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Difficulties of Senior High School Science, Technology, Mathematics and Engineering (STEM) Students in Research

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Abstract:
Research is considered to be the most important output of the students. In present day research is required not only in tertiary education but also in senior high school. This study aims to identify the difficulties encountered by senior high school STEM students in doing research. The study is primarily based on the theory of challenge and support which explained that the two factors need to be balanced to attain the students' personal development and growth.Utilizing content analysis as a design and latent analysis in analysing data, four categories of difficulties are identified in the study include paper-related, research partners, advisee to adviser, and personal issues and hindrances. Findings reveal that the most difficulties are searching for related literature, cooperation and participation, teacher's schedule, and poor time management. This study helps raise teachers' awareness on the common difficulties of students in doing research. Some recommendations are made to help the students in addressing the difficulties found in this study.

Keywords: *content analysis, difficulty, research, Science, Technology, Engineering and Mathematics, Senior high school.*

INTRODUCTION

Research is an extended form of text that requires time, effort, and critical analysis that is done by the author. It is a journey exploring issues that add not only to the author's experience but also to the reputation of the society and school community [1]. Research is an academic activity that requires a process of inquiry and investigation where authors search for new ideas and concepts, prove it to be true and become a fact [2].

Academically, research is an output that both the graduate and undergraduate students are required to do in able to obtain the degree. Teachers are also required to do research especially in the higher learning institutions as one of the major tasks aside from teaching and community service [3].

Teachers and students (graduate and undergraduate) around the world encountered difficulties in doing research. Undergraduate students in Zimbabwe experienced difficulties in conducting research such as lack of interest, experience, time, money, library resources, internet facilities, computer literacy, and workshops [4] [5]. Similar problems also encountered by the students in Libya [6], Pakistan [7], and Iran [8]. Likewise, graduate students also experienced difficulties in research like in Ghana and Iran they experienced difficulties in access to scholarly literature, accessibility of supervisors, and giving feedback [9] [10].

Similarly, teachers also experienced difficulties in research like in Turkey such as foreign language problems, data analysis, research publication, research collaboration, and reaching international resources [11].

In the Philippines, teachers also experienced difficulties in doing research like lack of time, training, interest, funds, institutional support, topics, mentoring, no solid foundation in research, reading habit, financial gain, internet access, fears of rejection and in English, and laziness [12].

The Philippine educational system today shifted into K to 12 Curriculum where research is required to senior high school students. The government thinks that through this curriculum the economic status of the country will change. The curriculum composed of different tracks and strands and one of it is the Science, Technology, Engineering, and Mathematics or STEM. STEM is the powerhouse of

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the K to 12 Curriculum and this will be a place for the next generation's researchers.

Senior High School is seen by the Philippine government to be the solution to the problems of the economy. Senior High School Education aims to prepare the students to either career or college.Because of the new system of education, the government will be able to produce more knowledgeable, trained and skilled learners that can compete in the global arena.

From the literatures gathered the researchers prompted to conduct study about the difficultiesencountered by senior high school students in research since research is new in their curriculum.

OBJECTIVE OF THE STUDY

The purpose of this study was to identify the difficulties encountered by STEM students in making or doing research.

METHODS

Research Design

This study was conducted using content analysis approach which aims to analyse the information given by the participants of the study. Content Analysis is a process of interpreting messages from different forms of communication whether it is written, verbal, or non-verbal [13]. This approach as a research method is an organized and objective means of describing and classifying events [14]. With the approach of Content Analysis, words can be, possibly, classified into fewer content-related categories. By classifying words into categories, the content may be different in words but shares the same meaning [15]. Content Analysis is a research approach that provides replicable and valid inferences from the content to their context. The aim of the Content Analysis Approach is to make a solid and wide description of the observation. The result of this approach is groups or categories that describe the observation.

Research Setting

This study was based on qualitative data from STEM students in four Secondary Schools in Laguna, Philippines. The four schools were composed of two public and two private and pioneered in offering STEM Education in Laguna.

Data Collection

This research was focused on all of the Grade 12 Senior High School Science, Technology, Engineering, and Mathematics (STEM) Students of four schools in Laguna. All of the 191 participants shared their own experiences and difficulties in research. In this study we conducted one day seminar in research. All senior high school students were required to attend as advised by the Principals.

After the seminar, we distributed bond papers to all the participants and we asked them to write down their difficulties encountered in doing research. At first, we informed them that any information gathered from their answers were became part of our study so that we can collect honest answers. Participants were given five minutes to write their answers. After all bond papers were collected, they were given the choice to remove their papers to guarantee voluntary participation and no one did.

The instrument of this study was made up of only one question with a purpose of identifying the difficulties encountered by senior high school STEM students in doing their research, no validation was necessary.

After the data analysed the results were shared with all the participants. The study would be shared with the principals involved in the study so that they could share the results to the teachers of research to easily address the difficulties of the students.

Data Analysis

In analysing the data given by the participants, we decided to use Latent Analysis. Latent Analysis focuses more on the deeper or underlying meaning of the data or words given by the participants. It is the process of analysing the hidden meaning of the data given by the research participants. We categorized the data or content given by the participants and we grouped the data accordingly.

RESULTS AND DISCUSSION

Thousands of responses were given by the participants. The researchers narrowed their responses as the Difficulties in Research encountered by the STEM students. These difficulties are further divided into 4 categories: (1) Paper-related, (2) Research Partners, (3) Adviser-to-Advisee, and (4) Personal Issues. We decided to discuss only top five subcategories in every category. The table presents the number of responses given by the participants for each of the category.The number of participants is not equal to

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the number of responses because the students gave more responses to the question. The subcategories in every category were ranked and discussed.

Table 1 show the 14 different subcategories under the category of paper-related difficulties. Paper-related difficulties divided into 14 subcategories. The first subcategory is *searching for information needed for review of related literature.* STEM students had hard time finding suitable information for review of related literature. STEM students find it difficult because they cannot access online journals that can be used to their research. They cannot find suitable information that can be used to support their research or study. They also had this difficulty because they do not have enough technological resources to use in searching for information for the Review of Related Literature. They both do not have a laptop or computer and internet access to use.

Other researches have proven that students encountered such difficulty because of the limited access to online journals, research journals, articles, and other online resources [2]. It is also caused by the topic's narrowed source for this part of the research. One of the researchers said that most of her students have this kind of difficulty because of the same reason. They were not able to find suitable information for their study.

The second subcategory is *conceptualizing topics or titles for research.* This difficulty was encountered by STEM students due to lack of background in making research. Most of the participants responded that they fail to generate a specific topic for their study. They cannot make a substantial topic for their research because they do not have any prior experience in making research. Another reason is that they cannot have a concise topic and they have troubles in narrowing the topic they have chosen. The school library also lacks information that is reliable and useful for their research because the research they are working on is focused on innovation and experimentation.

According to the previous research, students have failed in deciding and writing a thesis statement that will serve as their study [2]. They also failed on figuring out the main focus or objective of their study [16]. It also results from limited research in the library that will serve as their guide to conceptualizing topics [17].

The third difficulty that STEM students have encountered is *selecting and finding appropriate respondents.* This difficulty resulted from the students' challenge in determining the sample and selecting the site of the study they are about to conduct. They cannot choose their respondents because the criterion for selecting is very specific. They hardly selected the respondents in accordance with the criteria of their research. The STEM students cannot use under qualified respondents because this will result in a problem later on the process of their research. The students also reasoned out that it is hard to choose respondents because of the transportation from one respondent to another. They also had troubles in communicating with the respondents because of the age gap between the STEM students and the respondents.

Previous researchers also found out that this difficulty is also a result of their lack of social skills especially on interpersonal relationship with the respondents [18]. They also had a hard time to interrogate the respondents because of the ethical consideration needed for their study. Some of their questions were too sensitive and might cause an emotional attack on the respondents [19]. It is caused by the demographics and culture of the respondents. Selecting and finding respondents is hard for them because of the respondents' location. They had to travel and that cost them too much for transportation.

The fourth subcategory is *searching for Theoretical Framework suitable for the study.* Most of the STEM students find it hard to look for a theory that will support their study. STEM students said that they cannot find an appropriate theory because of the criteria for choosing the Theoretical Framework. The students said that the theory should be at least 5 to 10 years published online or else it should be rejected. STEM students explained that the theories should also be related to their studies and should be able to support the research throughout the process. They also said that they could not choose an appropriate theory because they are too lazy to read articles and theories that are available on the internet.

This is supported by a study that found out that students rely only on a few theories that can be easily found on the internet [20]. They did not try to dig deeper into the online journals available on the internet. They fail to make Theoretical Framework because they often use only one or two sources as their supporting literature [21]. They cannot find the right theoretical framework because they were not able to access the journals that require payment

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from the researchers [4]. Moreover, the fact that only few theories were suitable for their experimental research adds to this difficulty.

Table 1.Paper-related Difficulties in Research.

Paper-related Difficulties	School A	School B	School C	School D	**TOTAL**
1. Searching for Related Literature	40	27	14	6	**87**
2. Conceptualizing topics or titles for Research	17	1	1	9	**28**
3. Selecting and Identifying Respondents	16	-	2	3	**21**
4. Searching for Theoretical Framework	12	-	5	2	**19**
5. Looking for appropriate materials, equipment, tools for Experimental Research	9	7	1	1	**18**
6. Developing the Product or Output	10	4	1	-	**15**
7. Gathering Data	5	4	-	5	**14**
8. Meeting the Deadlines	4	1	-	2	**7**
9. Revising the Research Paper	5	1	1	-	**7**
10. Citing references for Bibliography	3	-	1	2	**6**
11. Analyzing the Data gathered from the Respondents	4	0	0	1	**5**
12. Interpreting the Data and Making Conclusions	2	-	-	1	**3**
13. Constructing the Background of the Study	-	1	1	-	**2**
14. Developing a Questionnaire or Research Instrument	1	-	1	-	**2**
Total	**128**	**46**	**28**	**32**	**234**
Total number of Participants	**88**	**55**	**20**	**28**	**191***

**Note: The number of responses is not dependent on the number of Participants.*

Looking for appropriate materials, equipment, and tools needed for Experimental Research is the fifth subcategory. STEM students from the four schools were assigned to conduct Experimental Research even though the school lacks equipment and tools that are appropriate to use for Experimental Research. It is hard for a researcher to conduct research that requires tools that is exclusive to use inside the laboratory. They also spent too much to find the appropriate materials for the machine they have been working on.

Supported by a study, the problem is that the school cannot provide this materials and tools that the researcher needs to use [2] [4]. It delays the researcher's process and limits the study to be successful.

Table 2 show the 10 different subcategories under the category of research partners' difficulties. The first subcategory is C*ooperation and Participation.* STEM students find it hard to make the research because most of the members of the group do not cooperate with the group. Some students said that the absences of their groupmates are the main reason for the stagnant development of the research. They also said that lack of cooperation and participation in the meeting makes them encounter problems with due dates.

It was proven on research that students find it hard to make research because of groupmates' lack of cooperation and participation [22]. The students believe that to achieve successful research they have to work together as a team. Lack of Cooperation and Participation hinders the students to meet the goals and schedule set by the whole group. Making the research alone will never be effective especially when the time comes that the presentation of their study.

Procrastination is also a factor that adds to the difficulties the STEM students are experiencing. Laziness or Procrastination is a behaviour or attitude of unwilling to work on something that will benefit him or the group he belongs to. STEM students were not able to finish their research on time because some of their research partners are so lazy. The lazy members would always play games and absent the meeting of the group to meet their girlfriend or boyfriend. The other members think that this causes them to spend time on waiting for the lazy members, which delays them on working with the research.

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Researchers from other country said that students experienced that some of their groupmates are very lazy and irresponsible for their actions [4]. Most of those lazy students rely on or depend on those who perform beyond their limits. This is one of the major reasons why the group is suffering in deadlines or submission of the paper. The lazy students prefer to play games or check on their social media rather than helping their other groupmates on writing their research [23] [24].

The third subcategory for Research Partners Difficulties is *Communication.* The groups always had arguments and troubles that result in bigger issues. This makes the group divided into two which is a bad thing in making research. Because groups were assigned by the teacher, the members of the group were arguing with the decisions for the research. The STEM students always argue with others because of their different opinions and beliefs. They cannot make a concise and precise decision for the whole group. Lack of Good Communication makes them delay their work because they will always argue with each other.

If Good Communication will be gone, the group will suffer more to make successful research. Teamwork depends on the communication that happens inside the group [25]. If this will be disregarded by the members, the target or goals might not be met by the members themselves. This may result in poor performance not only in research but also to other academic matters.

Time Management is another subcategory that ranked fourth among the ten subcategories of Research Partners Difficulties. The students have failed to manage their time in making research because of other problems they have. Problems such as other subjects also demand time for projects and assignments, procrastination due to games and social media, school activities that require the attendance of the students, suspension of classes due to bad weather.

Researchers said that these problems, such as procrastination and interrupted schedule, are some of the major reasons for the delay in making the research [26]. Poor Time Management is also caused by the irresponsible attitudes of the students [24].

The fifth subcategory is *Financial Support.* The research paper is an academic activity of inquiring information of a certain problem and finding answers for the problem. Although this is only a task given by a teacher, Research requires a lot of effort not only educational effort but also financial effort. Students should provide every single need in the research even it talks about financial support from them.

This result is supported with a study saying that there is a problem in supporting the research financially the students also needs support from their parents [4]. They said that they are also depending on the financial support of their parents and it is limited because there are different expenses in able for their families to survive their daily lives.

Table 2.Research Partners' Difficulties in Research.

Research Partners Difficulties	School A	School B	School C	School D	**TOTAL**
1. Cooperation and Participation	41	27	1	6	**75**
2. Procrastination	46	11	5	3	**65**
3. Communication	21	6	7	9	**43**
4. Time Management	12	16	1	3	**32**
5. Financial Support	16	4	-	-	**20**
6. Priorities or Personal Affairs	4	12	2	-	**18**
7. Distance of Groupmates' Houses	9	4	-	1	**14**
8. Research Skills and Knowledge	7	4	-	2	**13**
9. Attitudes and Personality	6	1	4	2	**13**
10. Focus and Concentration	-	1	1	1	**3**
Total	**162**	**86**	**21**	**27**	**296**

Table 3 show the 9 different subcategories under the category of adviser-to-advisee difficulties. The first subcategory, *Teacher's Schedule,* is about the research time spent by the students with their teacher or adviser. The teacher and how she spends her time affect the students' progress in research. The teacher also had other school commitments and activities that require her presence which affects her time with the students and their research. The teacher also had prior meetings that cause her to not to attend her class and guide the students in making

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research. STEM students also mentioned that their teacher or adviser has too much work loaded for her; it causes the students to suffer in making research successful.

According to other researches, the students had a hard time on the teacher's schedule for consultation [27] because the teacher is absent in their class or have prior commitments that cannot be delayed. These result to delay of the progress of the students' research [2].

The teacher has *high expectations* and standards. This is the second subcategory that explains why the student feels anxious or afraid to approach their research adviser. They feel like they will fail once they went to their adviser. The students were traumatized of the teacher's high standards and expectations which lead to the low academic performance of the students. It has been a problem of the students for a very long time.

A study has found out that the teacher has high expectation to the point that she even corrects even the smallest errors of the paper [27].

The third subcategory is *Pressure on Deadlines*. This subcategory discusses how the teacher put too much pressure on the students with the deadline given to them. The students feel too much pressure on the deadlines given to them because the teacher gives the time that is too short. They are pressured because the research teacher gives only one day to make a chapter that should be done for a month. Research is done for a certain amount of time. One year is the least amount of time that should be allotted for making the whole research paper.

Other researchers from abroad explained that the time allotted for making chapters of research is too short, which causes stress and anxiety for the students [4].

Teacher or Research Adviser has *unpleasingattitudes and personality* is the fourth subcategory. The students experienced a situation that is very traumatizing for them. Situations such as the teacher threw a paper to their faces; the teacher disesteemed them in the front of the class, and more.

Researchers said that the unpleasing attitude of the teacher is the reason why the students were afraid to approach their research adviser [29]. It is not helpful to students because the teacher's attitude and behaviour affect the students' perception and attitude towards school and education [30]. This will also result in poor academic performance and the slow progress of the students' research.

The next subcategory is the teacher has *other priorities and personal affairs.* This subcategory explains the reasons for the teachers' absences in class meetings and research consultation. Teachers also have their personal affairs that cannot be suspended or postponed.

Personal affairs like daily check-up for pregnant teachers, private family affairs, and more [4]. The teacher is also a mother and a person that has other things to do. They are not committed only to their school works but also to affairs that are related to their personal lives. Time is really hard to manage for a teacher especially when you are a research adviser.

Table 3.Adviser-to-Advisee Difficulties in Research.

Adviser-to-Advisee Difficulties	School A	School B	School C	School D	**TOTAL**
1. Teacher's Schedule	73	31	10	7	**121**
2. High Expectations	30	6	3	6	**45**
3. Pressure on Deadlines	27	12	-	1	**40**
4. Teacher's Attitudes and Personality	28	1	-	-	**29**
5. Teacher's Priorities and Personal Affairs	3	19	1	1	**24**
6. Teacher's encouragement, motivation, and guidance	12	5	1	-	**18**
7. Teacher's Research Skills, Knowledge, and Experience	13	1	-	-	**14**
8. Teacher's Interest	5	-	-	2	**7**
9. Teacher's favoritism	2	1	2	-	**5**
Total	**193**	**76**	**17**	**17**	**303**

Table 4 show the 13 different subcategories under the category of personal issues or hindrances in doing research. This category refers to the issues that STEM students have which are personal, or problems within self. The students should know

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what the problems they have within themselves are. The first subcategory to be discussed is *Time Management.* Students already know that they have poor management of time that causes the delay or slow progress of their research. Poor time management is very common for students because they failed to use their time wisely. Time management is very crucial for students especially in Senior High School and College. Senior High School STEM included a subject, called Work Immersion that requires students to immerse or experience jobs that are connected to their strand. This causes them to worry about their time management because their duty in Work Immersion is a minimum of eighty hours to a maximum of one hundred and sixty hours. It is very crucial for the students to manage their time because of the workloads received from the school.

A study supported this result and concluded that the students failed to set a schedule that plots all of their works and assignments [4]. Students experienced this kind of difficulty because all of the other subjects, including research, are equally demanding for time [27].

Financial Support, the second subcategory, is about how money affects the students' performance in making research. As what has been mentioned in the Research Partners Difficulties, Supporting the students financially is the parents' duty but the students should take responsibility on how to spend it wisely. It is the duty of the students to manage the financial support received from their parents. Students also lack financial management because they would rather buy things that would feed their emotions and attitudes. Things that are not in immediate use should be set aside and they should prioritize what is needed at the moment that is an opportunity cost. The students should realize what things would be useful and not.

Researchers have found out that financial support is a very important factor in the academic success of students [4].

The third subcategory, *Laziness*, is also mentioned in this category - "Personal Issues". STEM students admit that they are lazy. What they do not know is that Laziness has a great impact on the performance of their research. It would have a great impact on the attitudes of their groupmates. It will also contribute to the negative perception of students towards Education.

It is supported by a study and explained that procrastination or laziness can affect everyone that is involved in making the research [4] and in the process of Education.

The fourth subcategory is *Research Skills, Knowledge and Experience.* The STEM students are true to their selves that they are lacking skills, knowledge, and experience in writing research. This issue is a result of the teacher's lack of research skills and knowledge. They were not able to research on their own because they do know what to do. The students depend on what the teachers can teach them and what they can learn for their selves. As what have mentioned earlier, research skills and knowledge is essentials to make research successful.

Other research said that students lack skills that are essential to making research [31]. The students cannot make research without the guidance from their research adviser.

Another issue is *Technological Resources*, which discusses the limited resources of the students. Resources like Laptop, Computer, Desktop, and other technology used in research is very limited among the students. These resources are very expensive and only few can afford these. STEM students explained that these resources are very limited to them. A group only have one laptop for the whole group. Since the group decided to divide the works to the members of the group, it will be easier but the problem is the only one can use the laptop. Division of labour is great management for the team it only happened that the resources of the team are very limited. This causes them to delay the progress in writing research.

It is supported with a study and concluded that the resources the students use in writing research affect their performance in making research. If one resource is not available, it may affect the student's performance [4].

Table 4.Personal Issues or Hindrances in Research.

Personal Issues or Hindrances	School A	School B	School C	School D	**TOTAL**
1. Poor Time Management	31	47	-	8	**86**
2. Financial Support	41	10	4	5	**60**
3. Procrastination	28	8	3	11	**50**

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4.	Research Skills, Knowledge, and Experience	27	2	7	6	**42**
5.	Technological Resources	15	13	2	-	**30**
6.	Internet Access	19	8	-	-	**27**
7.	English Grammar	17	1	1	4	**23**
8.	Workloads from other subjects	5	14	1	1	**21**
9.	Priorities and Personal Affairs	6	12	1	1	**20**
10.	Emotional Incapacity	10	4	1	4	**19**
11.	Focus and Concentration	7	4	2	1	**14**
12.	Motivation	5	-	2	-	**7**
13.	Social Skills	2	1	-	-	**3**
	Total	**213**	**124**	**24**	**41**	**402**

CONCLUSION AND RECOMMENDATION

This study has presented four major categories of difficulties encountered by senior high school STEM students in doing research and these are paper-related, research partners, advisee to adviser, and personal issues and hindrances. In every category five subcategories has presented. For paper related difficulties searching for related literature, conceptualizing topics or titles for research, selecting and identifying respondents, searching for theoretical framework, and looking for appropriate materials, equipment, and tools for experimental research were the major difficulties. For the second category, the difficulties were cooperation, procrastination, communication, time management, and financial support. For the third category, the difficulties encountered were teachers' schedule, high expectations, pressures on deadlines, teachers' attitudes and personality, priorities and personal affairs. Lastly, for the fourth category the difficulties were poor time management, financial support, procrastination, research skills, knowledge and experience, and technological resources.

Time has a very big impact on the performance of the STEM students especially to projects that are allotted with limited time such as research. For the students, they should learn to manage their time to make their research successful. The students should learn to be productive and motivated in making the research. The school and the teacher should, at least, teach the students on how to manage their time and be productive at the same time.

The Department of Education should consider revising the curriculum implemented in Senior High School. The time that is allotted for making research should be lengthened. Making research should start from the second semester of Grade 11 until the second semester of Grade 12. The title proposal of the thesis should be set in the middle of the second semester of Grade 11. The students might be able to make a research that is valid and supported by other studies that can be found online. The change of time limit from 8 months to 12 months can be helpful for the students. With the additional 4 months, the students will be able to make research with ease and no time pressure.

The school, especially the research adviser, should constantly monitor the research of the students. The teacher or adviser should monitor the research without putting pressure on the students. The teacher should plot a schedule of checking of the papers. The schedule should be strongly followed by the students and theteachers. The teacher should give a clear instruction with this schedule because this will be the basis of the students' progress in research. Monthly monitoring of the research would be a great schedule for all of the groups and for the teacher.

The research teacher or adviser should teach all the processes needed for the research. STEM students are very dependent on what they are taught. Some students are not familiar with making research that is why it is necessary for the teacher to teach everything to them.

STEM students should propose research topics that are economical and time-bound. In Experimental Research, the students should consider the materials and equipment needed for the topic they are about to propose. The students should also consider the laboratory tests needed for the study. The students should also consider the time

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that is needed for the research. They should propose research that is possible to be done within a year.

Research is a very important output of STEM students. It will be the students' greatest contribution to the school and to the whole research community. In addition, if the STEM students encountered difficulties in making Research, these difficulties should be confronted and corrected right away to prevent it from growing into chains of problems and difficulties. Students can conquer these difficulties with the help of the school, teachers, and research adviser.

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