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Implementation of 21st Century Skills-Based Science Instruction and Organizational Support

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Abstract

This study examined the implementation of 21st-century skills-based science instruction and the organizational support provided to teachers. It adopted a quantitative descriptive survey design and involved 25 junior high school science teachers from Surigao del Norte National High School during the school year 2022–2023. The study assessed the extent to which learning and innovation skills, information, media and technology skills, and life and career skills were integrated into science instruction. It also evaluated the level of organizational support received by teachers, including resources, professional development, and administrative assistance. Findings indicated that the integration of 21st-century skills was moderately to highly implemented, with teachers demonstrating active efforts to foster critical thinking, creativity, collaboration, and digital literacy in their classes. Organizational support was also perceived as moderate, highlighting areas for improvement in resource allocation and teacher training. Statistical analysis revealed significant relationships between the extent of 21st-century skills integration and the level of organizational support. These findings underscore the importance of aligning institutional policies, professional development, and resource provisions to enhance the quality of science instruction and prepare learners for the demands of a knowledge-based society.

Keywords: 21st-Century Skills, Science Instruction, Organizational Support, Learning And Innovation Skills, Information And Technology Skills, Life And Career Skills, Educational Reform, Teacher Development

1. Introduction

Background

The rapid transformation of economies and societies in the 21st century, driven by globalization, technological advancements, and the digital economy, has emphasized the need for competencies such as critical thinking, collaboration, creativity, and digital literacy (National Academies of Science, 2009). The global movement toward integrating these competencies—widely known as 21st-century skills—into educational frameworks reflects a consensus among educators, employers, and policymakers that traditional academic knowledge alone is insufficient for preparing students for future challenges.

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In secondary science education, the integration of 21st-century skills has gained increasing attention. Cebrero (2025) synthesized findings from 17 empirical studies, showing that students' achievement in science improves when teaching strategies intentionally incorporate these competencies. The study also emphasized the importance of teacher training and instructional alignment to sustain skill development. In the Philippine context, a mixed-methods study among junior high school science teachers in Camarines Sur revealed that teachers demonstrated competence in critical thinking, collaboration, communication, creativity, self-direction, and technology integration but needed improvement in global connections, prompting the design of a targeted upskilling program.

National policies in the Philippines reinforce this shift. The Second Congressional Commission on Education (EDCOM II) under Republic Act No. 11899 explicitly mandates the promotion of creativity, communication, collaboration, leadership, and critical thinking, supported by digital transformation and science, technology, and innovation integration. Despite this policy focus, there remains limited research examining how instructional practices and organizational support interact in specific school contexts to enhance the integration of 21st-century skills in science education.

Rationale

This study addresses this research gap by examining the interplay between the implementation of 21st-century skills–based science instruction and organizational support. Existing literature affirms the effectiveness of inquiry-based and technology-enhanced pedagogies in developing 21st-century competencies, but few studies have explored the organizational enablers or barriers that influence their integration (Cebrero, 2025). In the Philippine educational landscape, where digital infrastructure and teacher preparation remain uneven, understanding how schools support teachers through resources, professional development, and leadership becomes crucial for transforming policy into practice.

By focusing on the case of Surigao del Norte National High School, this study provides context-specific insights into how science instruction can be aligned with the demands of a knowledge-based society. The findings aim to inform education reforms, teacher capacity-building programs, and institutional strategies for sustaining effective integration of 21st-century skills in secondary science classrooms.

Aim and Research Questions

Aim

To examine the implementation of 21st-century skills–based science instruction and evaluate the organizational support provided to junior high school science teachers.

Research Questions

1. To what extent are learning and innovation skills (e.g., critical thinking, creativity, collaboration) integrated into science instruction by junior high school teachers?
2. How well are information, media, and technology skills (e.g., digital literacy, ICT use) embedded in science teaching practices?
3. To what degree are life and career skills (e.g., self-direction, adaptability) fostered in science instruction?
4. What is the perceived level of organizational support in areas such as:
    a. Resource provision (materials, ICT infrastructure)
    b. Professional development and training opportunities
    c. Administrative and leadership support
5. Is there a significant relationship between the extent of 21st-century skills integration in instruction and the level of organizational support perceived by teachers?

Hypotheses

Based on the aim and research questions, the study tested the following null hypotheses at the 0.05 level of significance:

H_o1: There is no significant difference in the extent of implementation of 21st-century skills–based science instruction in terms of learning and innovation skills when respondents are grouped according to their profile variables (sex, highest educational attainment, years of teaching, and level currently teaching).

H_o2: There is no significant difference in the extent of implementation of 21st-century skills–based science instruction in terms of information, media, and technology skills when respondents are grouped according to their profile variables.

H_o3: There is no significant difference in the extent of implementation of 21st-century skills–based science instruction in terms of life and career skills when respondents are grouped according to their profile variables.

H_o4: There is no significant difference in the level of perceived organizational support when respondents are grouped according to their profile variables.

H_o5: There is no significant relationship between the extent of implementation of 21st-century skills–based science instruction and the level of perceived organizational support.

2. Literature Review

Framing 21st-Century Competencies in Secondary Science

Global frameworks converged on a broad competency view that integrates knowledge, skills, attitudes, and values. The OECD Learning Compass 2030 defined "transformative competencies"—creating new value, reconciling tensions and dilemmas, and taking responsibility—as essential outcomes, underpinned by core foundations and learner agency (OECD, 2018; OECD, 2020a; OECD, 2020b). Within this framing, science education is positioned to cultivate critical thinking, problem-solving, collaboration, and communication through inquiry and authentic tasks that mirror scientific practice. Mapping studies of secondary education research showed that "21st-century skills" are variably operationalized but consistently connected to pedagogies that emphasize student agency and complex problem-solving (Kain, 2024).

Complementing OECD's competency lens, the Partnership for 21st Century Learning (now Battelle for Kids) articulated the 4Cs—critical thinking, creativity, collaboration, and communication—as focal outcomes supported by systems of standards, assessments, curriculum, professional development, and learning environments (Battelle for Kids, 2019). These frameworks informed national and school-level reforms and provided a shared vocabulary for designing, supporting, and evaluating skill-rich instruction in science.

Integrating 21st-Century Skills in Science Instruction

Empirical syntheses increasingly linked skill-rich pedagogies to improved science outcomes. A systematic review reported that secondary students' science achievement correlated with intentional integration of 21st-century competencies, encouraging alignment of instruction, assessment, and teacher learning (Cebrero, 2025). In parallel, a review of the 5E model argued that inquiry-oriented sequences can be re-tooled as "skill-based STEM" designs to more explicitly develop creativity, collaboration, and problem-solving (Koyunlu Ünlü & Dökme, 2022). Broader literature on digital learning in science highlighted mixed but generally positive effects when technologies are used to scaffold inquiry, visualization, feedback, and collaboration—especially when teacher capacity and curricular alignment are addressed (Momani, 2023).

Science classrooms serving diverse learners also benefited from technology-enhanced designs that support access and participation. A systematic review found that digital tools can increase motivation and engagement for students with disabilities in science when integrated with clear pedagogical intent (Mikropoulos & Natsis, 2023). These findings reinforced the proposition that technology is an enabler rather than an end in itself; the quality of instructional design and teacher support remains decisive for cultivating 21st-century competencies.

Information, Media, and Technology Skills: Digital Literacy as a Foundation

Digital literacy sits at the core of "information, media and technology" skills. A systematic review synthesized 43 studies and identified themes spanning access, skills, usage, and self-perceptions, emphasizing that digital inequalities shape learning opportunities and life chances (Tinmaz et al., 2022). Related reviews of critical digital literacies at school level underlined the need to integrate evaluation of information quality, ethical use, and participatory practices into subject teaching, including science (Ilomäki et al., 2023). School-level "digital culture" was further linked to scientific literacy and science outcomes, suggesting that institutional norms and supports amplify classroom-level efforts (Litina, 2024).

Life and Career Skills and the OECD "Transformative Competencies

Life and career skills—self-direction, adaptability, responsibility, and collaboration—align closely with OECD's transformative competencies. Evidence-informed frameworks recommended situating these in project-based and inquiry-driven science experiences where students navigate ambiguity, collaborate, and communicate findings to authentic audiences. This framing positioned science education as a prime context for cultivating agency and ethical responsibility alongside disciplinary understanding (OECD, 2018; OECD, 2020a).

Organizational Support and Teachers' Instructional Practice

A large cross-cultural meta-analysis established robust links between perceived organizational support (POS) and attitudinal/behavioral outcomes across 54 countries, indicating that POS predicts engagement, commitment, and performance with meaningful cultural contingencies (Rockstuhl et al., 2020). Sector-specific studies in education echoed these patterns: school- and teacher-level POS predicted teacher engagement and organizational citizenship (Hsieh et al., 2022), while POS and ICT self-efficacy jointly predicted teachers' adoption of blended learning (Ye et al., 2022). Recent evidence also suggested that POS fosters innovative work behaviors among teachers and buffers burnout through thriving at work (Jamal et al., 2023). Together, this literature implies that resource provision, leadership, professional development, and supportive culture are not merely contextual; they are proximal determinants of whether teachers can and will integrate 21st-century skills in science instruction.

Policy guidance in the Philippines positioned 21st-century skills as core K–12 outcomes, explicitly naming information/media/technology skills, learning and innovation skills, communication, and life and career skills, and embedding them in standards and performance expectations (Department of Education [DepEd], 2019). This policy framing underscores the importance of alignment between instructional practice and organizational support at the school level to realize intended learning outcomes in science.

Synthesis and Gap

Across international and local literatures, three converging claims emerged: (a) frameworks now consistently define the competencies science education should cultivate; (b) inquiry-oriented and technology-supported pedagogies can develop these competencies when deliberately designed; and (c) organizational support—through leadership, resources, and professional learning—conditions teachers' capacity and willingness to implement such pedagogies at scale. However, there remained a contextual gap: few studies examined, within a single secondary school, how the extent of 21st-century skills integration in science instruction covaries with perceived organizational support, using validated measures and linking categories of skills (learning & innovation; information/media/technology; life & career) to concrete forms of support. The present study addressed this gap

by investigating these relationships in a defined school context, thereby contributing practice-proximal evidence that can inform targeted school improvement and teacher development initiatives.

3. Methodology

This study employed a **quantitative descriptive survey design** to assess the implementation of 21st-century skills–based science instruction and the level of organizational support among junior high school science teachers at Surigao del Norte National High School during the 2022–2023 school year. Universal sampling was used to include all 25 full-time science teachers, ensuring comprehensive representation of the target population. Data were collected using a structured questionnaire adapted from Heretape (2019) for measuring the extent of skills integration and from Eisenberger et al. (1986) for perceived organizational support, both of which demonstrated high reliability and content validity. The survey covered demographic profiles, the extent of implementation of learning and innovation skills, information, media and technology skills, and life and career skills, as well as perceived organizational support. Responses were analyzed using descriptive statistics to summarize the data and inferential statistics, including t-tests, ANOVA, and correlation analysis, to test the stated hypotheses at a 0.05 level of significance. Ethical considerations, including informed consent, confidentiality, and voluntary participation, were strictly observed throughout the study.

4. Results and Discussion

Research Question 1

What is the profile of the respondents?

Table 1. Profile of Respondents (n = 25)

Profile Variable	Category	Frequency	Percentage (%)
Sex	Male	10	40.0
	Female	15	60.0
Highest Educational Attainment	Bachelor's Degree	14	56.0
	Master's Degree (units or full)	11	44.0
Years in Teaching	1–5 years	6	24.0
	6–10 years	9	36.0
	11+ years	10	40.0
Grade Level Taught	Grade 7	5	20.0
	Grade 8	7	28.0
	Grade 9	5	20.0
	Grade 10	8	32.0

As shown in **Table 1**, most respondents were female (60%) and held a bachelor's degree (56%), while 44% had completed or were pursuing graduate studies. Teaching experience was distributed across early-career (24%), mid-career (36%), and veteran teachers (40%), indicating a balanced range of professional backgrounds. Grade-level assignments reflected a strong presence in Grades 8 and 10.

Research Question 2

To what extent are learning and innovation, information/media/technology, and life and career skills integrated into science instruction?

Table 2. Extent of Implementation of 21st-Century Skills-Based Science Instruction (n = 25)

Skills Domain	Mean	Verbal Interpretation
Learning and Innovation Skills	3.45	Highly Implemented
Information, Media, and Technology Skills	3.28	Highly Implemented
Life and Career Skills	3.10	Moderately Implemented

As indicated in **Table 2**, learning and innovation skills (M = 3.45) and information, media, and technology skills (M = 3.28) were **highly implemented**, showing teachers' emphasis on collaboration, creativity, and digital literacy. Life and career skills (M = 3.10) were **moderately implemented**, suggesting the need for further strategies to enhance adaptability, leadership, and self-direction in science instruction.

Research Question 3

What is the level of organizational support provided to teachers?

Table 3. Level of Organizational Support (n = 25)

Dimension	Mean	Verbal Interpretation
Resource Provision	3.15	Moderate Support
Professional Development	3.05	Moderate Support
Administrative and Leadership Support	3.25	Strong Support
Overall Mean	**3.15**	**Moderate Support**

As shown in **Table 3**, organizational support was **moderate overall (M = 3.15)**. Teachers recognized strong support in leadership and administration (M = 3.25), but resource provision and professional development were only moderate, indicating gaps in training opportunities and availability of materials to fully sustain 21st-century instruction.

Research Question 4

Is there a significant difference in implementation of skills based on profile variables?

Table 4. Differences in Implementation of 21st-Century Skills-Based Science Instruction by Profile

Profile Variable	F-value / t-value	p-value	Decision
Sex	0.85	0.41	Not Significant
Highest Educational Attainment	3.22	0.04	Significant
Years in Teaching	2.89	0.05	Significant
Grade Level Taught	0.92	0.38	Not Significant

As presented in **Table 4**, significant differences were observed in the implementation of skills when grouped by **educational attainment (p = 0.04)** and **years in teaching (p = 0.05)**, suggesting that teachers with graduate studies

and longer experience tend to integrate 21st-century skills more effectively. No significant differences were noted based on sex or grade level taught.

Research Question 5

Is there a significant difference in organizational support based on profile variables?

Table 5. Differences in Organizational Support by Profile

Profile Variable	F-value / t-value	p-value	Decision
Sex	1.12	0.29	Not Significant
Highest Educational Attainment	2.56	0.06	Not Significant
Years in Teaching	2.10	0.08	Not Significant
Grade Level Taught	0.77	0.45	Not Significant

As shown in **Table 5**, there were **no significant differences** in perceived organizational support across sex, educational attainment, years in teaching, or grade level taught, indicating a generally uniform perception of support among all respondents.

Research Question 6

Is there a significant relationship between skills implementation and organizational support?

Table 6. Correlation Between Implementation of Skills and Organizational Support

Variables	r-value	p-value	Interpretation
Skills Implementation × Organizational Support	0.72	0.001	Strong Positive Correlation

As illustrated in **Table 6**, there was a **strong positive correlation (r = 0.72, p = 0.001)** between the extent of 21st-century skills implementation and perceived organizational support, indicating that higher levels of support are associated with more effective integration of skills in science instruction.

5. Discussion

The findings revealed that junior high school science teachers demonstrated high implementation of learning and innovation skills and information, media, and technology skills, but only moderate integration of life and career skills, echoing global frameworks such as the P21 model (Battelle for Kids, 2019) and supporting claims that adaptability and leadership require stronger scaffolding in instruction (Cebrero, 2025; Koyunlu Ünlü & Dökme, 2022). Organizational support was perceived as moderate overall, with stronger leadership but gaps in resource provision and professional development, consistent with studies emphasizing the role of institutional backing in effective pedagogy (Rockstuhl et al., 2020; Hsieh et al., 2022). Significant differences in skills implementation were observed based on educational attainment and years of experience, suggesting that advanced training and professional longevity enhance teacher capacity (Jamal et al., 2023). Moreover, the strong positive correlation between organizational support and skills implementation affirmed Perceived Organizational Support Theory (Eisenberger et al., 1986), indicating that supportive environments drive innovation and engagement in science instruction. These results align with national policy directions (DepEd, 2019) and international calls (OECD, 2018,

2020) to strengthen teacher training, resource allocation, and leadership strategies for developing future-ready learners.

6. Conclusion and Recommendations

Conclusion

This study revealed that junior high school science teachers have effectively integrated learning and innovation skills, as well as information, media, and technology skills, into their classroom instruction, while life and career skills remain moderately applied. Organizational support was generally moderate, with strong administrative backing but limited resources and professional development opportunities. Significant differences in skills implementation based on educational attainment and years of teaching experience suggest that advanced academic preparation and professional longevity enhance teachers' ability to deliver 21st-century skill-based instruction. The strong positive correlation between organizational support and the level of skills integration highlights the importance of a supportive institutional environment in fostering innovative and effective teaching practices. These findings confirm the relevance of Perceived Organizational Support Theory and emphasize the need for strategic alignment of instructional practices, teacher training, and organizational support to fully prepare students for the demands of a globalized, knowledge-based society.

Recommendations

Schools should prioritize comprehensive professional development programs that are continuous, collaborative, and tailored to the unique challenges of integrating 21st-century skills into science instruction. Investments in adequate resources and digital infrastructure are necessary to support technology-driven pedagogies and enhance classroom delivery. Leadership should cultivate a supportive and innovative school culture by encouraging collaboration, reflective practice, and recognition of teachers' efforts. Further, monitoring and evaluation mechanisms should be established to assess progress in integrating these competencies and to inform targeted interventions. Future research should explore longitudinal approaches and qualitative insights to provide a deeper understanding of how organizational support evolves and influences skill-based instruction over time, especially in diverse and resource-constrained educational contexts.

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