

## **Secondary school students' attitudes and practices toward research writing and reporting in science**

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This study aimed to explore and analyse the perceptions, attitudes, and practices of secondary school students toward research writing and reporting in science. Fifty-three Grade Eight students from a private school in the Philippines were purposively chosen to serve as respondents in this research. Data collection was done in two ways: (1) self-administered survey questionnaires and (2) a small focus group discussion to elucidate dominant themes that surfaced in the survey responses. Statistics such as percentages, frequencies, and means were used to summarise information gathered from the questionnaire. Significant differences in mean scores were determined using t-test. Correlations of variables were examined using a Pearson correlation test. Results show that the majority of students have no prior experience in writing formal research papers or laboratory reports. Nonetheless, the respondents considered research to be relevant in developing critical thinking, solving real-world problems, and providing a sense of fulfillment. Key motivations in doing research include teachers' expectations, and the personal drive to grow, excel, and obtain good grades. Reported barriers to research included lack of time, insufficient background in research, and lack of resources. As this study presents relevant information about students' perspectives toward research it can be used by teachers, administrators, and other stakeholders for planning, instruction, and follow-up interventions.

### **Introduction**

Research is crucial in any science, technology, engineering, and mathematics (STEM) curriculum. This is reflected by the increasing attention given to research instruction in international science curricula (Vossen, Henze, Rippe, van Driel & de Vries, 2018). Research as a discipline focuses on acquiring and developing knowledge which can be employed in categorising, describing, explaining, evaluating, correlating, comparing, predicting, and controlling situations, phenomena, and other observations (Walliman, 2011). It is closely linked with the development of students' mental ability to gather, filter, and use information (Emsen, Kilic & Suran, 2011).

Equally important as writing is the ability to effectively communicate complex concepts and processes. Haworth and Garrill (2003) underscored the significance of verbal communication among scientists who are expected to share their knowledge in events such as lectures and conferences. Studies have also shown that communication skills are crucial in the sciences and are important in reflecting the cognitive abilities of adolescents (Anderman & Sinatra, 2012). Science communication can also ease the tension between science and society (Holliman, 2005). Indeed, research widens the perspectives of students and develops their understanding and awareness about science and engineering (National Research Council, 2012; Vossen et al., 2018).

In the Philippines, the K-to-12 basic education curriculum emphasises the development of scientific literacy among students (Department of Education, 2013). Scientific literacy is intertwined with the goal of deeply understanding the nature of science (Glaze, 2018). The current science curriculum aims to develop the scientific literacy of its junior high school students through scientific investigations (Department of Education, 2013).

However, issues and concerns in teaching and conducting research are present across the different levels of the K-to-12 curriculum. In a study conducted to explore students' perception of their science classes, Bernardo et al. (2008) discovered low student perception of scientific inquiry activities. Scientific inquiry activities examined in this study included activities that promote scientific inquiry and thinking skills such as laboratory exercises and doing scientific research projects (Bernardo et al., 2008). Other studies also indicate that there is an emerging trend among students to express negative attitudes towards science and technology as they progress in secondary school (Vossen et al., 2018).

Students in more advanced levels also encounter obstacles that thwart the conduct of their own research. For example, AlGhamdi et al. (2013) discussed how barriers such as lack of training, poor access to databases, scarce funding, and lack of time hinder senior medical students from pursuing and undertaking research. Moreover, writing, in general, is sometimes seen by students as a difficult task, a struggle, and a chore to be accomplished (Magulod, 2018; Pablo & Lasaten, 2018). Because of these negative views about doing research, there is a danger of regarding the entire research process as difficult and impractical. In fact, a number of studies have claimed that students feel they lack the skills to seek information, that they exert minimum effort on assessing sources, and they equate inquiry with simple collation of facts about a topic of interest (Hongisto & Sormunen, 2010).

Opportunities and challenges in scientific research writing and reporting in junior high school are varied. Just as in any academic program or initiative, awareness of the learners' context is vital in improving practices and addressing concerns in research. It was noted that students' interest and values influence their attitude towards doing research (Emsen, Kilic & Suran, 2011). Thus, efforts to better understand students' appreciation of research should be given support and attention.

The present study looks into how Grade Eight junior high school students in the Philippines view research activities such as writing and reporting. Results obtained from this research may benefit students, teachers, and administrators by providing insights that can help in formulating strategies to strengthen current teaching and curriculum related to undertaking research projects. Specifically, this study aimed to answer the following questions:

- RQ1: What are the perceptions, attitudes, and practices of the participants toward research writing and reporting?
- RQ2: What motivates the participants in doing research activities?
- RQ3: What are the common challenges or barriers experienced by the participants in doing research?

## Method

This research followed a mixed-method design. Fifty-three students from two Grade Eight sections of a private school in Laguna province participated in this study. These classes were both handled by the teacher-researcher. The respondents were aged from 13 to 15 years at the time of this study, and were commencing a general science subject that followed a spiralling curriculum. In a spiral curriculum or spiral progression approach, students revisit the concepts and skills at each grade level with increasing depth (Ferido, 2013).

The participants had previously performed a "coffee-cup" calorimetry experiment. For this task, they were divided into nine groups with three to four members each. The results of this laboratory activity were reported in a research paper and were presented through an oral presentation to class.

Quantitative and qualitative data were collected, respectively, using a questionnaire and during a small focus group discussion. The questionnaire, adapted from van Aalderen-Smeets and van der Molen's (2013) *Dimensions of Attitude toward Science* (DAS) instrument, was given individually to all the respondents after obtaining their informed consent. The DAS instrument consisted of seven subscales which include relevance of teaching science, difficulty of teaching science, gender-stereotypical beliefs regarding teaching science, enjoyment in teaching science, anxiety in teaching science, self-efficacy, and context dependency. In this study, only four of the seven subscales (self-efficacy, relevance, anxiety, and enjoyment) of the DAS instrument were adapted and contextualised for the purposes of this research. The questionnaire comprised five sections which sought (1) socio-demographic information including gender, age, and prior experiences in research writing and/or reporting; (2) personal views and attitudes regarding the conduct of research, especially in the natural sciences; (3) personal and group practices when performing experiments, writing research papers, and presenting results; (4) students' motivation in conducting research; and (5) the obstacles that they encountered during the entire research experience and the challenges that they might face in future research endeavours.

The second, third, and fifth sections of the questionnaire used a 5-point Likert scale (1=strongly disagree, 2=disagree, 3=neutral, 4=agree, and 5=strongly agree). The scale items in these three sections had Cronbach alpha values of 0.76 (13 items), 0.80 (five items), and 0.72 (five items), respectively, indicative of acceptable internal validity. A total of 23 items were answered using this 5-point scale. Tables 1, 2 and 4 show the items included in the second, third, and fifth sections, respectively. The fourth section included a checklist of all possible motivations that the students had in writing and reporting their research paper. Open ended questions were also employed in the first and fifth sections.

Three students from each of the two sections were invited to participate in a small semi-structured focus group discussion. This small focus group aimed to examine their attitudes, beliefs, and experiences regarding the conduct of research. Unfortunately, conflicts in scheduling allowed only three of the invited students to participate. They will

be referred to as P1, P2, and P3, respectively. None of the focus group participants had prior experience of formal research writing in science.

Responses to the questionnaire were summarised using statistics such as frequency, range, percentage, and mean. Significant differences between mean scores were analysed using *t*-tests. A Pearson correlation test was used to measure the relationship or association of variables.

Necessary permits, clearances, and consents from the school administrators, parents, and respondents were secured prior to the conduct of this study.

## **Results and discussion**

This study was conducted in the last two quarters of School Year 2018-2019. The demographic profile of the participants indicates that 53% of the respondents were male while 47% were female. The majority (72%) of them mentioned that they have limited or no experience in formal research writing in science. Those who had prior exposure to research writing reported that they encountered it in their previous schools. Despite not being required to submit the same research requirements, the rest of the respondents mentioned that they had been taught and given similar tasks which involved gathering of information, writing, and reporting.

### **Perceptions, attitudes, and practices of students toward research**

Students agreed that research is important in developing critical thinking skills and in solving real-world problems. The majority of the students (75.5%) indicated that their research activity helped them understand the topic more. During the small focus group, P1 expressed that “research is good for an individual because when you start typing and writing the research paper, you get to understand more what you are writing.” This was supported by P2’s statement that “the (research) activity was able to help us (them) understand the topic at our (their) own pace.” This is consistent with Papanastasiou’s (2005) findings with a group of students who indicated the relevance of research in personal and non-academic lives as factors in their attitude towards research. Habineza (2018) also noted the same attitude among undergraduate students in Rwanda. These students underscored the usefulness of research and indicated a positive predisposition towards it. Table 1 summarises the responses of the participants to questions regarding their perceptions and attitudes toward research.

The benefits of conducting research across all levels have been supported by a number of existing studies. Jiang and Roberts (2011) found that students perceived research as a new way of learning which they described as active and challenging. Research enhances students’ understanding of their own learning process and to see nuances in other research designs (Jiang & Roberts, 2011; Madan & Teitge, 2013). Doing research allows one to engage in a systematic way of addressing issues or concerns, by gathering information and discriminating findings that are deemed relevant to the study’s objectives. Developing this sense of judgement is critical in problem-solving and decision-making in

science (Marchaim, 2001). Moreover, Ketelhut (2007) enumerated how scientific inquiry-based activities helped in posting gains in concept attainment and learning retention among students. The present study corroborates with these findings with 75% of the respondents indicating that their research activity had helped them to understand the topic better.

Table 1: Overall mean scores of students' perceptions and attitudes toward research (N=53)

Factor	Survey items(a)	Mean(b)	SD
1: Self-efficacy	1. I am well able to deal with the expectations of the research paper	3.5	0.8
	2. I have enough knowledge of the topics being explored in the research paper	3.7	0.7
	3. I have a sufficient command of all the materials needed to finish the final paper	3.6	0.8
2: Perceived relevance	4. I believe that research writing must be included in earlier years of science high school curriculum	3.8	1.1
	5. I think that research skills are important for students' development	4.4	0.7
	6. I think that research will help students in solving real-world problems	4.3	0.7
	7. The activity helped me appreciate/understand the topic more	3.9	0.7
	8. The activity allowed me to think critically	4.1	0.7
3: Anxiety	9. I feel tense whenever we have a research writing activity	3.8	1.0
	10. I feel nervous reporting the result of our science experiment	3.9	0.8
4: Enjoyment	11. I feel happy whenever I write research paper	3.0	0.8
	12. Writing and reporting a research paper makes me feel more enthusiastic	2.9	0.8
	13. Research gives me a sense of fulfillment	4.0	0.9

(a) Adapted from van Aalderen-Smeets and van der Molen (2013)

(b) Highest value is 5.00

Beyond the academic world, acquiring research skills is seen to be indispensable, given the complexity of society and the demands to be scientifically literate (Murtonen et al., 2008). Research is considered to be crucial to the economic development of any state and in addressing social, political, religious, and environmental concerns (Garg, Madhulika & Passey, 2018). In the field of education, research is generally considered to foster critical thinking among students. Critical thinking involves the capacity to evaluate information and decide how to deal with it (Lamb, Maire & Doecke, 2017). This sentiment is shared by 75.5% of the respondents. During the small focus group, P3 mentioned that their research activity might "help in future research and other written outputs."

Positive conceptions of research among students might be a good start for future research directions. This should hopefully translate into more positive learning achievements and study orientations. Murtonen et al. (2008) posited that students' beliefs and views toward

research may impact their views of its role in their future careers. Positive attitudes also boost resiliency among students until they accomplish the tasks assigned to them (Habineza, 2018). Students who were given research tasks before are generally considered to be more prepared for future work (Garg, Madhulika & Passey, 2018).

When asked about whether research writing should be included in junior high school science classes, the overall mean recorded was 3.9. Almost 68% of the respondents agreed with this idea. In a similar study conducted among first and second year undergraduate university students, Hromova (2018) discovered that almost half (27 out of 58) were willing to join future scientific projects. This positive attitude towards research may be construed as the consequence of previously mentioned positive conceptions about research and other external factors. Cultural background, as well as pressure from parents, peers, and media, can all influence this understanding (Murtonen et al., 2008).

The average scores for the first three statements shown in Table 1 suggest that students generally consider themselves capable of fulfilling their research objectives. Vossen et al. (2018) noted the same observations among Dutch secondary school students, who rated themselves high on self-efficacy when doing research.

Despite the above-average means for self-efficacy, respondents in the current study scored 3.79 when asked if they feel tensed whenever writing a research. Two-thirds of the participants (68%) also felt nervous when they presented their reports before an audience. Given that the majority of the participants had no prior experience in research writing and presentation, these observations are not surprising.

When students are faced with new and challenging materials, stress levels, anxiety, and uncertainty may be triggered (Papanastasiou & Zembylas, 2006; Oguan et al., 2014). Several reasons have been advanced for this increased anxiety, including the amount of workload and difficulty in the materials covered (Oguan et al., 2014). When research activity involves peer-reviewing and receiving of negative reviews, emotional stress sometimes bothers the students and lowers their confidence level to the point of giving up (Hromova, 2018).

When their anxiety levels were compared, results suggest that girls felt more “tensed” and “nervous” compared to their male counterparts. Unpaired *t*-tests revealed significant differences (at  $p < 0.05$ ) between male ( $M = 3.7$ ,  $SD = 0.8$ ) and female ( $M = 4.1$ ,  $SD = 0.58$ ) students' research anxiety,  $t(51) = -1.7$ ,  $p = .04$ . A significant difference was also observed between male ( $M = 3.9$ ,  $SD = 0.5$ ) and female ( $M = 4.3$ ,  $SD = 0.6$ ) students with regard to their view on the relevance of research,  $t(51) = -2.3$ ,  $p = .01$ . These values corroborate with earlier studies by Oguan et al. (2014) and Vossen et al. (2018), who have reported higher levels of research anxiety among females. Vossen et al. (2018) have also observed that girls scored significantly lower than boys in the sub-categories future and relevance of undertaking design activities. In an earlier study, Desy, Peterson and Brockman (2011) observed that middle school and high school students in the US still show gender difference with regard to attitudes toward science. Barmby, Kind and Jones (2008), on the other hand, have mentioned that the difference in the attitudes toward

science of female and male Year 7 students was small and became more pronounced later on as the girls' attitude declined more as they moved to Year 9. In terms of scientific data gathering, Ketelhut (2007) has noticed that the effect of gender on scientific data gathering is insignificant at earlier levels but showed noticeable difference in time. These gender differences in anxiety levels among students have been linked to a variety of factors including gender roles, biological stress reactivity, and cultural influences (Hosseini and Khazali, 2013).

A Pearson correlation test at .05 significance level revealed a weak positive correlation between self-efficacy and relevance of research ( $r(51) = .44, p < 0.01$ ), between self-efficacy and enjoyment ( $r(51) = .52, p < 0.01$ ), and between the perceived relevance of research and enjoyment ( $r(51) = .41, p < 0.01$ ). Students' research practices was positively correlated to their perceived relevance of doing research ( $r(51) = .65, p < 0.01$ ), their self-efficacy ( $r(51) = .44, p < 0.01$ ), and enjoyment ( $r(51) = .44, p = 0.03$ ). A negative correlation ( $r(51) = -.29, p = 0.03$ ) was found between self-efficacy and barriers to research. No significant correlation was noted between the barriers and motivations in research. Describing the relationship of these factors and how they affect each other could help the students in fostering more positive attitudes toward research, improving their research practices, and overcoming barriers to research. Previous studies have illustrated the importance of these factors in students' science achievement in general. For example, Juan, Hannan and Namome (2018) found a positive relationship between Grade 9 South African students' self-efficacy and science achievement. In another study, Agranovich and Assaraf (2013) mentioned the importance of science to be a factor influencing students' interest in the subject. Students' enjoyment also plays a crucial role in learning and has been found to help in the didactic process, in the retention of information, in learning, and in generally feeling good during meetings (Hernik & Jaworska, 2018).

In terms of their research practices, the respondents valued collaboration. Despite some group concerns such as difficulty in communication, they viewed themselves as generally collaborative and regarded this attribute to be valuable in their task. In a study among undergraduate students in a comprehensive university, Tan (2007) has indicated that lack of support from unmotivated groupmates became a source of frustration. In general, this frustration was not seen among the respondents. They, in fact, rated themselves above-average for group efficiency. This may be attributed to their high regard for group collaboration. Personally, the respondents tried to be present and to cooperate in all meetings and group work. Table 2 presents how students rated their practices toward research.

### **Students' motivations to do research**

Good grades topped the list of students' motivations to do research. This was followed by teacher's expectations and personal drive to excel at 67.9% and 66.0%, respectively. Table 3 summarises other motivations stated by the respondents.

Table 2: Students' belief about research practices (N=53)

Research practices	Mean	SD
My team was able to work efficiently	3.8	1.0
For me, it is important that my teammates are collaborative and efficient	4.6	0.6
My group mates helped me all throughout the activity	4.0	0.9
I tried to contribute and be present in all meetings and group work	4.5	0.7
My group made me realise the importance of collaboration	4.4	0.8

Table 3: Students' motivations to do research (N=53)

Motivation to do research	Responses %
Good grades	86.8
Teacher's expectations	67.9
Personal drive to excel	66.0
Training for future research	56.6
Influence from parents	28.3
Motivation from peers	22.6
Others	13.2

The idea of grades as motivation for students has been affirmed and challenged by earlier studies. Chamberlin, Yasue and Chiang (2018) indicated that grades do not increase academic motivation but instead heighten the anxiety levels of students. In contrast, Reddan (2013) has argued that in their experience, grading a previously non-graded course resulted in positive effects on student motivation, sense of achievement, and overall enjoyment.

Results also suggest that teacher's expectations motivated the respondents to complete their research project. This is consistent with what the Education Commission of the States (2012) said about the effects of teacher's expectations on students' performance. In addition, Sakiz (2015) has showed that teachers' affective and mastery-oriented behaviours can influence students' achievement.

When it comes to their personal motivation to excel and develop themselves, several studies have shown that intrinsic motivation help students achieve more, lower their anxiety levels, and engage them in learning (Saeed & Zyngier, 2012). This might have also affected the respondents' attitudes toward research. This can be gleaned from the responses of P3: "...my two other siblings have done researchers before. I want to have the same, if not better, quality. I can keep improving."

### Common barriers to research

Challenges encountered by the respondents when doing their research task included lack of time, lack of previous experience in research writing, and the difficulty in looking for available resources. These barriers are not new in the field of research. Hongisto and Sormunen (2010) have mentioned the same categories of problems faced by students in their first research paper.

Table 4: Reported barriers to research (N=53)

Problems encountered in research	Mean	SD
Lack of time	3.5	1.1
Lack of training or exposure to research writing	3.3	1.1
Difficulty in looking for available literature/resources	3.2	0.9
Poor accessibility to resources	2.9	1.1
Unavailability of technological support (e.g. laptops, Internet, etc.)	2.6	1.3

Lack of time is the most apparent concern expressed by the respondents. As mentioned earlier, the majority are first-time research writers who have not had exposure to formal research writing. Because of this unfamiliarity, more time was needed for the students to pace themselves in the process. P1 also mentioned difficulties in choosing the right words for their paper. "Our vocabulary is not yet developed. So the way we wrote the research paper was not yet professional in level."

In addition, students also reported that they found it difficult to look for related literature or resources. During their research project, the majority of the respondents used online resources such as web pages and online articles. It might be the case that they shared the same concern as students in the University of Nigeria who lacked appropriate browsing skills to collect information (Ugwu & Orsu, 2017). Discerning which among all available resources were useful for their own research paper might have been a challenge for most of the participants, especially as the majority of them were given this task for the first time. Just as in any other skill, data gathering, writing, and presenting are essential skills which require time in order to develop.

## **Conclusion and recommendations**

This study examined the attitudes, perceptions, and practices of eighth grade students toward understanding research. Addressing the research questions, respondents expressed positive perceptions of the importance of research yet also scored high in terms of research anxiety. For them, collaboration and personal commitment were critical for the success of any research endeavour. With regard to their motivations, the participants reported that good grades, teachers' expectations, and personal drive to excel drove them to finish their research paper and reporting. However, several barriers such as lack of time and lack of prior experience in research may hinder them in accomplishing these tasks.

These results present several key points that could be taken up for further discussion. For example, a cross-sectional analysis among cohorts can be done in order to observe differences and similarities among students in all high school levels. Comparative studies among schools are also recommended for confirmation and/or validation. When giving students instruction on research, teachers might consider designing and evaluating classroom activities that help in minimising research anxiety, such as regular classroom reporting and constructive peer critiquing. Parents, school administrators, and other stakeholders can all contribute to attaining these goals by fostering a learning environment that promotes scientific inquiry and the right attitudes to succeed in such endeavour.

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