharing

of ideas in addressing the challenges amidst pandemic.

Collaborative meetings with faculty members and students: This is significant in addressing challenges faced by teachers and students to work collaboratively for students' effective learning.

5. CONCLUSION

The study is grounded on the challenges faced by teachers and students of the engineering division and highlighted the mechanisms used in finding the solutions. The study used maxQDA software in the analysis of responses to develop a model based on the existing practices of an engineering division. This model includes mechanisms to address the technological challenges like regular meetings and collaborative meetings with teachers and students. These practices address the technological challenges on management, teaching, and learning. The school must embody key characteristics to face all challenges and must start with collaboration among the teachers and students before extruding to collaboration with external stakeholders like alumni and local government units. This study further showed the effect of poor internet connectivity, thus school administrators should look into the need providing internet connection in the campus for teachers needs in providing effective instructions. According to Kamal, T. and Illiyan, A. (2021), cited to persuade educational institutions and policymakers to improve the quality of online instruction using the most up-to-date teaching methods, along with government assistance in developing rural areas, bridging the digital divide, and improving basic infrastructure and internet connectivity to increase the success and acceptance of e-learning [16].

The results further showed the challenge in adapting new technologies like software and online platform intended for learning of students. In this regard, the department should look into capacity building and in house training through innovations in terms of methods of teaching, and update with the trend of technology. According to a study, technology needs to be introduced in classrooms via a creative mechanism [17]. The head of the division must be supportive of the teaching needs of the staff which results in good relations and collaboration of subordinates and students. Lastly, lecturers must be compassionate to teaching to address the

learning needs of students and consider methods like video clips, tutorial sessions, and consultation.

Higher education lecturers can adapt the model to address the challenges they are encountering in their classes and see how these model could be further improved looking on factors like trainings and seminars, capacity buildings, and update of new technology in a digitalized environment. Kapur (2022) cited, seminars and workshops have benefited students and the educational system as a whole [18].

Since the study used a small sample, future researchers can adopt the methodology of the study using a bigger sample.

6. RECOMMENDATIONS

The following recommendations are forwarded:

First, the researchers advise using the characteristics, best practices, and processes of the engineering division in a challenging circumstance like this pandemic, particularly the collaboration between staff, students, alumni, and local governing bodies and the encouragement of strong school and community relationships.

In addition, challenges of students are encouraged for further studies.

CONSENT

As per international standard or university standard, Participants' written consent has been collected and preserved by the author(s).

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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APPENDIX

Interview Questions for Department Head:

Research Questions	Interview Questions
1. What were the technological management challenges encountered by the lecturers	What were the Technological Management challenges that you encountered as Head of the Department in terms of planning, organizing, executing, and controlling? Are there specific challenges you observed as encountered by the teachers? What about the technological challenges for students? In as much detail as possible, can you explain these challenges?
2. How did the teachers and students respond to these challenges?	How did the teachers respond to these technological challenges? How did the students respond to these technological challenges?
3. How did the teachers and administrators come up with the mechanism used in achieving the solutions to the technological challenges faced?	How did you come up with a solution to these challenges? What are the reasons behind the solution? How and who was involved in this process of identifying this solution? How did you implement the solution, and who was involved? Did the solution address the problem as implemented? During the process of implementation, is/are there any other problem that arises? What is it? And what have you done to solve it? What one of the solutions that you think is the best among the other solutions and why?

Interview Questions for Teachers:

Research Questions	Interview Questions
1. What were the technological management challenges encountered by the lecturers?	What were the technological management challenges that you encountered as a teacher in the context of the time of pandemic? What about the technological challenges for students? In as much detail as possible, can you explain these challenges?
2. How did the teachers and students respond to these challenges?	How did you respond to these technological challenges? How did the students respond to these technological challenges? How did the administrator address these challenges?
3. How did the teachers and administrators come up with the mechanism used in achieving the solutions to the technological challenges faced?	How did you come up with a solution to these challenges? How did your administrator come up with a solution to these challenges? What are the reasons behind the solution? How and who was involved in this process of identifying this solution? How did you implement the solution, and who was involved? Did the solution address the problem as implemented? During the process of implementation, is/are there any other problem that arises? What is it? And what have you done to solve it? What one of the solutions that you think is the best among the other solutions and why?

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