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Earth Science Education Research in the Philippines: Insights from Published Scholarly Work (2013–2022)

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Abstract: Addressing many of today's global challenges requires solid understanding of the different geologic processes that operate in and shape our planet. As such, Earth science has been included in the national science standards of many countries, including the Philippines. To describe the status of scholarly work in this discipline, one can draw insights from the systematic analyses of published research outputs, such as journal articles. This paper presents the state of research on Earth science education in the Philippines from 2013 to 2022. Google Scholar searches and a survey of locally published journals yielded 28 open-access research papers for analysis. Inclusion criteria were based on previous bibliometric studies conducted in other subfields of science education. Data collection was accomplished from January to November 2024. Most research studies focus on learning conceptions and adopt a quasi-experimental research design. The most frequently investigated demographic group are high school students and sample sizes vary from 30 to more than 500. Researcher-made tests and questionnaires were widely used as data collection tools, while inferential statistical methods were commonly utilized in data analysis. Implications to Earth science education research and recommendations to expand the scope of similar studies in the future are also discussed.

Keywords: Earth science education; K-to-12 Science; Philippines; publication record; research trend; scientific productivity

Introduction

The demand to strengthen human capital has become more apparent in today's highly competitive and rapidly evolving global community. To achieve individual and collective well-being, students are expected to develop competencies through the acquisition and application of essential knowledge and skills, as well as the attainment of desirable attitudes and values (Organisation for Economic Co-operation and Development, 2018). This highlights the critical role assumed by the education sector in securing the social and economic progress of any country (Campbell, 2006; Ozturk, 2001). Science, Technology, Engineering, and Mathematics (STEM) education, in particular, aims to foster among learners the necessary scientific, technological, and environmental literacies needed to address the challenges of the 21st Century.

One of the components of school-level science is Earth science. This academic discipline delves into our planet's natural history, composition, structure, and processes (Dal, 2009; Orion, 2019). Globally, the placement of Earth science within the basic education curriculum varies. For instance, Earth science, which is sometimes referred to as *Earth and Space Science* or *Earth and Environmental Science*, is integrated within the General Science subject from primary years to junior high school and is taught as a standalone subject at the advanced grade levels (e.g., Grades 10, 11, or 12) in Japan and Iran (Kawamura et al., 2016; Kimiagari & Abedini, 2016). Moreover, the inclusion of Earth science in the curriculum may also depend on the educational policies

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enforced in each state within a country. As an example, Earth and Environmental Science is taught in Australia at the senior level in four states and one territory (McNamara & Nicholls, 2016). In Germany, Indonesia, and the United Kingdom, Earth science contents are integrated in other courses, such as geography (Amijaya, 2016; Felzmann & Hlawatsch, 2016; King, 2016). Meanwhile, other countries have yet to develop their respective Earth science curriculum (Abd El-Maksoud, 2016; King, 2008).

In the Philippines, topics in the Earth and Space Science domain are part of the K-to-12 basic education curriculum mandated by Republic of the Philippines (2013) or the Enhanced Basic Education Act of 2013 (Department of Education [DepEd], 2016a). Subsequent reforms in the country's educational framework led to the current spiral progression approach. This pedagogical model supports continuity and progression in learning, while helping teachers design lessons that can deepen students' thinking skills (Dunton & Co, 2019). Specifically, the K-to-12 Science curriculum employs student-centered and inquiry-based strategies in presenting concepts in chemistry, physics, life sciences, and Earth sciences, with increasing complexity from one grade level to the next (DepEd, 2016a). With regard to Earth science, the current content standards indicate that topics in geology, meteorology, and astronomy are integrated and taught for a quarter within the Science subject from Grades 3 to 10 (DepEd, 2016a). At the senior high school level, Earth Science and Earth and Life Science are offered as a core curriculum subject in the STEM and non-STEM strands, respectively (DepEd, n.d.; DepEd, 2013; DepEd, 2016b).

One of the ways to describe the current state of STEM education is through the systematic review of published research articles in this discipline. As such, bibliometric studies have been conducted in the field of STEM education (e.g., Ha et al., 2020; Irwanto et al., 2022; Lee et al., 2009; O'Toole et al., 2018; Zhan et al., 2022) and, more specifically, in biology education (e.g., Abdullah, 2022; Gul & Sozbilir, 2016; Lo et al., 2019), chemistry education (e.g., Taber, 2019; Teo et al., 2014; Vega, 2024), and physics education (e.g., Bitzenbauer, 2021; Lee & Kim, 2018; Prahani et al., 2022; Yun, 2020).

In the case of geoscience education research, Perkins (2004) represents one of the earliest attempts to document the status of scholarship in terms of teaching, learning, and assessment. Later on, Piburn and colleagues (2011) provided an overview of earlier scholarly outputs, most of which were published from 2001 to 2010 as articles in the Journal of Geoscience Education (JGE), special papers of the Geological Society of America (GSA), or presentations in GSA meetings. Recently, Arthurs (2019) discussed the emergence of undergraduate geoscience education research by examining the literature from 1985 to 2016.

Given that Earth science is now formally integrated in the Philippine K-to-12 Science curriculum, it has become a fertile ground for research studies that may inform not only teachers but also students, school administrators, curriculum designers, and other key stakeholders. However, no bibliometric analysis of Earth science education research has been reported in the Philippines in recent years. A quick search in major databases can likewise attest to this paucity in literature.

Motivated by the above-mentioned research gap, the present study aims to provide an initial survey of Earth science education research in the Philippines through documentary review and analysis of research papers published in reputable academic journals between 2013 and 2022. The inclusion criteria used in identifying qualified research studies were based on earlier bibliometric analyses in biology (Gul & Sozbilir, 2016), physics (Lee & Kim, 2018), and chemistry (Teo et al., 2014) education research. Specifically, these research publications in school-level Earth science education will be described in terms of total number of published studies, year of publication, research topic, research design, research participants, research instruments, methods of analysis, and key research findings.

Method

This study employed a descriptive research design with document analysis as the primary method of data collection. This approach utilizes existing documents for data collection and allows researchers to conveniently and efficiently access information that are pertinent to their studies (Creswell, 2009).

Publications considered in this review are empirical studies on school-level Earth science accomplished in the Philippines and published between 2013 and 2022 in peer-reviewed journals with open-access copies online. These open-access articles should be freely available through the Internet and should not require readers to login or pay any subscription charges (Pandian et al., 2008). The study must have taken place in a school setting, either as part of formal classroom instruction or in other co- or extra-curricular activities, within the context of the K-to-12 curriculum. The main author or at least one of the authors must be affiliated with a Philippine-based institution or organization when the study was published. Commentaries, editorials, position papers, book reviews, concept papers, and non-peer reviewed articles were excluded, as previously done in other bibliometric analyses (e.g., Gul & Sozbilir, 2016; Teo et al., 2014). Research articles on closely related topics such as environmental education, climate change

education, and disaster risk reduction education were further examined if they correspond to contents from the K-to-12 Earth science curriculum. Meanwhile, the chosen timeframe (2013–2022) coincides with the first decade of implementation of said curriculum.

Data collection was carried out between January and October 2024. The study protocol was approved beforehand by the author's faculty development office (Approval Date: January 22, 2024). Google Scholar was used to search for articles with keywords such as "earth science education," "geoscience education," and "Philippines." The rationale behind the use of Google Scholar is the size of its collection and its status as the largest academic database (Crew, 2019; Gusenbauer, 2019).

In addition, online archives of locally published journals were manually searched for qualified articles. This additional step was done to augment the scope of this study and gain additional insights into how Earth science education research has progressed at the local level. To ensure that these journals adhere to the highest standards of scholarship and quality, only those previously recognized by the Philippine Commission on Higher Education (CHED) or those listed in the CHED Memorandum Order No. 50 and 66, series of 2017 were considered. Prior to the manual search, initial appraisal of these journals was carried out by looking into their focus and scope. Journals that are multidisciplinary in breadth and those publishing articles on education, Earth and environmental science, and other related disciplines were examined. Given these parameters, only the following local journals were considered: (1) Asia–Pacific Social Science Review; (2) Asia Pacific Journal of Multidisciplinary Research (continued as Asia Pacific Journal of Management and Sustainable Development since 2021); (3) Bicol University R&D Journal; (4) Journal of Educational and Human Resource Development; (5) Journal of Environmental Science and management; (6) Journal of Science, Engineering and Technology; (7) PRISM; (8) Recoletos Multidisciplinary Research Journal; (9) Science Diliman; (10) The Normal Lights; and (11) The Palawan Scientist.

Information collected from the journals and from Google Scholar searches were filtered, organized, and tabulated based on the established inclusion criteria. Quantitative data describing the qualified research papers were summarized using descriptive statistics, such as frequencies and percentages.

Results and Discussion

Total Number of Qualified Research Articles

The search queries used and the number of documents retrieved from the Google Scholar searches are shown in Table 1. Note that the frequency counts in this table reflect the unfiltered search results. Some titles appeared in more than one of these searches. Duplications within a single search were also present. These duplicates were removed prior to the selection of qualified research articles.

Table 1. Number of documents found per search query

Search Query	Number of Documents in Search Results
intext:"geoscience education" AND "Philippines"	233
intext:"earth science education" AND "Philippines"	99
intext:"earth science" AND "senior high school" AND "Philippines"	220
intext:"earth science" AND "junior high school" AND "Philippines"	231
intext:"earth science" AND "grade school" AND "Philippines"	58
intext:"earth science" AND "elementary school" AND "Philippines"	370

A total of 28 open-access articles appearing in 24 research journals were retrieved for analysis. Eight research papers (29%) were published by Philippine-based institutions and organizations, while the majority (71%) was hosted by publishers abroad. All of the research studies were written in English. Most of them (68%) were authored by two or more researchers. Only one multi-authored article (Crisostomo et al., 2020) had international collaborators based on declared author affiliations in the byline.

Of the 28 research papers included in this analysis, three appeared in the *Journal of Physics: Conference Series*, two in *Psychology and Education*, and one in each of the following journals: *Asia Pacific Higher Education Research Journal*; *Asia Pacific Journal of Education*; *Arts and Sciences*; *Asia Pacific Journal of Social and Behavioral Sciences*; *Asian Journal of Science Education*; *Asian Review of Social Sciences*; *AsTEN Journal of Teacher Education*; *European Scholar Journal*; *Formatif: Jurnal Ilmiah Pendidikan MIPA*; *International Electronic Journal of Environmental Education*; *International Journal of Curriculum and Instruction*; *International Journal of Education, Teaching, and Social Science*; *International Journal of Innovation in Science and Mathematics Education*; *International Journal of Multidisciplinary Research and Publications*; *International Journal of Scientific & Engineering Research*; *International Journal of Scientific Research in Multidisciplinary Studies*; *International Journal of Trend in Scientific Research and Development*; *IOER International Multidisciplinary*

Research Journal; *New Trends and Issues Proceedings on Humanities and Social Sciences*; *Revista Latino-Americana de Educação em Astronomia*; *Romblon State University Research Journal*; *The Normal Lights*; and the *World Wide Journal of Multidisciplinary Research and Development*.

Year of Publication

Table 2 provides the number of Earth science-related research papers published from 2013 to 2022. The year 2022 recorded the highest number at eight research studies, followed by 2021 and 2020, with six journal articles each. Hence, the majority of studies (74%) examined in this paper came from the last three years (2020–2022) of the period covered. A generally increasing trend in publication was noted, particularly from 2017 onwards.

Table 2. Number of published papers per year (2013-2022)

Year	Number of Published Papers	Research Papers Published Per Year
2013	0	--
2014	1	Toledo et al. (2014)
2015	1	Micayabas (2015)
2016	0	--
2017	1	Estacio and Martinez (2017)
2018	3	Arce et al. (2018), Davalos and Malaluan (2018), Quitaneg–Abaniel (2018)
2019	2	Abas et al. (2019), Mamon (2019)
2020	6	Cahapay and Ramirez (2020), Crisostomo et al. (2020), Landicho (2020), Marces (2020), Morados (2020a, 2020b),
2021	6	Acut and Latonio (2021), Estacio and Cornejo (2021), Gabucan and Sanchez (2021), Gumbao (2021), Ramirez (2021), Santiago et al. (2021)
2022	8	Cabalang and Cabalang (2022), Caraig and Quimbo (2022), Conel and Avilla (2022), Salindao et al. (2022), Sy et al. (2022), Taratata–Fadero (2022), Tiria et al. (2022), Ugbamen et al. (2022)
	TOTAL: 28	

Research Topic

The selected publications were categorized according to their research topics. The classification scheme used by Tsai and Wen (2005) and Lee et al. (2009) was adopted for analysis. In their systematic review, Tsai and Wen (2005) examined the trends in science education research published between 1998 and 2002 in three leading academic journals, namely, *International Journal of Science Education*, *Science Education*, and *Journal of Research in Science Teaching*. Lee et al. (2009) published a follow-up study covering the same journals for the period of 2003–2007.

Similar to the procedures of Tsai et al. (2011), the papers analyzed in this study were assigned to multiple categories, when deemed appropriate. For example, the paper of Toledo et al. (2014) which reported the use of media cartoons in teaching Earth and Environmental Science topics to first-year high school students and its influence on the issue resolution skills of learners. This study was coded under "Teaching" and "Learning–Conception" categories. Table 3 presents the number of research studies that qualify under each category.

Table 3. Number of published papers per research topic

Research Topic Categories*	Number of Published Papers	Sample Papers
Teacher Education	0	--
Teaching	9	Toledo et al. (2014), Cabalang and Cabalang (2022)
Learning – Students' Conceptions and Conceptual Change (Learning – Conception)	21	Marces (2020), Conel and Avilla (2022)
Learning – Classroom Contexts and Learner Characteristics (Learning – Context)	9	Caraig and Quimbo (2022), Salindao et al. (2022)
Goals and Policy, Curriculum, Evaluation, and Assessment	1	Crisostomo et al. (2020)
Cultural, Social, and Gender Issues	0	--
History, Philosophy, Epistemology, and Nature of Science	0	--
Educational Technology	8	Gumbao (2022), Tiria et al. (2022)
Informal Learning	0	--

*Note: Based on Tsai and Wen (2005) and Lee et al. (2009)

Research Design

The majority of research studies (41%) included for analysis adopted a quasi-experimental research design. Despite certain limitations, this approach has been employed in the field of education to understand causal relationships between educational practices and student outcomes (Gopalan et al., 2020). This outcome implied that a significant fraction of Earth science education

research in the country focuses on the impact of certain instructional interventions and how they influenced students' learning. This finding is consistent with the earlier observation suggesting that *learning conception* is the most frequently investigated research topic, followed by *teaching* and *learning context*.

Table 4 summarizes the type of research design employed in the published papers based on how they were reported by their respective authors.

Table 4. Number of published papers per research design

Research Design	Number of Published Papers	Sample Papers
Quasi-experimental (*includes "two-group pretest-posttest design," "pretest-posttest control group design," "pretest-posttest randomized group design"*)	11	Micayabas (2015), Ramirez (2021)
Descriptive (*includes "descriptive–survey research method" and "action research design"*)	6	Mamon (2019), Landicho (2020)
Mixed-method research design (*includes "quantitative and qualitative methods of research," "dynamic research design"*)	3	Abas et al. (2019), Ugbamen et al. (2022)
Correlational research design	2	Acut and Latonio (2021), Cahapay and Ramirez (2020)
Case study design	2	Quitaneg-Abaniel (2018), Crisostomo et al. (2020)
Combined descriptive–correlational research design	1	Salindao et al. (2022)
Descriptive and developmental research design	1	Arce et al. (2018)
Nonexperimental, retrospective explanatory research	1	Morados (2020a)
Randomized pretest–posttest control group design	1	Estacio and Martinez (2017)

Research Participants

High school students are the most studied demographic group in Earth science education research in the Philippines. Fourteen (50%) of the research articles focused on senior high school students, followed by junior high school (43%) and first-year college (4%) students. The observed publication frequencies, especially among Grade 11 students (13 research papers), could be attributed to the mandated *Earth Science* and *Earth and Life Science* courses for STEM and non-STEM senior high students, respectively.

Four out of 12 studies involving junior high school students also presented Science teachers as their respondents. Noticeably, no research study among grade school pupils was published. Table 5 displays the number of published papers according to the recruited research participants.

Table 5. Number of published papers based on research participants

Participants or Respondents	Number of Published Papers	Sample Papers
Grade School Students	0	--
Junior High School Students	12	Cahapay and Ramirez (2020), Sy et al. (2022)
Senior High School Students	14	Abas et al. (2019), Acut and Latonio (2021)
College Students	1	Estacio and Cornejo (2020)
Science Teachers	4*	Micayabas (2015), Salindao et al. (2022)

**Note: These research papers also had junior high school students as their study participants or respondents.*

The study of Crisostomo et al. (2020) on astronomy education extracted the needed information from the national curriculum standards and science textbooks used in Japan and the Philippines. Meanwhile, Toledo et al. (2014) examined first-year high school students enrolled in the pre-K-to-12 curriculum at the time of the study. The observed sample sizes varied from 30 to more than 500, as shown in Table 6.

Table 6. Number of published papers based on sample size

Participants or Respondents	Number of Published Papers	Sample Papers
1 to 50	7	Quitaneg-Abaniel (2018), Tiria et al. (2022)
51 to 100	12	Abas et al. (2019), Ugbamen et al. (2022)
100 to 150	3	Ramirez (2021), Salindao et al. (2022)

Participants or Respondents	Number of Published Papers	Sample Papers
More than 150	5	Cahapay and Ramirez (2020), Morados (2020a, 2020b)

Research Instruments

Researcher-made tests (61%) and questionnaires (46%) are the primary data collection tools used in the research studies examined in this paper. Other data sources include students' scholastic records, interview logs, rating scales, and daily lesson plans. Table 7 shows the number of journal articles according to the research instruments utilized. Note that some studies used multiple research instruments during data collection.

Table 7. Number of published papers based on research instruments

Data Collection Tools	Number of Published Papers	Sample Papers
Researcher-made tests	16	Toledo et al. (2014), Cahapay and Ramirez (2020), Conel and Avilla (2022)
Questionnaires/surveys	13	Arce et al. (2018), Gabucan and Sanchez (2021), Taratara–Fadero (2022)
Existing documents (e.g., students' scholastic records)	7	Davalos and Malaluan (2018), Crisostomo et al. (2020), Morados (2020a)
Interviews	5	Marces (2020), Ugbamen et al. (2022)
Daily lesson logs/plans	2	Mamon (2019)
Adapted/adopted tests	1	Micayabas (2015)
Focus group discussion	1	Quitaneg–Abaniel (2018)
Observation form	1	Abas et al. (2019)
Rating scale	1	Abas et al. (2019)

Methods of Analysis

The research papers were classified according to how they processed and analyzed their data. Taherdoost (2020) identified six types of data analysis techniques but underscored the three commonly used methods, namely, descriptive, inferential, and explanatory. The categories reflected in Table 8 are based on Taherdoost (2020) and Çavdar and Yıldırım (2023).

Table 8. Number of published papers based on data analysis methods

Data Analysis Methods		Number of Published Papers	Sample Papers
Descriptive Analysis	Mean, frequency, percentage, standard deviations	14	Toledo et al. (2014), Cahapay and Ramirez (2020), Gabucan and Sanchez (2021)
Inferential Analysis	t-test (*including t-test for independent sample, t-test for dependent samples*)	15	Estacio and Martinez (2017), Acut and Latonio (2021), Gumbao (2021)
	Correlation	7	Marces (2020), Salindao et al. (2022), Taratara–Fadero (2022)
	Chi-square	3	Morados (2020a), Morados (2020b), Estacio and Cornejo (2021)
	f-test	1	Davalos and Malaluan (2023)
	Other quantitative analyses (e.g., Scheffe test, K-means cluster analysis)	2	Morados (2020b), Davalos and Malaluan (2018)
Exploratory Analysis	ANOVA or ANCOVA	4	Micayabas (2015), Santiago et al. (2021), Taratara–Fadero (2022)
	MANOVA or MANCOVA	2	Morados (2020a), Morados (2020b)
Qualitative Analysis		5	Quitaneg–Abaniel (2018), Mamon (2019), Ramirez (2021)

Key Research Findings

The research studies analyzed in this paper offer valuable insights into the different aspects of school-level Earth science, including teaching, learning

processes and context, assessment, and technology integration.

Instructional strategies and tools that effectively improved students' conception and views about the subject matter include utilizing media cartoons in enhancing the issue resolution skills of students (Toledo, et al., 2014), integrating climate change lessons in Grades 7 and 8 Science classes (Micayabas, 2015), using the Frayer model in developing students' vocabulary and academic performance in science (Estacio & Martinez, 2017), and reinforcing learners' conceptual understanding of Earth science ideas with the aid of Filipino-translated comics (Marces, 2020). In teaching the concept of Earth systems, Abas et al. (2019) concluded that using the 7E model within a lesson study framework results in enhanced comprehension among students. Gabucan and Sanchez (2021) noticed that Grade 9 students who were exposed to a strategic intervention material (SIM)-based lesson in global warming hold a generally positive perception of their learning experience, which could also be correlated with their improved achievement in the subject.

Other instructional methods were also discussed in a number of publications. Most of which are considerably student-centered in orientation. For instance, Quitaneg–Abaniel (2018) described how an open inquiry learning framework in teaching the different sources of electrical energy in a Grade 11 Earth science class advanced students' scientific, observational, and creative skills, as well as their interpersonal competencies. Mamon (2019) discussed how problem-based learning can deepen students' understanding of natural hazards and how it can be utilized in identifying and mitigating their impacts in the local community. Cabalang and Cabalang (2022) noted that an inquiry-based learning strategy is more advantageous than traditional lecture method when discussing concepts such as the universe and the solar system, Earth materials (i.e., rocks and minerals), and geologic processes (e.g., endogenic and exogenic Earth process, crustal deformation) and history. Sy et al. (2022) observed Grade 7 junior high school learners and underscored the potential of activity-based strategy in reinforcing students' conception and appreciation of Earth science. Taratara–Fadero (2022) reported that a contextual inquiry approach (CIA) could positively influence students' achievement and interest in Earth science, but found no correlation between these variables. Conel and Avilla (2022) discovered that experiential–reflective instruction (ERI) leads to the increased knowledge of environmental topics among Grade 9 students and developed peer collaboration, lesson retention, and active class participation.

Another emerging theme from the corpus of examined research papers is the role of technology in Earth science education. Arce et al. (2018) discussed the development and evaluation of a 3D-augmented reality-based application which can be used in teaching junior high school Earth science in the classroom and beyond. Similarly, Gumbao (2021) recorded how mobile jigsaw puzzles contribute to students' mastery of geologic concepts, such as continental drift and plate tectonics. Other online educational technologies were also found helpful in teaching specific Earth science contents. Acut and Latonio (2021) explored the use of the application *Stellarium* and reported that it can effectively promote students' achievement of Grade 11 competencies in astronomy. Landicho (2020) utilized *Google Maps* in his lesson on faults and mentioned that students hold affirmative views regarding its use, particularly on how it can assist in their comprehension of the topic. Santiago et al. (2021) and Ugbamen et al. (2022) concluded that video-assisted instruction is a beneficial teaching strategy. Ramirez (2021) stated the favorable effects of computer-supported collaborative learning on Grade 7 students' critical thinking and conceptual understanding. In the wake of the COVID-19 pandemic, Tiria et al. (2022) documented how senior high school students participated in online forum discussions and discovered that the learners are generally engaged while providing acceptable responses according to the established rubrics despite documenting a few instances of plagiarism.

Research papers delving into students' learning contexts were also identified. The study of Cahapay and Ramirez (2020) on Grade 8 students' knowledge of earthquakes and typhoons noted a weak and negative correlation with their level of disaster preparedness. Morados (2020a) described how Grade 11 students from a specialized Science, Technology, and Engineering (STE) junior high school curriculum outperformed their non-STE counterparts in both Earth science and General Mathematics courses. The majority of these students also took the STEM track in senior high school (Morados, 2020a). Morados (2020b) deduced that the Grade 11 STEM cohort scored better than their non-STEM counterparts in Earth science and math. Estacio and Cornejo (2021) revealed that senior high school students perceived hydrometeorological, geological, and coastal processes and their corresponding hazards and impacts as the most challenging topics in their Earth and Life Science course. Salindao et al. (2022) remarked no correlation is found between the performance in Earth science of Grade 9 students and teachers in a distance modular learning modality. Meanwhile, Caraig and Quimbo (2022) showed that the majority of senior high school students who participated in their study

demonstrate poor reading comprehension, particularly in Earth science and Disaster Risk Reduction, while emphasizing the positive influence of confidence on reading ability. Students also prefer reading through online platforms and consider a noisy environment as a deterrent to effective reading (Caraig & Quimbo, 2022).

Davos and Malaluan (2018) described the extent of implementation of performance tasks in Grade 10 Earth science along with those in biology, chemistry, and physics. This study noted that Grade 10 science teachers utilized Earth science performance most frequently, particularly when assessing students' mastery of topics such as plate boundaries, distribution of active volcanoes and earthquakes, and Earth's internal structure, among others.

Lastly, Crisostomo et al. (2020) compared school-level astronomy education in the Philippines and Japan and observed that, while the former shows more astronomy-related contents in its basic education curriculum, the latter offers more advanced research opportunities and facilities.

Conclusion

The publication of research findings in reputable academic journals allows researchers to share their most recent scholarly outputs. This undertaking contributes to the expansion of the knowledge base of related disciplines. One of the primary objectives of geoscience education research is to advance the process of teaching and learning in the Earth sciences (Manduca et al., 2011). Piburn et al. (2011) enumerated a number of possible research areas in geoscience education that include studies on the affective domain, underrepresented sectors in Earth science, expert–novice differences, and students' alternative conceptions, among others.

Readers can keep themselves updated with the latest research findings and gaps in the literature by accessing and utilizing research papers. This activity could further stimulate scholarly discussion and result in the articulation of new research questions. Systematic reviews of published journal articles can help identify and map current research trends in any domain, such as science education (Tsai & Wen, 2005).

In this paper, 28 open-access journal articles focusing on school-level Earth science education were identified and analyzed based on an established set of criteria. These research studies were published between 2013 and 2022, the period corresponding to the first decade of implementation of the Philippine K-to-12 curriculum. The results revealed that most of the papers concentrate on topics such as students' learning conception, teaching, and educational technology integration. With respect to sample population and size, the majority of the researchers directed their attention to high school students, with the number of participants ranging from 30 to more than 500. In most cases, data collection was accomplished with the aid of researcher-made tests and questionnaires. Commonly applied statistical tools include the t-test and descriptive statistics such as the different measures of central tendency.

In summary, this paper provides an overview of scholarly work on Earth science education research in the Philippines. However, readers are reminded to consider the limitations of this study in terms of methodology and scope. The research studies included for analysis were limited to the results of the abovementioned Google Scholar searches and concurrent review of selected local journals. The 28 journal articles that qualified are only a small fraction of all research papers published in the country. Extending the scope of this review to cover more journals, including subscription-based publications, and other forms of scholarly work, such as master's theses and doctoral dissertations, is highly encouraged. Moreover, bibliometric analyses of research studies in closely related disciplines such as environmental education, climate change education, and disaster risk reduction education, may be conducted to inform the geoscience education community of recent trends in scholarly work.

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Conflicts of Interest

The author declares no conflict of interest.

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