PROJECT i-CREATE (Intensive Collaboration through Research Enhancement and Advancement Training and Exercise): DIRECTION TOWARDS IMPROVED SCIENCE RESEARCH PROGRAM AT SAN PABLO CITY SCIENCE INTEGRATED HIGH SCHOOL

FRANZ KEVIN B. MANALO
ORCID: 0000-0002-7113-9494
franzkevin.manalo@deped.gov.ph
Department of Education, San Pablo City Science Integrated High School
Division of San Pablo City, Philippines

ABSTRACT

Science investigatory projects (SIP) provide students the opportunity to apply their gained knowledge, skills, and attitude (KSA) in Science. This study aimed to implement an intervention program called Project i-CREATE (Intensive Collaboration through Research Enhancement and Advancement Training and Exercise) at San Pablo City Science Integrated High School on school year 2019-2020. Moreover, it attempted to investigate its perceived effectiveness as to learning outcomes and explore the students' lived experiences. Explanatory sequential design was employed. Survey-questionnaire was used as the main instrument to describe the students' perceptions. This was administered among 90 respondents who were selected purposively. Mean and standard deviation were computed to analyze the data. Results showed that the students improved their KSA, developed 21st century skills, and became more motivated and interested. Furthermore, a Focus Group Discussion (FGD) was held among select participants to gather their lived experiences in conducting SIP as exposed to the intervention program. Thematic analysis was used to derive emerging themes such as (1) SIP provides opportunities for improvement and development; and (2) SIP entails challenges such as lack of resources and lack of training that hampers its success. Consequently, there was an increase in the number of science research projects produced, colloquia and forums conducted, partnership, publication, and winning in local science fairs signifying the success of the intervention program. Project i-CREATE helped to develop young researchers and improve the schools' science research program. Its implementation may be further strengthened through identifying other areas of development and opening its channels for benchmarking.

Keywords: action research, project i-CREATE, science research, science investigatory project, San Pablo City Science Integrated High School

INTRODUCTION

Science is the cornerstone of national development and economic progress. It enables the application of scientific knowledge to further improve the quality of life and attain sustainable development. The Science Curriculum of the Enhanced Basic Education Act of 2013 asserts that learners shall develop scientific literacy to recognize the role and function of science in a real-life setting. The Constitution of the Philippines highlights the role of science and technology to achieve growth and advancement, hence, it shall be inculcated among citizens of the nation. As stipulated in Article XIV, Section 10, the State shall give priority to research and development, innovation, and invention in which science acts as the underlying pillar (Philippine Constitution, 1987). In this regard, science research sets a major role for efficiency, productivity, and innovation in the society (NEDA,

2017). Science research directs a new paradigm of the 21st century to embrace the advancement and address the challenges of the Fourth Industrial Revolution era in creating innovative landscapes needed in the different facets of society such as education, economy, business, and environment. Hence, the curriculum that shall take place in the science classroom shall be anchored on the principles of relevance, responsiveness, and research (Republic Act No. 10533, 2013).

Learning science is experiential and applies scientific inquiry. It is more than just defining facts, identifying concepts, and memorizing terms. Its main goal is to put the learning discipline in an applicable and practical setting to empower lives, conserve the environment, discover novel things, invent, and innovate products and processes, and enable technological advancement. Science research plays an important role to unlock these potentials, thus, it shall be cascaded into the basic education curriculum so learners at their early age can appreciate science. The national research goals embedded in the Basic Education Research Agenda of the Department of Education (DO No. 39, s. 2016) states that science studies should be integrated in teaching and learning process such as instructional material development, community contextualization, and project-based learning. Therefore, science research has been incorporated in the basic education curriculum. The Junior High School offers this as an elective subject in Special Science Curriculum (SSC) and Science, Technology, and Engineering (STE) programs while the Senior High School offers this in the Inquiries, Investigation, and Immersion (3I's) subject for Science, Technology, Engineering, and Mathematics (STEM) strand. Therefore, conducting science investigatory project (SIP), a project-based learning approach allows learners to utilize process skills, do investigation and solve a problem in the community. Its integration in the curriculum develops curiosity and inquisitiveness leading students to make valuable impacts in the community and enrich their scientific understanding.

The Department of Science and Technology Science Education Institute (DOST-SEI) and the University of the Philippines National Institute of Science and Mathematics Education (UP NISMED) upholds science research projects such as SIPs as means to develop science-inclined individuals who manifest scientific attitudes, apply concepts and skills to solve real-world problems, and value science as instrument of societal development. Conducting science research projects foster public sense of awareness and appreciation of invention, innovation, and discoveries towards improved quality of life (DOST-SEI & UP NISMED, 2011). These investigative projects are effective methods of allowing students to redirect their perspectives to connect in the real-world views and help to formulate solutions on community problems (Autiere, Amirshokoohi & Kazempour, 2016).

Science investigatory projects (SIPs) provide students the practical experiences of a scientist who follows scientific method in conducting investigations and explorations within an area of inquiry. Doing SIPs is a good training ground to make contribution to the body of knowledge, generate beneficial impact to the community, and create new inventions – all for the gains and advantages of mankind (Lebednik, 2016). Science research, as it aids in the development of Science and Technology, reflects the significance of livelihood, environment conservation, and sustainable progress. Therefore, conducting SIP helps learners to become problem-solvers, critical and creative thinkers by immersing themselves in a problem-based tasks, authentic learning activities, and inquiry-based investigations. This enables them to translate their inquisitiveness into ideas to ask questions, formulate hypothesis, do experiments, and verify the truth (Sambeka, Nahadi & Sriyati, 2017). Studies revealed that the students improved their self-efficacy and developed 21st century skills such as collaboration, problem-solving, and critical thinking when they were exposed to problem- and project-based tasks like SIPs (Gomez, 2013).

San Pablo City Science Integrated High School is a public secondary science high school which offers research subject in its curriculum.

Students undergo different stages of learning to learn the basic concepts and process skills, and manifest scientific attitudes. They are exposed to investigative works leading them to craft research proposal, do experimental procedures, and make the final output (K to 12 Curriculum Guide in Research, 2017). Students are tasked to create and design SIP to complete the course. After which, they participate in question-answer activities such as colloquium and conference to showcase their scientific knowledge and communicate their significant findings. There are various organizations, both public and private, which hold events to encourage students and advisers to exercise collaboration, communication, and presentation of SIP. For many years, the school has already produced a few research projects and presented them in conferences, local and abroad. However, same problems and difficulties have been experienced by students and advisers. Common scenarios included lack of funds to do the laboratory tests, lack of laboratory facilities and equipment to perform the needed experiments, and lack of sustainable programs to improve the research competence of students. These challenges hamper the quality of research outputs and impeded the overall success of students' undertaking.

Thus, this study was conducted to implement an intervention program called Project i-CREATE (Intensive Collaboration through Research Enhancement and Advancement Training and Exercise) at San Pablo City Science Integrated High School on school year 2019-2020. This program aims to foster partnership and linkages among stakeholders, implement sustainable training and workshop to enhance students' research competence, and manifest collaborative and integrative learning across subject areas. The learning gains and challenges encountered in conducting SIP have not been widely explored. Hence, this study also attempted to determine the perceived effectiveness of Project i-CREATE as to learning outcomes and explore students' lived experience when exposed to the intervention program. This helps to deliver deeper understanding on how science research contributes to one's development and address recurring problems.

OBJECTIVES OF THE STUDY

This study aimed to implement an intervention program called Project i-CREATE (Intensive Collaboration through Research Enhancement and Advancement Training and Exercise) at San Pablo City Science Integrated High School on School Year 2019-2020.

In accordance, it sought to fulfill the following specific objectives: 1) Determine the respondents' perceived effectiveness of Project i-CREATE as to learning outcomes; 2) Probe the students' lived experiences in conducting science investigatory project when exposed to Project i-CREATE; 3) Ascertain how the Project i-CREATE improved the science research program of the school in terms of success indicators.

METHODOLOGY

This study made use of Explanatory Sequential Design, a type of Mixed Methods Research. This design begins with gathering and interpreting quantitative data followed by the collected and analyzed qualitative data. Qualitative results strengthen the quantitative results (Creswell & Creswell, 2017). The respondents of the study were ninety Grade 10 students from San Pablo City Science Integrated High School during the School Year 2019-2020. They were chosen through purposive sampling. Researcher-made survey-questionnaire regarding the effectiveness of Project i-CREATE in terms of learning outcomes was used as the main instrument of data collection. This was subjected to content validation from five experts and specialists in the science research and education field. The said tool was administered to the respondents to gather relevant data. Prior to the data collection, a letter of permission was submitted to the school head to inform on the purpose and nature of study. Pertinent research protocols were followed. Data confidentiality and person's anonymity were ensured, and ethical policies were adhered too. Descriptive statistics such as mean and standard deviation were

computed to analyze the data and determine the verbal remarks for each numerical datum. On the other hand, 10 participants were selected from the pool of respondents to be part of the Focus Group Discussion (FGD). This was held to determine the lived experiences of participants when exposed to Project i-CREATE. Thematic analysis was used to analyze the data. The documented responses were transcribed, coded, and clustered. Then, emerging themes were derived. Furthermore, the increase in different indicators were counted and compared to the accomplishments of the previous school year. These included the number of science research projects produced, colloquia and forums conducted, partnership, publication, and winning in local science fairs. Such served as the bases of success of Project i-CREATE.

RESULTS AND DISCUSSION

1. Perceived Effect of Project i-CREATE as to Learning Outcomes

Majority of the respondents marked *Strongly Agree* in 9 out of 10 indicators. These indicators were attributed to the statements focusing on the improvement, development, and enhancement of students when exposed to Project i-CREATE. The respondents strongly agreed on the statements stating that they improved their knowledge and skills in doing SIP; become innovative and resourceful; developed effective communication skills in writing and speaking; became more motivated and eager to finish their tasks; became collaborative to work well with others; understood science concepts better; became more persistent to finish SIP; manifested critical thinking in making reasons and judgments; and became more curious and inquisitive towards things in the environment. This implies that Project i-CREATE helped students to develop their research competence and enhance their motivation. These manifestations of effectiveness adhered to the learning outcomes that we want to develop and inculcate among learners in line with the thrusts of science learning and doing project-based approaches.

Table 1

Respondents' perceived effectiveness of Project i-CREATE as to learning outcomes

	Statements	M	SD	V.I
1	I improved my knowledge and skills in doing science investigatory project	3.68	0.47	SA
2	I enhanced my laboratory skills in conducting experiments and investigations	3.20	0.68	A
3	I became innovative and resourceful in doing science investigatory project	3.36	0.61	SA
4	I developed effective communication skills to express my ideas in writing and speaking	3.28	0.59	SA
5	I became more motivated and eager to finish science investigatory project	3.27	0.58	SA
6	I became collaborative to work pleasantly with others	3.30	0.45	SA
7	I understood science concepts better involved in science investigatory project	3.35	0.45	SA
8	I became more persistent in finishing science investigatory project	3.51	0.55	SA
9	I manifested critical thinking in making reasons and judgments	3.26	0.62	SA
10	I became more curious and inquisitive towards things in the environment	3.33	0.63	SA

The conduct of SIP enriches learners to become problem-solvers, critical thinkers, and creative thinkers as they venture themselves into the terrains of investigation and experimentation (DOST-SEI & UP-NISMED, 2011). Furthermore, these students' perceptions were aligned onto the findings mentioned by Weld and Funk (2005) stating that doing SIP is an effective way of learning science research as it develops self-

perceptions of effectiveness among learners. Also, Mintzes (2005) mentioned that learners become more interested in science lessons when facilitated through project-based learning approach. Students are given the opportunities to explore real-life problems and scenarios which improve their enthusiasm towards subject. Additionally, doing SIP enhances students' research skills and contributes to their values formation in which they become resourceful, creative, persistent, and patient. Scientific values are instilled to develop scientist-inspired characters (Sanchez & Rosaroso, 2019). Students broaden their scientific understanding towards their selected science disciplines. They become more engaged, motivated, and eager to do investigations. In line with these key literature and concepts and the results of the students' perception, Project i-CREATE help students to acquire 21st century skills and develop scientific literacy.

Consequently, indicator 2 stating that the students improved their laboratory skills through conducting experiments and investigations received the remark *Agree.* This received the lowest mean perception score among other indicators. This may be attributed to the lack of mentorship from the consultants and supervisors due to the limited schedule that hampers the provision of training and assistance that the students might receive. This resulted to inadequate skills acquired to perform the necessary experiments and laboratory works.

2. Students' Lived Experiences while Doing Science Investigatory Project as Exposed to Project i-CREATE

After collecting the relevant data from the Focus Group Discussion, data were coded, clustered, and analyzed. Two themes had emerged: (1) SIP provides opportunities for improvement and development; and (2) SIP entails challenges that hampers its success.

2.1 SIP provides opportunities for improvement and development

The participants mentioned that doing SIP helped them to appreciate and utilize science in the realms of real-life setting. As students explored their chosen topic, they contextualized it to the needs of their community. The students seek a problem and formulate methods to solve it. In the process of addressing it, they learn essential research skills which are useful not just in school but to deal with the challenges of everyday living. The process of science inquiry serves as important tool to make learning meaningful and valuable for learners, thus, connecting their experiences with daily life events (Setiawan, et. al. 2017). This is anchored on the students' perceptions in the survey-questionnaire indicators 1 and 7 as they improved their knowledge and skills in doing SIP and understood well the science concepts involved mainly in their research projects.

"Conducting SIP makes me realize the importance of science. Research projects allows me to put my gained knowledge and skills in application particularly in solving problems." (P4)

"SIP serves as a platform to view science in different perspectives. I learned to realize the importance of science, especially when I applied what I have learned in different situations in life." (P7)

Science education aids in the development of 21st century skills. Students are equipped with such needed skills to gain competitiveness in the globalization era and attain inventive thinking, effective communication, and high productivity (Turiman, Omar, Daud & Osman, 2012). Since SIP is taught as a project-based learning that is a student-focused pedagogy, it involves a dynamic approach in which learners acquire critical knowledge through active exploration of real-world problems. In connection thereto, the participants heralded that SIP concentrates on developing 21st century skills leading to improved critical thinking, creativity, collaboration, and communication. Students become knowledgeable in science concepts, inventive in formulating solutions, supportive to work harmoniously with others, and competent to

share their projects. Moreover, science research can be more relevant and interesting if the learning process adheres to experiential learning where 21st century skills are utilized and developed (Ocon, 2012). This is anchored on the students' perceptions in the survey-questionnaire indicators 3, 4, 6, and 9 as they perceived the development and improvements of skills centering on critical thinking, collaboration, creativity, and communication.

"I pushed myself to be creative and innovative in making relevant approaches in our SIP. I managed to work well with others, especially in performing our tasks, talking to people from higher offices, and collaborating with our consultants and supervisors." (P1)

"I become more rational and critical in making decisions and developing ideas. I think reading and writing related literature help me to develop my thoughts and insights." (P6)

"I was a bit hesitant and timid before. But through exposing myself to SIP especially during colloquiums, I develop my communication skills that allow me to express myself more." (P9).

Doing authentic and challenging tasks has been linked to increase students' engagement. As it promotes learning autonomy, science learning activities like conducting SIP fosters positive impact among students as it develops self-regulated motivation (Hattie, 2012). The participants stated that they became motivated and determined to finish their investigative projects. The drive comes from the support given by families, teachers, school, and consultants. And since the school provides support and assistance through the intervention program, students became eager and persistent to finish their SIP. Students' engagement and motivation in science learning activities yield commitment to goals and aspirations which are essential to meet success (Reeve, 2012). This can be attributed to the results of students' perceptions in survey-questionnaire 5, 8, and 10 in which students perceived that they became persistent, motivated, and curious which enable them to finish their investigative project.

"I felt enthusiastic to perform investigations since we are given assistance from Day 1 up to the end of our undertaking. We became motivated and eager to finish the task. We are encouraged to make quality outputs which will contribute to improve the community." (P4)

"We are given support in our undertakings in terms of finances, doing experiments, and writing the paper. This encourages us to become better and do a lot more." (P5)

2.2 SIP entails challenges that hamper its success

Resources are essential to complete an output. Just like any other undertakings, SIP needs finances/budget to pay for the laboratory tests and rent facilities. Equipment, tools, and facilities are also required when doing controlled experiments since conducting SIP follows standard procedures and protocols. Though the intervention program offers strategic plans to address the needs for financial and technical needs, still, students were challenged to fulfill the objectives of their study. The demand for resources such as funds and facilities are crucial to research. There were times when students need to repeat experiments and do pre-trial investigations in which funds and facilities were needed already. In this case, the project become too costly and expensive. To address this, students redesigned their procedures and lessened the number of trials. Doing so may affect the quality of outputs in the end (Aedh & Elfaki, 2019). However, such cases may vary among students (Yazgan, 2015) since some students are well-off and can carry the financial needs.

"It became difficult to carry out SIP since our project requires laboratory tests that are so expensive. We needed to adjust our methodologies so not to require much amount. However, it affected the research design and results in the end." (P10)

Adhering on the mean perception score obtained in the survey-questionnaire, the students agreed on Indicator 2 which states that their laboratory skills in conducting experiments and investigation were enhanced. However, this obtained the lowest mean perception. This is anchored on the lack of mentorship provided from the skilled professionals, which is considered as one of the major challenges encountered when doing scientific research (Akyurek & Afacan, 2018). The participants said that they cannot perform well the necessary procedures due to lack of training given by the consultants and supervisors. In the end, the students only learned minimum laboratory skills adequate to finish the experiment, but not fully sufficient to understand better the methods and practice in other investigations. The potential mentors are too busy with their work and have constrained time for consultation. If done so, the consultation only takes only limited time.

"We had a hard time looking for the research consultant who can assist us in doing our experiments. If ever we found one, we made appointments to meet him at consultation period. However, this had not happened easily since our consultant has a lot of works to be done. In the same way, we had problems on how to cope with research activities and school events." (P2)

"We had training before conducting the actual experiment, but I think it is not enough since we are dealing with complex procedures. The lack of sufficient training affected our performance. We committed errors that made us do frequent repetition of methods." (P8)

3. Effect of Project i-CREATE in the School Research Program

An increase in the success indicators was observed during the school year 2019-2020 when compared to the previous school year. From 33 Science research projects produced by the students, it was increased to 37. More students became engaged in undertaking SIP which resulted to additional research projects. This may be attributed to the support system that students received in their scientific undertaking. The number of colloquia and forums conducted also increased. From 4, it became 7.

Table 2

Increase in success indicators comparing the two school years 2018-2019 and 2019-2020

	Success Indicators	2018-2019	2019-2020
1.	Science research projects produced	33	37
2.	Colloquia and forums conducted	4	7
3.	Partnership	5	10
4.	Publication	2	5
5.	Winning in local science fairs	11	17

There were more internal and external conferences held to further enhance the knowledge and skills of students in their chosen fields. Aside from the science and research teachers from the school, experts and specialists from research institutes and higher education institutes were invited to evaluate and review the science research projects of the students. Also, as early as Grade 7, the students were already exposed to such kind of activities to build their confidence, enrich their communication skills, and enhance their scientific understanding. During the Grades 9 and 10, two colloquia were held already – one with internal panelists and one with external panelists. Consequently, the partnership fostered by the school with external stakeholders increased from 5 to 10. Aside from the frequent partners of the school, there were additional institutes and organizations that guaranteed their support. A more concrete memorandum of understanding was created to build stronger partnership and collaboration. Through this, it has become easier for students and advisers to look for possible research consultants and facilities on which the experiments were performed. The number of publication of students in journals increased also from 2 to 5. This was made possible through the help of the research supervisors and consultants. It is eyed that more publications will be yielded in high-impact journals

and international periodicals. Furthermore, the number of winners in local science fairs served also as a strong success indicator. From 11 winnings, it became 17. More students were able to join in local science fair and attained victories. The school has also emerged top places in Regional Science Fair and secured spots in National Science and Technology Fair. It is further looked forward that by the next school years, the school will seize top post in international competitions.

4. Proposed Intervention Program: Project i-CREATE (Intensive Collaboration through Research Enhancement and Advancement Training and Exercise)

Project i-CREATE is an intervention program which aims to support the conduct of science investigatory projects and contributes to the overall success of schools' science research activities. This was developed to enhance the research competence and skills of students through trainings and workshops, foster collaboration among external stakeholders and community to assist the students in their undertaking particularly in the needs of valuable resources such as finances, technical, facilities, and equipment.

The intervention program consists of three underlying strategies: (1) *Adopt-a-Researcher*; (2) *Project ITS (Inform, Talk, Share);* and (3) *CARE (Collaborative Assistance for Research Excellence).* Shown below is the action plan of Project i-CREATE with the identified strategies, objectives, persons involved, time frame and expected outputs.

Table 3

Action plan of the Project i-CREATE

Strategies	Objectives	Persons Involved	Time Frame	Expected Outputs
Adopt-a-Researcher *This is a collaborative act of partnership with different research institutions and human resources. Students are given support on their financial needs in transportation, laboratory tests, and food and printing allowances. Also, students are given technical assistance in experimentation and writing, use of facilities, and topic consultation.*	Assist and support students' financial and technical needs through partnership and linkages	• Research adviser • Students • Alumni • School clubs • Research institutes and HEIs • Private organizations	Whole year-round	Support program for students Memorandum of understanding between school and research institutes
Project ITS *(Inform, Talk, Share)* *This provides trainings and seminar-workshops to help students to enrich their competence. Experts and specialists from research and academic institutions are invited to discuss essential concepts and pertinent topics on research methodology, designing experiments, STEM research, etc.*	Enhance the research competence of students	• Research adviser • Students • Science and research teachers • Experts and specialist	Quarterly	Enhanced research competence of students Quality research outputs
CARE *(Collaborative Assistance for Research Excellence)* *This strategy includes collective efforts of teachers in English, Mathematics, Science, and Research teachers. Teachers work hand-in-hand to enhance students' outputs as to scientific concept, technical writing style, data analysis, and peer reviews.*	Foster collaboration and integration among subject areas	• Research adviser • Students • Science teachers • English teachers • Math teachers • Peers	Whole year-round	Quality research outputs Collaboration and integration across curriculum

CONCLUSIONS

Project i-CREATE improved the Science research program implementation at San Pablo City Science High School. Thus, the following conclusions were drawn:

1. The students perceived Project i-CREATE as an effective intervention program that helped them improve their knowledge, skills, and attitudes. They developed 21st century skills such as critical thinking, creativity, collaboration, and communication. Moreover, the students became more motivated and engaged in conducting SIP. These manifestations of learning gains ensured the acquisition of scientific literacy among learners.
2. Opportunities and challenges were derived as core themes to describe the lived experiences of learners. Students were able to develop and improve themselves by putting their gained learning in application and manifesting 21st century skills. Consequently, challenges had been identified such as lack of resources, training and mentorship which contributed to the inadequate laboratory skill acquired by learners.
3. As observed in the schools' success indicators, there was an increased in the number of science research projects produced, colloquia and forums conducted, partnership, publication, and winning in local science fairs when compared with the previous school year. Project i-CREATE has enabled the school to provide a support system among students in conducting SIP through partnership and linkages among stakeholders, implement relevant training and workshop to enhance students' research competence, and exhibit collaborative and integrative learning across the curriculum.

RECOMMENDATIONS

While Project i-CREATE was found effective to improve the Science research program implementation of the school, the following recommendations were hereby suggested:

1. Strengthen the implementation of Project i-CREATE by adding more strategies that would enhance other areas of development and generate more success.
2. Open the Project i-CREATE for benchmarking of other school to establish District-based and Division-based results.
3. Obtain the self-efficacy of the students in conducting Science research projects.

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AUTHOR'S PROFILE

Franz Kevin B. Manalo is a Science and Research teacher at San Pablo City Science Integrated High School, Division of San Pablo City. At present, he pursues the degree Doctor of Philosophy in Science Education at Philippine Normal University, Manila. He finished the degree Master of Arts in Education major in Science and Technology at Laguna State Polytechnic University San Pablo City Campus in 2019. He has been the Philippine participant to the Southeast Asian Ministers of Education Organization Regional Centre for Education in Science and Mathematics (SEAMEO RECSAM) regular course on Fostering Higher Order

Thinking Skills in Secondary Science Education at Penang, Malaysia in 2018. He has served as a resource speaker, trainer and facilitator in various seminar-workshops and research-related activities on science investigatory projects, action research, pedagogy, and content.

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