

Higher Education Pedagogy in Promoting Education 4.0: the Future of Higher Education Teaching and Learning

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UDK: 378.

DOI: <https://doi.org/10.15291/ai.4779>

PRETHODNO PRIOPĆENJE

Primljeno: 16.05.2025.

ABSTRACT

KEYWORDS:

andragogy, Education 4.0, future-oriented teaching and learning, higher education

In developing countries like the Philippines, the concept of Education 4.0 is relatively unfamiliar. However, the onset of the COVID-19 pandemic has highlighted the critical importance of integrating modern technology into all levels of education. This study provides empirical evidence of how educators in a public higher education institution promoted Education 4.0 in their classrooms prior to the pandemic. Utilizing a cross-sectional research design and simple random sampling, the study surveyed higher education students at the bachelor's, master's, and doctoral levels. The findings reveal that students recognized how their professors employed various pedagogical strategies to enhance teaching and learning, aligning with the principles of Education 4.0. This study has significant implications for the education sector, particularly higher education, urging institutions to embrace the transformation of teaching and learning in the context of Education 4.0. While the implementation of Education 4.0 poses challenges, especially in developing countries, a positive outlook and incremental efforts in providing meaningful learning experiences will yield substantial outcomes, regardless of the future trajectory of higher education.

INTRODUCTION

The education system has evolved through various models in response to societal needs. Education 1.0 emerged in the context of an agricultural society, where teachers acted as passive transmitters of knowledge, and students were mere recipients. This model, which began after the first Industrial Revolution at the end of the 18th century, was characterized by mechanization using water and steam power. It also led to innovations such as the paper-making machine, mechanical printing, the graphite pencil, the ballpoint pen, and the typewriter (Maria, Shahbodin, & Pee, 2018). The period was dominated by educational philosophies of essentialism and behaviorism, where the learner followed the teacher, who focused on explanation and demonstration as the primary teaching methods (Cruz, 2020; Puncreobutr, 2016).

Following this, Education 2.0 emerged in response to the needs of industrial society at the start of the 20th century. This era was defined by mass production, industrialization, and electricity. Education began to shift from memorization to access to greater knowledge, aided by the rise of internet-enabled learning. During this time, the role of teachers evolved from sages to facilitators, encouraging collaboration and interaction in the classroom. Educational philosophies such as andragogy and constructivism became central (Miranda et al., 2021).

Education 3.0 addressed the needs of a technological society in the late 20th century, marked by globalization. This era saw a significant leap in educational practices, fueled by the internet's expansion and the rise of online learning. Students were empowered to engage in self-directed learning, supported by multimedia resources, online tools, and virtual laboratories (Miranda et al., 2021). The role of teachers and students continued to evolve, with both becoming collaborators and co-creators of knowledge, fostering more dynamic and participatory interactions (Barreiro, 2021).

Education 4.0 emerges in response to the societal need for innovation, drawing from principles of connectivism, parallelism, and visualization (Goldie, 2016). It is closely tied to Industrial Revolution 4.0 (IR 4.0), a period marked by the rise of high technology. While technology plays a significant role, humans remain at the center of this transformation, necessitating an alignment between education systems and the evolving needs of society. Education 4.0 emphasizes the use of diverse tools and techniques to address learners' needs, preparing students to adapt to the rapidly changing cultural, economic, polit-

ical, and social landscapes (Hussin, 2018; Semerci et al., 2018). Developed in response to IR 4.0, it aims to equip students with the knowledge, skills, and competencies that align with future industry and societal demands. This model promotes the development of essential skills for innovation, including critical thinking, cooperation, creativity, productivity, self-awareness, and lifelong learning (Sinlarat, 2016; Puncreobutr, 2016).

While Education 4.0 has gained global attention, its implementation remains uneven, particularly in developing contexts. In the Philippines, the COVID-19 pandemic accelerated the adoption of digital technologies in higher education and compelled institutions to rethink their pedagogical approaches. However, despite increasing policy interest and technological initiatives, empirical evidence on how Education 4.0 pedagogies are actually being practiced in Philippine higher education is still scarce. Much of the existing literature focuses on conceptual discussions rather than documenting students lived experiences or examining how institutions operationalize Education 4.0 principles in real teaching–learning environments.

This lack of empirical insight presents a significant challenge. Without a clear understanding of current pedagogical practices, it becomes difficult for educators, policymakers, and institutions to assess institutional readiness, identify existing gaps, or design context-responsive interventions aligned with the competencies demanded by the Fourth Industrial Revolution (IR 4.0). Although global scholarship has explored the theoretical dimensions and potential of Education 4.0, few studies investigate its actual implementation in Philippine HEIs, especially from the perspective of students across different degree levels. There is a pressing need for research that examines concrete pedagogical practices rather than focusing solely on technology adoption or policy frameworks.

In response to this gap, this study explores the common pedagogical practices in a Philippine higher education institution as experienced by students, offering empirical insights into how Education 4.0 principles are being enacted in everyday instruction. Specifically, this study addressed the following research questions:

1. What pedagogical practices do students across different degree levels experience in a Philippine higher education institution?
2. To what extent do these practices reflect the principles and expectations of Education 4.0?

This study is significant in addressing several Sustainable Development Goals (SDGs), particularly SDG 4: Quality Education, by promoting inclusive, equitable, and quality education. It aligns with SDG 4.4, emphasizing critical skills for future employment, and SDG 4.7, fostering a culture of creativity, collaboration, and sustainable development. Additionally, it contributes to SDG 10: Reduced Inequality by ensuring access to quality education through personalized learning and technology, especially for marginalized communities, aligning with the educational needs of the Philippines and similar developing countries.

Theoretical Framework

This study is grounded in connectivism, constructivism, and 21st-century skills theory, which together provide a coherent foundation for understanding Education 4.0 pedagogies. *Connectivism* (Siemens, 2005; Downes, 2012) highlights learning as the process of forming and navigating networks of people, information, and digital tools. It is an essential feature of Education 4.0's technology-mediated, data-rich environments and evidenced in studies showing improved collaboration and digital fluency in networked learning contexts (Goldie, 2016; Torres & Ortega-Dela Cruz, 2024; Ortega-Dela Cruz, 2019). *Constructivism* supports Education 4.0's emphasis on experiential, inquiry-based, collaborative, and reflective learning, aligning with research demonstrating that constructivist strategies enhance engagement, deep learning, and higher-order thinking (Cardino & Cruz, 2020; Mansor et al., 2020). Meanwhile, *21st-century skills theory* (Trilling & Fadel, 2009) identifies critical competencies such as creativity, problem-solving, communication, collaboration, digital literacy, and lifelong learning that Education 4.0 seeks to cultivate to meet Industry 4.0 demands. It is consistent with global findings from the World Economic Forum (2016) and empirical studies on skill development in tech-integrated learning environments (Bituin Dorado & Alvar Ortega-Dela Cruz, 2024; De Leon & Ortega-Dela Cruz, 2024; Palines et al., 2025). These frameworks guide the study in examining how pedagogical practices foster learner engagement, integrate technology meaningfully, and develop future-ready competencies essential for the evolving higher education landscape.

MATERIALS AND METHODS

Research design

This research employed a descriptive cross-sectional design to capture the current state of higher education pedagogy in a developing country context, specifically the Philippines. A cross-sectional study provides a “snapshot” of the frequency and characteristics of a particular condition within a population at a specific point in time (Ihudiebube-Splendor & Chikeme, 2020; Cruz, 2022). This research design commonly involves the use of questionnaires to collect data from selected groups. Aligned with established research practices, this study utilized a survey questionnaire to examine the types of pedagogical approaches that students experience in higher education settings.

Subject of the Study

A total of 127 students from a public higher education institution in the Philippines were randomly selected as participants. The sample included 44 undergraduates and 83 postgraduates (63 master’s and 20 doctoral students). Overall, 45 participants (35%) were male and 82 (65%) were female. By academic level, 35% were in a bachelor’s program, 49% in a master’s program, and 16% in a doctoral program.

Instrumentation

Higher education pedagogy was assessed using a structured, self-administered questionnaire consisting of 55 items grounded in Education 4.0 principles, informed by constructivist and connectivist learning theories and 21st-century skills frameworks. The instrument initially captured five theoretical dimensions: Learner Engagement and Autonomy, Collaboration and Communication, Digital and Technological Integration, Creativity and Innovation, and Assessment Practices Aligned with Education 4.0. Responses were recorded on a seven-point Likert scale ranging from 1 (strongly agree) to 7 (strongly disagree).

Face validity was confirmed by three education specialists, and a pilot test with 20 students (10 undergraduate, 5 master’s, and 5 doctoral students) showed strong internal consistency, with Cronbach’s alpha values ranging

from 0.85 to 0.90 across the five dimensions and an overall reliability of 0.89.

Exploratory factor analysis (EFA) using principal axis factoring with Pro-max rotation was conducted to examine the underlying factor structure. The Kaiser-Meyer-Olkin (KMO) measure of sampling adequacy was 0.92, and Bartlett's test of sphericity was significant ($\chi^2=2598.34$, $p < 0.001$), confirming the suitability of the data for factor analysis. The EFA revealed a four-factor solution, rather than the original five domains, which accounted for 66.7% of the total variance. Eight items with low factor loadings (<0.50) or cross-loadings were removed, reducing the instrument from 55 to 47 items. The retained items loaded strongly (0.53–0.88) onto their respective factors, demonstrating good construct validity and discriminant properties.

The revised four domains reflect: (1) *Learner Engagement, Autonomy, and Personalization*, (2) *Collaboration and Communication*, (3) *Digital and Technological Integration*, and (4) *Assessment Practices and Creativity*. This empirical refinement strengthens the instrument's reliability and validity, providing a robust tool for assessing Education 4.0-aligned pedagogical practices. These validated factors can guide higher education institutions in curriculum redesign, faculty development, digital infrastructure planning, and policies promoting learner-centered, technology-integrated, and innovative teaching practices.

Ethical consideration

Throughout this investigation, the author adhered to key ethical principles. Informed consent was obtained from all respondents prior to the distribution of survey forms. The purpose of the study was clearly explained, and participants were assured that their involvement was entirely voluntary and would have no impact on their academic standing. They were also informed of their right to withdraw from the study at any point without any negative consequences. These measures were implemented to ensure the well-being and rights of all participants were respected throughout the research process.

Confidentiality

To ensure confidentiality, each respondent was assigned a unique code upon completing the survey. This code was used by the researcher to identify individual responses without revealing personal identities. By recording the code

on each survey, the researcher was able to link responses to participants while maintaining their anonymity. Although the survey results remained identifiable to the researcher, all findings were presented in aggregate form, with no personally identifiable information disclosed. This coding system effectively protected the identities of individual students.

Data analysis

The study utilized descriptive statistics such as frequencies, percentages, means, and standard deviations to analyse and summarize the collected data. To further validate the responses, Kendall's W, or the Coefficient of Concordance, was employed to assess the level of agreement among student-respondents. Kendall's W ranges from 0 to 1, where a value of 0 indicates no agreement among respondents, and a value of 1 signifies perfect agreement (Dela Cruz & Dela Cruz, 2020; Dela Cruz & Ortega-Dela Cruz, 2022).

RESULTS AND DISCUSSIONS

Teaching Practices Experienced by Students

The study identified the top 25 most commonly applied pedagogical practices in higher education (see Table 1). Key findings include: *Diversified feedback/assessment techniques* were reported by 82% of students, including use of e-portfolios, explicit performance guidelines, and regular constructive feedback. *Integrative teaching* connecting lessons across topics, disciplines, and real-life applications was reported by 81% of respondents. *Personalized teaching* encouraging students to explore different roles and tasks was observed by 79%. *Constructivist strategies* supporting knowledge construction based on prior experiences were reported by 79%. *Problem-based learning* fostering inquiry and self-directed investigation was reported by 76%. *Metacognitive/self-regulation strategies* and *learning partnerships* were reported by 75% and 74%, respectively. Other frequently applied practices included *open class discussions* (70%), *hands-on experiential activities* (72%), *peer tutoring* (72%), *differentiated instruction* (66%), and *diversified instruction* to accommodate multiple intelligences and learning styles (72%).

Kendall's Coefficient of Concordance indicated moderate agreement among

respondents regarding the pedagogies used in higher education (Kendall's $W=0.38$, $p=0.00$), confirming consistent implementation of these strategies across the sample.

TABLE 1. Teaching practices in higher education

Teaching Practices	f	Mean	SD	Kendall's W
1. Diversified feedback/assessment techniques such as using clear, objective and variety of methods of assessment.	104	1.21	0.50	0.36
2. Integrative teaching by connecting the lesson to one another, to other disciplines and to life.	103	1.25	0.59	0.36
3. Providing explicit guidelines on how to get better/higher grades, which are consistent with most performance assessment.	101	1.23	0.51	0.36
4. Personalized teaching by encouraging the students to work in different roles to discover their strengths, preferences, and interests, thus giving them opportunities to explore and move out of their comfort zones.	100	1.26	0.54	0.43
5. Constructivism by making the students construct knowledge and meaning by connecting lesson with their past experiences.	100	1.24	0.50	0.38
6. Designing appropriate and fair assessments of achievement consistent with the teaching methods such as using e-portfolios to track assignments throughout the semester.	97	1.27	0.51	0.32
7. Problem-based learning by encouraging students to ask questions and investigate their own ideas to improve their problem-solving skills as well as gain a deeper understanding of academic concepts.	96	1.29	0.59	0.40
8. Metacognitive/self-regulation by making students think about their cognitive and thought processes and reflective by encouraging the learners to reflect on what they have learned as well as how they have learned.	95	1.28	0.50	0.38
9. Providing regular and prompt constructive feedback, positive and negative, print, online, and face-to-face.	95	1.29	0.58	0.32

Teaching Practices	f	Mean	SD	Kendall's W
10. Learning partnership by building trusted and effective partnership with students and peer teachers, where they are becoming partners in learning with students.	94	1.28	0.48	0.32
11. Varied by using different techniques that will keep the students engaged in different ways.	94	1.34	0.75	0.43
12. Diversification by systematically incorporating diversity issues into the content, whether or not the class is diverse by creating opportunities for cultural, racial, ethnic, and gender mix of students to interact in various activities, especially in group assignments in and out of class.	94	1.31	0.59	0.36
13. Tapping students 'multiple intelligences and learning styles to give every student the chance to succeed in the course.	92	1.35	0.67	0.38
14. Allowing the students to complete portion of assignments and submit them for review, thus giving them opportunities to correct work and resubmit them.	92	1.43	0.88	0.32
15. Helping students find and build on their interests and aspirations through deep learning tasks.	92	1.31	0.53	0.40
16. Providing hands-on, exploratory, and trial-and-error problem-solving exercises.	92	1.41	0.80	0.43
17. Peer tutoring by assisting students in developing awareness and mastery of the learning process by encouraging them to teach their peers and their teachers.	91	1.35	0.66	0.38
18. Open class discussions	89	1.32	0.52	0.40
19. Requiring challenging learning goals, tasks and success criteria for self and students that require creation and use of new knowledge.	89	1.35	0.61	0.40
20. Considering the students 'needs for speed and instant gratification in turnaround time for grading, returning assignments, quizzes, and exams as quickly as possible.	88	1.46	0.88	0.36

Teaching Practices	f	Mean	SD	Kendall's W
21. Developing and supporting student autonomy by making use of self and peer assessment but with guidance, support and feedback from the content experts.	88	1.39	0.64	0.38
22. Making use of demonstration or showing the students what they need to know, through giving a lecture, or conducting a seminar, which includes multimedia presentations and activities.	87	1.35	0.57	0.43
23. Inquiry-based instruction by posing thought-provoking questions which inspire the students to think for themselves and become more independent learners.	87	1.35	0.57	0.36
24. Assigning problems where students, individually or in groups, can test their own strategies to discover the solutions.	85	1.42	0.67	0.38
25. Differentiated instruction by allocating tasks based on students' abilities, to ensure no one gets left behind.	84	1.49	0.82	0.43

Kendall's W level of agreement: 0.00 No; 0.10-Weak; 0.30-Moderate; 0.60-Strong; 1.00-Perfect

The findings indicate that higher education students are exposed to a broad range of pedagogical strategies aligned with the principles of Education 4.0, which are deeply rooted in constructivism, connectivism, and 21st-century skills theory. *Constructivist-oriented practices* including personalized teaching, integrative instruction, problem-based learning, and opportunities for reflective knowledge-building were prominent in the reported experiences of students. These strategies reinforce the view that learning is an active, student-centered process in which learners construct meaning through interaction with content, peers, and real-world contexts. This aligns with studies showing that constructivist pedagogies enhance deeper understanding, motivation, and transfer of learning (Cardino & Cruz, 2020; Mansor et al., 2020). Similar findings across Asian higher education contexts confirm that differentiated instruction, inquiry tasks, and reflective activities strengthen learner engagement and improve academic performance (Cruz, 2020; Torres & Ortega-Dela Cruz, 2024). *Connectivism* was also strongly reflected in the teaching practices identified. Students frequently engaged with technology-mediated

instruction, including multimedia presentations, digital learning tools, flipped classroom approaches, e-portfolios, and online feedback systems. These practices reflect connectivist assumptions that learning occurs through forming, navigating, and maintaining knowledge networks across digital platforms (Siemens, 2005). Research shows that such digitally rich environments foster information literacy, collaboration, and rapid knowledge updating competencies critical in dynamic technological contexts (Bituin Dorado & Alvar Ortega-Dela Cruz, 2024; De Leon & Ortega-Dela Cruz, 2024). Moreover, blended learning models, which emerged strongly in the findings have been found to promote flexibility, personalization, and improved learning outcomes (Cruz, 2020), particularly when combined with active learning strategies. In terms of *21st-century skills*, the pedagogical practices reported by students foster a broad set of competencies emphasized in the global literature, including critical thinking, creativity, collaboration, communication, and self-directed learning (Sumaya & Ortega-Dela Cruz, 2024; Trilling & Fadel, 2009). Inquiry-based tasks, fieldwork, experimentation, group projects, and learning partnerships are strongly associated with the development of higher-order thinking skills and collaborative problem-solving abilities (Caramay & Cruz, 2023; Leonardo II & Cruz, 2024). Differentiated and personalized instruction, noted in the findings, also supports learner autonomy and metacognitive awareness skills linked to academic resilience and lifelong learning (Cruz, 2020; Nobles & Ortega-Dela Cruz, 2020).

The shift from traditional, lecture-dominated instruction toward experiential, inquiry-driven, and digitally enhanced learning reflects a global pedagogical transformation (Palines et al., 2025). Such approaches align with the World Economic Forum's (2016) declaration that future-ready graduates must possess complex problem-solving skills, creativity, technological literacy, and socioemotional competencies (Pasco & Cruz, 2023). The findings also demonstrate that digital integration and flexible learning modalities play a central role in supporting learner autonomy and personalized learning pathways, an essential Education 4.0 outcome noted in international frameworks (Hussin, 2018; Bunwirat & Boonsathorn, 2018). By enabling students to self-direct their learning, collaborate in networked environments, and apply knowledge in authentic contexts, these teaching practices contribute meaningfully to the cultivation of lifelong learning habits and innovation capacity.

The study's findings show that higher education pedagogy in the institu-

tion has meaningfully integrated constructivist, connectivist, and 21st-century principles. While the practices already reflect strong alignment with Education 4.0, the results also highlight opportunities to further strengthen digital transformation, interdisciplinary collaboration, and innovation-driven teaching models. These insights reinforce existing literature calling for continuous professional development and institutional support to fully realize Education 4.0's transformative potential in higher education.

CONCLUSIONS

This study provides empirical evidence of how educators in a public higher education institution in the Philippines implement Education 4.0 in their classrooms. The findings reveal that the most frequently applied pedagogical strategies such as diversified assessments, personalized and constructivist approaches, problem-based learning, metacognitive practices, and learning partnerships actively promote student engagement, autonomy, and the development of 21st-century skills. Students reported being exposed to a variety of learning modalities, reflecting the integration of digital tools, inquiry-based instruction, and collaborative practices that align with Education 4.0 principles. These results underscore the evolving role of educators as facilitators who guide students in constructing knowledge, developing critical and creative thinking, and participating meaningfully in digital and networked learning environments.

To capitalize on these insights, higher education institutions should implement *targeted faculty development programs* that train educator in Education 4.0 pedagogies, including digital fluency, inquiry-based instruction, differentiated teaching, and assessment strategies that promote higher-order thinking and creativity. Institutions must also prioritize the *enhancement of digital infrastructure*, ensuring reliable access to Learning Management Systems, interactive multimedia tools, virtual collaboration platforms, and mobile learning resources to support anytime-anywhere learning. In addition, *assessment redesign* is critical; evaluative methods should move beyond rote memorization toward tasks that foster problem-solving, creativity, and critical reflection, such as portfolios, project-based assessments, and peer review activities. Finally, HEIs should develop *policies that promote interdisciplinary collaboration and learner autonomy*, encouraging cross-departmental projects, team-based

learning, and flexible learning pathways that empower students to take ownership of their educational journey.

The contributions of this study extend to *institutional decision-making, curriculum design, and policy reform* by providing evidence-based insights into the effectiveness of current pedagogical strategies. Administrators can use these findings to inform decisions on faculty training priorities, resource allocation, and technological investments. Curriculum designers can integrate Education 4.0 principles by incorporating active learning, digital literacy, and cross-disciplinary projects into program structures. Policy-makers can formulate guidelines that institutionalize flexible, student-centered, and technology-enhanced learning practices, ensuring that graduates are equipped with the competencies required for the dynamic demands of the Fourth Industrial Revolution.

Given the study's limitations particularly its focus on a single premier university in the Philippines, which may not represent other state universities, and its reliance on self-reported student perceptions, future research should broaden the sample to include multiple institutions across diverse regions to improve generalizability. Longitudinal studies could further explore how pedagogical strategies evolve over time and how they influence student competencies and career outcomes. Incorporating additional data sources such as faculty perspectives, classroom observations, and objective performance measures would also provide a more comprehensive understanding of Education 4.0 implementation. Moreover, future research may examine the effectiveness of specific interventions, such as digital tool integration or interdisciplinary projects, in promoting learner autonomy, collaboration, and creativity.

Ultimately, this study demonstrates that a deliberate, evidence-based approach to Education 4.0 implementation supported by trained educators, robust digital infrastructure, innovative assessment, and enabling policies can transform higher education into a future-ready, learner-centered environment, even in resource-constrained contexts. By linking pedagogical practices directly to student outcomes, institutions can foster meaningful learning experiences that cultivate autonomy, collaboration, creativity, and lifelong learning.

ACKNOWLEDGEMENT

This study has been duly registered under the Office of the Vice Chancellor for Research and Extension (OVCRE) of the University of the Philippines Los Baños.

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VISOKOŠKOLSKA PEDAGOGIJA U PROMICANJU OBRAZOVANJA 4.0: BUDUĆNOST VISOKOŠKOLSKE NASTAVE I UČENJA

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SAŽETAK

KLJUČNE RIJEČI:

andragogija, Obrazovanje 4.0, poučavanje i učenje usmjereno na budućnost, visoko obrazovanje

U zemljama u razvoju poput Filipina, koncept Obrazovanja 4.0 relativno je nepoznat. Međutim, pojava pandemije bolesti COVID-19 istaknula je ključnu važnost integracije suvremene tehnologije na svim razinama obrazovanja. Ova studija pruža empirijske dokaze o tome kako su nastavnici na javnoj visokoškolskoj ustanovi promicali Obrazovanje 4.0 u svojim učionicama prije pandemije. Koristeći presječni istraživački dizajn i jednostavno slučajno uzorkovanje, studija je obuhvatila studente preddiplomske, diplomske i doktorske razine. Rezultati pokazuju da su studenti prepoznali kako su njihovi profesori primjenjivali različite pedagoške strategije za unapređenje poučavanja i učenja, u skladu s načelima Obrazovanja 4.0. Ova studija ima značajne implikacije za obrazovni sektor, osobito za visoko obrazovanje, potičući institucije na prihvaćanje transformacije poučavanja i učenja u kontekstu Obrazovanja 4.0. Iako provedba Obrazovanja 4.0 donosi izazove, osobito u zemljama u razvoju, pozitivan pristup i postupni napori u osiguravanju smislenih iskustava učenja donijet će značajne rezultate, bez obzira na budući smjer razvoja visokog obrazovanja.