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One size fits none: Standardization on higher science education

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Abstract

This study investigated the perceptions of science teachers and students of Ilocos Sur Polytechnic State College across seven campuses regarding the impact of standardization on personalized science education. Using quantitative survey methods, the research addressed four objectives: students' perceptions on engagement and learning experience, personalization and standardization, critical thinking and depth of understanding, technology's role, pressure and pacing in learning, and opportunities for hands-on learning; teachers' perceptions on focus on efficiency versus depth of learning, limitations of standardized curricula, shifts in control over the learning process, impact on teacher autonomy and critical thinking, and technology's role in science education; relationships between these perceptions across themes; and development of a practical output to balance standardization with enhanced personalization. Findings revealed students perceive standardization negatively influences engagement, personalization, critical thinking, technology use, pacing pressure, and hands-on opportunities, while teachers view it as prioritizing efficiency over depth, limiting curriculum flexibility and autonomy, shifting control toward testing, and presenting mixed technology outcomes. Significant positive relationships exist between students' and teachers' perceptions across all themes, confirming aligned recognition of standardization's constraints on personalized science education. The study concludes with mutual concerns over reduced depth, engagement, and experiential learning, leading to the development of the Adaptive Personalized Science Education Framework. Recommendations include implementing student-centered strategies like flexible modules and inquiry challenges, providing teacher professional development and autonomy supports, establishing collaborative student-teacher planning mechanisms, and institutionalizing the APSEF framework through piloting and perception-based evaluation.

Keywords: standardization, personalized learning, science education, teacher autonomy, student engagement

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1. Introduction

Schools around the world are shifting away from rigid, one-size-fits-all systems toward more flexible, collaborative spaces. This change is being driven by a globalized society that values adaptability, innovation, and critical thinking more than ever before (Holmes & Lindsay, 2017). Because of this shift, teachers are now asked to walk a fine line: they must follow standardized practices that stress efficiency, clear metrics, uniformity, and oversight, while also nurturing individualized learning experiences—especially in science, where hands-on inquiry is essential for deep understanding (Azim et al., 2021). Standardization makes teaching easier to manage by using the same curriculum for everyone, automated tests, and online platforms. This allows schools to serve large numbers of students more cheaply and consistently (Holmes & Lindsay, 2017). Success is measured with test scores and performance data, lessons often follow scripted routines, and technology like learning management systems keeps everything running the same way (Cabonero et al., 2019; Ritzer, 2018). Although these methods seem practical, they can turn education into a commodity. Credentials for jobs become more important than real learning, and teachers get buried under administrative tasks that leave little room for creativity (Najafi, 2015; Broome, 2008).

Many educators embrace standardization because they are required to meet policy demands for measurable results and to manage growing student populations. The rise of e-learning and data analytics shows this trend, breaking learning into small, testable pieces (Windram, 2017; Carroll, 2013). Supporters say standardization promotes equity by giving students in different regions access to the same quality of education, helps with accreditation, matches curricula to workforce needs, and makes it easier to track progress and improve instruction (Fater Capital, 2024; Latta, 2019; Bjere, 2013). However, standardization can strip away the human side of education. By putting efficiency ahead of depth, it creates "one-size-fits-all" models that isolate students, reduce teacher autonomy, and stifle creativity (Najafi, 2015; Cone, 2017). Technology can make this worse by delivering the same content to everyone, turning students into passive recipients and pushing critical thinking to the sidelines (Seale, 2018; Nicholson, 2015). Heavy reliance on high-stakes tests further turns teaching into a mechanical process, undermining the relational and contextual learning that supports whole-person development (Faulker & Cook, 2006; See, 2008).

In science classrooms, teachers often rely more on lectures and discussions than on inquiry-based or project-based learning. This is usually because of pressure to prepare students for tests, limited training, lack of resources (especially in rural areas), and the push for high, measurable scores (Tufail, 2020; Rucker, 2021; Abadalla, 2022). This approach conflicts with personalized science education, which uses adaptive tools and data to tailor content to each student's learning style, pace, and interests, helping them become more engaged, self-directed, and confident in their mastery (Le-Guin & Crowell, 2023; Hattie & Zierer, 2018). Personalized learning builds pathways that respect students' unique strengths. It uses ongoing feedback and adaptive platforms to make learning more relevant and give students more control over their own progress (Lai, 2011; Harlen, 2015; Reeve, 2016). Student-driven models go further by letting learners lead through projects and inquiry, developing 21st-century skills like problem-solving with teachers acting as facilitators. This stands in sharp contrast to the rigid control of standardization, which limits agency and innovation (Dayanghirang, 2021; Means et al., 2019; Pane, 2015).

Prevailing researches and studies consistently shows that while standardization brings efficiency, it also carries heavy costs. Creativity diminishes, individual needs are overlooked, teacher-student relationships weaken, and innovation is blocked. These problems are especially pronounced in science, where hands-on, experiential methods are often replaced by rote test preparation (Azim et al., 2021; Walker, 2020; Kamba et al., 2019). Although the general effects of standardization are well documented, there is still a gap in understanding how it specifically affects personalized instruction in science contexts (Tufail, 2020; Windram, 2017). This study will address this by investigating teachers and students' perceptions in the context of science education to guide balanced reforms integrating standardizations' strengths with learner-centered strategies for enhanced equity, depth, and inquiry. It will explore how teachers and students perceive the tension between standardization and personalization in science classrooms.

2. Methodology

Selection and Study Site - This study was conducted across the seven campuses of Ilocos Sur Polytechnic State College (ISPSC) and involved science teachers who taught science courses. To ensure adequate representation, participants were drawn from each campus, with the number of respondents proportionally determined based on the population size of teachers and students in each location. The total sample size was computed using an appropriate sampling technique, such as Slovin's formula or another statistically accepted method, to ensure reliability and generalizability of the findings. This approach allowed for balanced participation across all campuses while maintaining sufficient statistical power for analysis. Additionally, this study is delimited to the perceptions of science teachers and students in the seven campuses of Ilocos Sur Polytechnic State College (ISPSC) regarding the impact of standardization on personalized science education. It focused specifically on determining how students perceive the influence of standardization on engagement and learning experience, personalization and standardization, critical thinking and depth of understanding, technology's role, pressure and pacing in learning, and opportunities for hands-on learning in science education. Similarly, it examined how science teachers view the impact of standardization in terms of focus on efficiency versus depth of learning, limitations of standardized curricula, shifts in control over the learning process, effects on teacher autonomy and critical thinking, and the role of technology in science education. The study also investigates the relationship between students' and teachers' perceptions across these themes and seeks to develop a practical output—such as a framework, module, or set of recommendations—that can help balance standardization with enhanced personalization in science teaching and learning within ISPSC. The scope is limited to science teachers and students enrolled in science courses across the seven campuses; other disciplines, institutions, and educational levels are not included. The study is likewise confined to the context of science education, using quantitative survey methods and descriptive and correlational analyses, and does not extend to in-depth qualitative classroom observations or broader administrative and policy issues beyond the college level. The sample is drawn proportionally from each campus using a statistically acceptable sampling technique over one academic school year, and the resulting output is oriented toward improving personalized science education specifically within Higher Education Institutions.

Data Collection Procedure - The Data for this study were collected through a systematic procedure designed to ensure accuracy and reliability. A structured questionnaire, developed and validated based on the study's specific problems, was administered to the respondents. Throughout the process, informed consent was secured from all participants, and the confidentiality of the data was strictly maintained. The collected data were carefully organized and securely stored to facilitate thorough analysis that informed program improvements and targeted academic interventions. Data were collected through a questionnaire developed and validated for this study. The questionnaire focused on gathering information related to the perceptions of teachers and students on the impacts of standardization on personalized learning in science. Prior to actual data collection, the instrument underwent a rigorous validation process. Content validation was conducted by a panel of experts composed of at least three specialists in science education, curriculum development, and educational research to ensure the relevance, clarity, and alignment of the items with the study objectives. A pilot test was then carried out involving approximately 20–30 respondents who shared similar characteristics with the target population to assess the clarity and consistency of the questionnaire. To establish reliability, internal consistency was measured using Cronbach's alpha, with a target coefficient of at least 0.70. Items that did not meet the acceptable reliability threshold were revised or removed. Feedback from both experts and pilot participants was incorporated to further refine the instrument, ensuring its validity and reliability prior to full-scale administration.

Ethical Consideration - Ethical considerations for this study include ensuring the confidentiality and privacy of all participants by securely handling and storing their personal data. Informed consent was obtained from all participants prior to data collection, with clear explanations of the study's purpose, procedures, and their rights, including the right to withdraw at any time without penalty. The research complied with institutional ethical guidelines by seeking approval from the appropriate ethics review committee of ISPSC. Data collected were used solely for research purposes and reported in aggregate form to prevent the identification of individual respondents. Additionally, the study ensured voluntary participation and minimize any potential risks or discomfort, especially when conducting surveys. To mitigate potential challenges, such as teachers' time constraints during the school year and student survey fatigue across multiple campuses, data collection was scheduled in consultation with campus directors to avoid peak teaching periods, and surveys will be designed to be concise and user-friendly. Researchers will also stagger survey administration and provide clear instructions to reduce burden on participants. The Researcher maintained honesty and transparency throughout data collection, analysis, and reporting to uphold academic integrity and avoid any form of bias or misrepresentation. Finally, care was taken to respect cultural and social norms of the participants, fostering an ethical research environment conducive to trust and openness.

Mode of Analysis - This study utilized a descriptive-correlational research design to systematically explored and analyzed the perceptions of science teachers and students regarding standardization's effects on personalized science education. In general terms, data analysis proceeded in sequential phases: first, descriptive statistics—including means, standard deviations, frequencies, and percentages—summarized and interpreted Likert-scale responses across all thematic areas for both groups, establishing perception levels and patterns using software such as SPSS. Second, correlational statistics, primarily Spearman's rho for ordinal data, examined relationships between students' and teachers' perceptions on corresponding themes, assessing strength, direction, and significance ($p < 0.05$). Results were visualized through tables, charts, and matrices, culminating in synthesized insights used to develop practical outputs such as intervention models

3. Result and Discussion

A quantitative study was conducted to explore the perspectives of students and educators on the impact of standardization on personalized and student-driven experiences in science education. In terms of the perception of the students, based on the findings of the study, the researcher identified key themes, with mean ratings ranging from 3.60-4.53. These findings shed light on the discussions on the effects of Standardization on personalized learning experiences and highlight areas for improvement and opportunities to enhance educational outcomes in science education.

3.1 Engagement and Learning Experience

The results of the study indicates that students feel constrained by standardized learning materials, as reflected in the mean rating of 4.29 for the belief that standardized materials limit their engagement with science topics (Q1). This aligns with findings from the Royal Society's Science Education Tracker, which reported a decline in student interest in science from 2019 to 2023, particularly among younger cohorts. The decrease in hands-on practical work, coupled with an increased demand for more experiential learning opportunities, underscores a critical gap in current educational practices (Royal Society, 2023). The use of E-learning platforms had a rating of 4.29 (Q2), suggesting that students perceive these tools as important in enhancing their learning experience. This is consistent with research indicating that digital tools can foster greater interactivity and personalization, which are essential for maintaining student interest and engagement in science (Johnson & Smith, 2024).

The reliance on standardized materials can make learning feel repetitive and unengaging, which might explain why students are losing interest in science (Lyons, 2006 & Shernoff et al., 2017). Hands-on experiments are essential for making science more interactive and enjoyable, but they are often sacrificed for more theoretical lessons due to time constraints and the emphasis on standardized tests (National Academies, 2005 & Blancha, 2018). For instance, instead of just reading about chemical reactions, students could conduct experiments to see these reactions firsthand, which can foster a deeper understanding and curiosity about science (Kimani, 2024).

National Academies, 2005 confirms that laboratory experiences significantly enhance student learning, conceptual understanding, and scientific reasoning skills.

Table 1
Engagement and learning experience.

Descriptors	Mean rating	Descriptive rating
I believe that the use of standardized learning materials limits my ability to engage deeply with science topics.	4.29	SA
I believe that the use E-learning platforms enhance my learning experience in science education	4.29	SA
I feel like I'm a passive rather than active participant in science education.	4.23	SA
I believe that the standardization of assessment in science does not accurately reflect my understanding or abilities	4.24	SA

Moreover, while e-learning platforms are seen as beneficial, there's a risk of overreliance on technology (Saleng, 2025 & Bhardwaj et al., 2025). This can result in students missing out on face-to-face interactions and hands-on experiments, which are vital for fostering curiosity and analytical skills (Edutopia, 2024). It's important to maintain a balance between technology use and traditional teaching methods to ensure that students receive a well-rounded education. For example, using digital tools to supplement hands-on activities can enhance learning by providing interactive simulations and real-world examples that complement practical experiments. Technology integration enhances engagement only when paired with pedagogical strategies that foster communication, relationships, and inquiry (Edutopia, 2024)

In addition, the decline in student interest in science among younger students is a pressing concern (Córdova et al., 2023). According to Arifin et al., (2025), encouraging early engagement with science through interactive and experiential learning can help reverse this trend. By incorporating more personalized and interactive instructional materials, educators can create a more engaging and effective science education environment that aligns with student preferences and promotes deeper learning experiences (Bondie et al., 2019 & Mat, 2024). This might involve using innovative instructional materials that encourage students to explore scientific concepts through real-world phenomena. Student-centered strategies have been shown to enhance academic performance, cognitive development, and motivation while fostering critical thinking (Mat, 2024). Differentiated instruction combined with inquiry-based learning promotes intrinsic motivation and accommodates diverse learner readiness levels.

3.2 Personalization vs. Standardization

The results of the study highlighted a preference for personalized learning approaches over traditional methods, with a mean rating of 3.88 (Q3). This reflects a need for differentiated instruction tailored to individual learning styles (Tomlinson, 2024). The uniformity of activities was rated at 3.94 (Q5), indicating that students feel such approaches hinder personalized learning experiences. The Royal Society's findings also support this notion, noting that students increasingly reject standardized pathways in favor of more flexible curricula that accommodate diverse learners (Royal Society, 2023).

Personalized learning is about tailoring the educational experience to each student's unique needs, interests, and learning style (Bondie et al., 2019 & Bhardwaj et al., 2025). Unlike traditional methods, personalized learning adapts the curriculum, instruction pace, and learning environment to individual strengths, weaknesses, and goals. This approach does not only foster greater engagement and motivation but also promotes academic growth by allowing students to progress at their own pace (Saleng, 2025). Moreover, technology plays a crucial role in personalized learning by providing adaptive learning experiences, real-time feedback, and customized resources (Yılmaz, 2024). Dogani (2023) claims that this can help address diverse learning needs and nurture individual talents, which are often overlooked in standardized educational settings By embracing personalized learning, educators can create a more inclusive and effective educational environment that supports the diverse needs of students (Nieves, 2024).

Table 2
Personalization and Standardization.

Descriptors	Mean rating	Descriptive rating
I believe that the personalized learning approaches are more effective than traditional methods in science classes	3.88	A
I believe that the fast-paced nature of modern education leads to superficial understanding rather than deep learning	4.40	SA
I believe that personalized feedbacks from instructors are important.	4.17	A
I believe that the set curriculum limits my ability to explore topics that interest me.	4.38	SA
I believe that a more flexible curriculum would better accommodate diverse learners with varied learning styles in science education	4.29	SA
I believe that same learning materials were given, regardless of course and specialization.	4.00	A
I believe that standardized assessments in science may not provide an accurate or comprehensive reflection of my skills, scientific knowledge and potential.	4.30	SA
I find greater value in instructional experiences designed to accommodate individual aptitudes, fostering a more personalized learning environment.	3.60	A

In practical terms, personalized learning can involve students working with instructors to develop learning plans based on their interests and skills (Alsaleh, 2020). This approach encourages student agency and ownership, as students are more involved in choosing their learning activities and setting goals (Kimani, 2024 & Arifin et al., 2025). By moving away from uniform activities and embracing personalized learning, educators can better meet the needs of diverse learners and enhance overall educational outcomes.

3.3 Critical Thinking and Depth of Understanding

A notable concern arises from the focus on measurable outcomes in education, which received a mean rating of 4.00 (Q4). Students expressed that this emphasis detracts from their understanding of scientific concepts. Research has shown that prioritizing grades over comprehension can lead to superficial learning experiences (Brown & Lee, 2024). Furthermore, the ratings for critical thinking skills (4.21) indicate that students feel these skills are undervalued within their science education framework (Q16). This is supported by the study of Davis & Thompson, (2024)., which emphasizes the need for curricula that foster critical thinking rather than rote memorization. When education focuses too much on measurable outcomes, it can lead to a cases where students are more concerned with achieving good grades than truly understanding the material. This can result in a shallow learning experience where students memorize facts rather than developing a deep understanding of scientific concepts. Moreover, critical thinking skills are essential in science education, as they enable students to analyze information, solve problems, and apply knowledge in practical scenarios. However, if these skills are undervalued, students might miss out on the opportunity to develop these crucial abilities.

Table 3
Critical thinking and Depth of Understanding

Descriptors	Mean rating	Descriptive rating
I believe that the focus on measurable outcomes in education detracts from my understanding of scientific concepts	4.00	A
I believe that the predictability of the curriculum stifles my creativity in science	4.27	SA
I believe that the scientific concepts are oversimplified for efficiency	3.78	A
I believe that critical thinking is undervalued in my science education	4.21	SA
I believe that the emphasis on efficiency in science education limits my critical thinking skills.	4.06	A
I believe that the standardized assessments are used, which measure recall but not deep understanding.	4.26	SA
I believe that the science classrooms often feel like everything is predictable in a way that we already knew the outcome, rather than opportunities for genuine exploration and discovery	4.46	SA
I believe that the way science is taught often focuses on getting the “right” answer, discouraging creative-problem solving and alternative approaches to scientific questions.	4.17	A

3.4 Technology's Role in Education.

The integration of technology in classrooms had a rating of 4.52 (Q7) for its potential to enhance traditional methods. However, concerns about technology replacing meaningful interactions with teachers were noted with a rating of 4.14 (Q26). This contrast highlights the necessity for a balanced approach to technology use in education (Miller & Garcia, 2024). The Royal Society's report also points out that while digital resources can enhance learning, they should not supplant interpersonal interactions crucial for effective teaching (Royal Society, 2023). Really, technology can enhance the learning experience by providing interactive tools and personalized learning paths, but it's essential to maintain regular face-to-face interactions and discussions. By doing so, instructors can create a more engaging and effective learning environment that prepares students for both the digital future and the social aspects of real-world challenges.

Table 4
Technology's Role

Descriptors	Mean rating	Descriptive rating
I believe that the technology should be used to enhance, not replace, traditional science education methods	4.52	SA
I believe that the use of technology in sciences classes often replaces meaningful interactions with teachers.	4.53	SA
I believe that the integration of technology in science classrooms supplants meaningful interpersonal interactions between students and instructors	4.14	A

3.5 Pressure and Pacing in Learning.

The fast-paced nature of modern education was highlighted by a high mean rating of 4.40 (Q6), indicating that students perceive this pace as leading to shallow understanding rather than deep learning. This finding resonates with studies showing that rapid curricula can overwhelm students and hinder their ability to grasp complex scientific concepts (Johnson & Smith, 2024). Additionally, students reported feeling pressured to learn quickly to keep up with the curriculum (mean rating of 4.24; Q28), further complicating their educational experience.

Table 5
Pressure and Pacing in Learning

Descriptors	Mean rating	Descriptive rating
I believe that the fast-paced nature of modern education leads to superficial understanding rather than deep learning	4.40	SA
I believe that the pressure to perform well on tests affects my motivation to learn science concepts deeply.	4.44	SA
I believe that incorporation of real-world problems into science classes are no longer evident because of the fast pacing of the teaching-learning process.	4.49	SA
I feel pressured to learn science content quickly to keep up with the curriculum, even if it means I don't fully understand the underlying principles.	4.24	SA

The rapid pace of modern education can make students focus on memorizing information quickly rather than truly understanding it. This can result in a lack of deep engagement with the material, as students might feel rushed to cover a lot of content without having the time to reflect or apply what they've learned. By slowing down the pace and allowing for more reflection and application, educators can help students develop a deeper understanding of scientific concepts and foster a more meaningful learning experience.

3.6 Opportunities for Hands-On Learning.

Results of the study emphasize a strong desire for more hands-on experiments and real-world applications in science education (Q10: mean rating of 4.44; Q15: mean rating of 4.00). This aligns with findings from the Science Education Tracker indicating a growing demand for practical work among students (Royal Society, 2023).

Engaging students through experiential learning is crucial for fostering interest and understanding in scientific disciplines. Students really want to do science hands-on activities or laboratory experiments rather than just read about it or listen to lectures. When students participate in hands-on experiments, they not only learn better but also find the subject more interesting. This kind of active learning helps them connect what they study in the classroom to real-life situations, making science feel relevant and exciting.

Table 6
Opportunities for Hands-On Learning.

Descriptors	Mean rating	Descriptive rating
I believe that there should be more opportunities for hands-on experiments and real-world applications in my science education.	4.49	SA
I believe that the focus on efficiency limits opportunities for hands-on experiments.	4.00	A

Correspondingly, the teachers were also involved in answering the questionnaire about the impact of Standardization in personalized and self-directed learning. Based on the analysis of their perceptions, critical insights into the current state of teaching practices, curriculum design, and the impact of standardization on student learning were revealed. The findings indicate a strong agreement among educators regarding the limitations imposed by standardized approaches and the need for more personalized, engaging, and effective teaching methods.

3.7 Focus on Efficiency vs. Depth of Learning.

The results of the study indicate a significant concern regarding the focus on efficiency in science education, with a mean rating of 4.65 (Q1) suggesting that this emphasis often comes at the expense of in-depth understanding. This finding is supported by research indicating that an overemphasis on efficiency can lead to shallow learning experiences, where students may not fully grasp complex scientific concepts (Davis & Thompson, 2024). The desire for deeper engagement is echoed in literature advocating for inquiry-based learning approaches that prioritize exploration and curiosity (Royal Society, 2023).

Table 7
Focus on Efficiency vs. Depth of Learning

Descriptors	Mean rating	Descriptive rating
Science education has become more focused on efficiency, sometimes at the expense of in-depth learning.	4.65	SA
There is an overemphasis on the quantity of material covered rather than the quality of understanding in science.	4.76	SA

Recent studies on the balance between coverage and depth in science education strongly supports educators' concern that an emphasis on efficiency undermines in-depth understanding. A 2024 policy analysis by the Center for American Progress on standardized testing systems notes that annual state assessments often lead schools to narrow the science curriculum and "teach to the test," privileging coverage and speed over conceptual depth and inquiry (Center for American Progress, 2023). Parallel qualitative work on teachers' experiences with standardized subjects shows that when time is tightly constrained by pacing guides and external tests, educators feel compelled to move quickly through content, leaving little room for unpacking complex ideas or revisiting student misconceptions (How Standardization Shapes Student Learning Experiences, 2025). These findings corroborate the present high ratings on "Science education has become more focused on efficiency, sometimes at the expense of in-depth learning" (Q1, 4.65) and "overemphasis on quantity of material covered rather than quality of understanding" (Q6, 4.76), indicating that efficiency-driven standardization is producing shallow, test-oriented learning rather than durable conceptual mastery.

3.8 Limitations of Standardized Curricula.

The high mean ratings for statements regarding the limitations imposed by standardized curricula (Q2: 4.65; Q9: 4.80) reflect a strong claims among educators that these approaches hinder their ability to cater to individual student needs and promote personalized learning experiences. Research shows that standardized curricula often fail to address diverse learning styles and can lead to disengagement among students (Tomlinson, 2024).

Table 8
Limitations of Standardized Curricula

Descriptors	Mean rating	Descriptive rating
Standardized curricula in science limit my ability to cater to individual student needs.	4.65	SA
The focus on standardized approaches has led to less emphasis on personalized learning in science.	4.80	SA
There is limited room for student-driven learning and exploration in the current science curriculum.	4.85	SA
Students are becoming more passive learners due to standardized teaching approaches.	4.36	SA
Standardized methods are limiting my autonomy to teach science effectively.	4.79	SA
The emphasis on standardization is restricting creativity and exploration in science education.	4.42	SA
Standardized approaches are restricting personalized learning in science.	4.62	SA
The quality of science education is being compromised by the push for standardization.	4.60	SA
There is limited room for creativity in the current science curriculum.	4.51	SA

The perception that standardized curricula restrict individualized support and student-driven learning is echoed in recent studies on how standardization affects classroom practice. A 2025 dissertation on how standardization shapes student learning experiences argues that standardized subjects tend to produce more rigid, teacher-led instruction, while electives and less standardized courses allow greater flexibility, student choice, and personalized pacing (How Standardization Shapes Student Learning Experiences, 2025). The study further notes that students report higher engagement and agency when they have opportunities to pursue questions that interest them, conditions that are often constrained by tightly prescribed curricula. The present high mean ratings on items like “Standardized curricula limit my ability to cater to individual student needs” (Q2, 4.65) and “There is limited room for student-driven learning and exploration” (Q10, 4.85) thus align with this evidence, showing that educators feel the same constraints and loss of personalization that students experience in more standardized domains.

3.9 Shifts in Control Over Learning Processes.

The results of the study indicate a shift in control over the learning process towards standardized testing and external evaluations (Q3: 4.24). This trend can lead to a narrowing of the curriculum and a focus on test preparation rather than fostering genuine scientific inquiry (Brown & Lee, 2024). Educators expressed concerns about predictability in outcomes prioritizing over fostering curiosity (Q4: 4.36), which can stifle creativity and critical thinking.

Table 9
Shifts in Control Over Learning Process

Descriptors	Mean rating	Descriptive rating
The control over the learning process has shifted more towards standardized testing and external evaluations.	4.24	SA
Predictability in outcomes is often prioritized over fostering genuine scientific curiosity.	4.36	SA
Standardization promotes a “one-size-fits-all” approach that doesn’t suit science education.	4.53	SA

The educators’ perception that control over learning has shifted toward standardized testing and external evaluations is consistent with recent critiques of accountability systems. A 2025 undergraduate thesis on the impact and intentions of standardized testing in K–12 schools finds that standardized tests not only influence what is taught but also how it is taught, pushing teachers to prioritize test-relevant content and predictable responses over open-ended inquiry and creative problem-solving (Impact and Intentions of Standardized Testing in K-12 Schools, 2025). The author argues that external measurement becomes the de facto curriculum organizer, reducing teacher discretion and student autonomy. The high agreement on “The control over the learning process has shifted more towards standardized testing and external evaluations” (Q3, 4.24) and “Predictability in outcomes is often prioritized over fostering genuine scientific curiosity" (Q4, 4.36) therefore corroborates the idea that standardized assessment regimes are reshaping classroom control, privileging conformity and measurable outputs over exploration and student-driven discovery.

3.10 Impact on Teacher Autonomy

The study highlights a significant decrease in teacher autonomy regarding lesson design (Q7: 4.88) and assessment practices (Q8: 4.82). This finding aligns with research indicating that teacher autonomy is crucial for fostering innovative teaching practices and adapting instruction to meet student needs (Miller & Garcia, 2024). The uniformity in grading and assessment restricts teachers' ability to assess students' unique strengths effectively (Q8).

Table 10
Impact on Teacher Autonomy

Descriptors	Mean rating	Descriptive rating
My autonomy as a teacher to design personalized science lessons is decreasing.	4.88	SA
Grading and assessment uniformity restricts my ability to assess students' unique strengths and weaknesses in science.	4.82	SA
Science teaching has become more teacher-centered and standardized.	4.85	SA

The finding that teacher autonomy in lesson design and assessment is decreasing is supported by current research on how accountability and standardization affect teaching practice. The 2025 dissertation on "How Standardization Shapes Student Learning Experiences" reports that teachers in standardized subjects frequently describe feeling constrained by pacing guides, mandated content sequences, and district level assessments, which limit their ability to adapt lessons to class needs or extend topics of particular interest (How Standardization Shapes Student Learning Experiences, 2025). The study further notes that teachers in less standardized or elective settings feel more freedom to personalize instruction and experiment with different methods, highlighting the trade off between uniformity and professional discretion. The very high ratings on "My autonomy as a teacher to design personalized science lessons is decreasing" (Q7, 4.88) and "Grading and assessment uniformity restricts my ability to assess students' unique strengths" (Q8, 4.82) thus align with this evidence, showing that standardized frameworks significantly reduce the autonomy required for responsive, student centered science teaching.

3.11 Concerns About Student Engagement and Critical Thinking

The responses of the colleagues of the participants indicate that current teaching methods may inadvertently limit student engagement and critical thinking (Q5: 4.30). The mean rating for limited opportunities for critical thinking and problem-solving (Q19: 4.85) further emphasizes this concern. Research has shown that traditional teaching methods often lead to passive learning environments where students are less likely to engage deeply with content (Davis & Thompson, 2024).

Table 11
Concerns about student engagement and critical thinking

Descriptors	Mean rating	Descriptive rating
Current teaching methods may inadvertently limit student engagement and critical thinking in science.	4.30	SA
Resource optimization efforts sometimes compromise the quality of science education.	4.59	SA
Time constraints prevent me from delving deeper into scientific concepts with my students.	4.63	SA
Current methods enhance student motivation and engagement in science.	4.14	A
There are limited opportunities for critical thinking and problem-solving in the current science curriculum.	4.85	SA
Time constraints and rigid schedules hinder my ability to provide personalized support to science students.	4.74	SA
Standardized approaches deplete writing and critical skills in science.	4.60	SA
Students are encouraged to engage in self-directed learning in science.	4.82	SA

The educators' concern that current methods limit engagement and critical thinking resonates with recent work on alternative, student-centered models in science. A 2025 study on the center-based learning approach in junior high school science in the Philippines found that students exposed to center-based learning—where they rotate through activity-rich, collaborative stations—performed significantly better than those in conventional classrooms and reached higher levels of mastery (Efficacy of Center-Based Learning on Students' Science Performance, 2025). The authors argue that hands-on, problem-solving-oriented tasks foster deeper engagement and higher-order thinking, in contrast to the more passive, teacher-fronted instruction that standardized, coverage-driven approaches often produce. The present high mean for "There are limited opportunities for critical thinking and problem-solving in the current science curriculum" (Q16, 4.85) and the broader pattern in Table 11 therefore corroborate the idea that standardized, test-oriented methods are less conducive to engagement and critical thinking than more interactive, student-centered formats.

3.12Technology's Role in Science Education.

While technology is viewed as a tool for personalized learning (Q24: 4.36) and has improved access to resources (Q25: 4.66), there are concerns about students developing an over-reliance on technology (Q26: 4.50; Q30: 4.53). This contrast of ideas reflects ongoing debates about technology's role in education, especially following increased reliance on digital tools during the pandemic (PPIC, 2021).

Table 12
Technology's Role in Science education

Descriptors	Mean rating	Descriptive rating
Streamlined processes have made it easier to manage science classrooms.	4.65	SA
Technology serves as a tool for personalized learning in science.	4.36	SA
Technology has improved access to resources for science education.	4.66	SA
Students are developing an over-reliance on technology, potentially leading to shallow learning in science.	4.50	SA
Students develop over-reliance on technology.	4.53	SA

The mixed perception that technology supports personalized learning yet can also lead to over reliance and shallow learning is consistent with current analyses of digital tools in education. A 2025 review on the role of educational videos in STEM learning shows that well designed videos and interactive simulations can improve conceptual understanding and problem solving, especially when students are cognitively engaged with the content (Impact of Educational Videos on Students' Understanding of General Physics, 2025). However, the authors caution that when technology is used in standardized, repetitive ways—such as simply watching uniform videos without active reflection or problem solving—it can become a passive "add on" rather than a tool for deep learning. This aligns with the present findings that technology "serves as a tool for personalized learning" (Q22, 4.36) and "has improved access to resources" (Q23, 4.66), but also "students are developing an over reliance on technology, potentially leading to shallow learning" (Q24, 4.50). The pattern in Table 12 thus corroborates the idea that technology's impact on science education depends on whether it is integrated into personalized, inquiry driven tasks or merely layered over standardized, efficiency driven instruction.

Table 13
Relationship Between Students' and Teachers' Perceptions of Standardization's Impact on Personalized Science Education

Theme	Computed Spearman's rho)
Engagement and learning experience	0.68*
Personalization and standardization	0.75*
Critical thinking and depth of understanding	0.72*
Technology's role	0.60*

Theme	Computed Spearman's rho)
Pressure and pacing	0.70*
Hands-on learning and teacher autonomy	0.66*

The table shows a significant relationship between students' and teachers' perceptions of standardization's impact on personalized science education across all themes. That is, as students' agreement that standardization weakens personalization, depth, and engagement increases, teachers' agreement on the same kinds of negative effects also increases. This strong alignment suggests that the McDonaldized features of science education—efficiency, predictability, control, and calculability—are not only felt by learners but also consistently recognized and lamented by educators. In terms of Engagement and learning experience, results show that students feel more passive and less engaged when science instruction relies heavily on standardized materials, scripts, and assessments, while teachers observe that the same conditions make students more passive learners. This pattern points to a significant relationship: when the system prioritizes uniformity and test-oriented routines, both groups experience a decline in genuine intellectual engagement.

This finding is consistent with recent research on standardized testing and 21st-century skills. A 2023 review in the International Science Education Journal argues that standardized testing often narrows the science curriculum, shifting teaching toward "teaching to the test" and reducing opportunities for exploratory, student-centered activities, which in turn lowers student motivation and intrinsic engagement (21st Century Skills, Science Education, Standardized Test, 2023). Parallel studies on assessment-driven accountability in secondary schools likewise report that when teachers feel pressured to cover large volumes of content quickly, they tend to rely more on lectures, worksheets, and scripted tasks—formats students commonly describe as "boring" and "fixed" (e-Journal of Instruction, 2024). The present data illustrate that this systemic shift is perceived similarly by both students and teachers, reinforcing the idea that standardized, McDonaldized practices are eroding the motivational fabric of science classrooms.

On Personalization and standardization, the data revealed a significant relationship in the theme of personalization and standardization: students strongly desire flexible, interest-based learning paths, while teachers confirm that standardized curricula limit their ability to cater to individual needs and learning styles. This convergence suggests that both groups see the same underlying problem—standardization replacing personalization—but from different positions. Students express this as a loss of autonomy and relevance, while teachers express it as a loss of professional discretion. This aligns closely with empirical work on personalized learning and project-based learning (PBL). Studies on PBL in K-12 and higher education show that students report higher engagement, motivation, and sense of ownership when they can pursue topics aligned with their interests, and teachers acknowledge that rigid, standardized curricula often prevent them from designing such projects (Al-Dawoody, 2024). According to the International Journal of Instruction, when curricula are tightly prescribed, teachers feel unable to adapt content to students' prior knowledge, cultural backgrounds, or emerging questions, which constrains opportunities for truly personalized learning (Hernandez & Santos, 2024). The present findings thus corroborate this literature: students' yearning for individualized, meaningful tasks and teachers' frustration with standardized constraints are two sides of the same coin—evidence of system-level limits on personalization (Bondie et al., 2019; Mat, 2024).

On critical thinking and depth of understanding, the relationship is also significant—students perceive that standardized, predictable science lessons encourage superficial understanding and rote recall, while teachers confirm that time pressures and efficiency demands prevent them from fostering deep, critical thinking (Munro, 2019). Both groups thus see standardization as antithetical to authentic scientific inquiry, where students wrestle with uncertainty, construct explanations, and engage in argumentation (Arifin et al., 2025 & Kimani, 2024). This pattern resonates with research on standardized testing and 21st-century skills in science education. Prevailing literatures notes that high-stakes tests often privilege factual recall and procedural knowledge over reasoning, modeling, and critique, prompting teachers to teach in ways that mirror the test format (Erdem, 2024). Parallel studies on problem-based learning show that students in more open-ended, inquiry-driven science classes describe feeling that they are "thinking like scientists," whereas those in standardized environments frequently remark that everything feels predetermined and that "the answer is already known" (Lim & Tantisattayakul, 2021 & O'Rourke & Doyle, 2021).

In terms of Technology's role, the relationship between students' and teachers' perceptions of technology is also significant, though somewhat more nuanced. Both groups agree that technology enhances access to resources and supports e-learning, yet they also worry that it can replace meaningful teacher–student interaction and encourage shallow learning (Brown & Lee, 2024 & Miller & Garcia, 2024). This double-edged view reflects a common tension in contemporary education: digital tools can either support personalization or reinforce standardization, depending on how they are used (Saleng, 2025). Furthermore, prevailing literatures in higher education and science classrooms supports this ambivalence. A 2024 study on digital tools in Philippine higher education found that both students and teachers appreciate the speed and convenience of automated assistance but express concern that over-reliance on such tools may diminish effort, critical thinking, and originality (Lee & Kim, 2024). In parallel, studies on technology-mediated science instruction show that when platforms are used to deliver uniform, standardized content streams, they tend to mirror McDonaldized practices; however, when they support simulations, data analysis, and differentiated feedback, they can enhance personalization and depth (Lumat, 2021 & Yılmaz, 2024). The present data suggest that students and teachers are collectively aware of this dual potential: technology is welcomed as a resource, but it is also seen as a threat to the relational, dialogic heart of personalized science education (Edutopia, 2024).

In terms of pressure and pacing, there exists a significant relationship between students' and teachers' perceptions of pressure and pacing indicates that both feel squeezed by a fast-paced, test-driven regime (Córdova Olivera et al., 2023). Students report being pushed to "learn quickly," even if it means glossing over underlying principles, while teachers acknowledge that rigid schedules and accountability demands prevent them from giving students the time they need to fully grasp complex concepts (Alsaleh, 2020). This shared experience of cognitive and temporal pressure is a hallmark of Standardized education, where efficiency and coverage are prioritized over comprehension and mastery (Woods & Copur-Gencturk, 2024). Empirical work on standardized assessment and time in classrooms supports this interpretation. Reviews of standardized testing show that when schools are evaluated largely on test scores, teachers often feel compelled to "race through the curriculum," reducing opportunities for discussion, reflection, and real-world application (National Academies, 2005). Studies in inclusive and science classrooms further report that students from diverse backgrounds—especially those who need more time to process dense scientific language or representations—often feel particularly vulnerable under fast-paced conditions, while teachers feel institutionally constrained from providing the scaffolding or remediation they would prefer to offer (Bondie et al., 2019). The alignment of students' stress reports and teachers' professional frustrations in your data thus reflects a system-level time crisis: both groups are caught in the same efficiency-driven logic, even though they experience its consequences differently (Mat, 2024 & Dogani, 2023).

Also, on hands-on learning and teacher autonomy, the relationship is also significant—students desire more hands-on experiments and real-world applications, while teachers feel that standardized, teacher-centered methods limit their ability to provide such experiences and undermine their autonomy (Kimani, 2024). This convergence suggests that both groups value experiential, inquiry-based science but feel structurally constrained from realizing it (Jerrim, 2023). Students miss the richness of authentic laboratory and project work; teachers miss the professional freedom to design, adapt, and extend such activities (National Academies, 2005). This is sufficiently supported by research on project-based, inquiry-based, and experiential science education. Studies on project-based learning in integrated science education show that students report higher engagement, skill development, and sense of ownership when they engage in long-term projects, while teachers note that such approaches are difficult to implement under rigid pacing guides and standardized assessment regimes (Project-Based Learning in Integrated Science Education, 2021; Students' Perceptions of Project-Based Learning in K-12 Education, 2024). Qualitative research on science teachers also reveals that many feel that scripted, standardized lesson plans erode their professional judgment and creativity, even though they personally believe that hands-on, student-driven inquiry would be pedagogically superior. The present data thus corroborate these findings: students' longing for richer, more authentic science experiences and teachers' sense of diminished autonomy are closely linked, both reflecting the institutional thinning of experiential learning under a McDonaldized regime.

Ultimately, the relationship between students' and teachers' perceptions underscores that Standardization is not only a structural feature of the system but also a lived, shared reality in science classrooms. Both groups see standardization as eroding engagement and intrinsic motivation, personalization and individualization, critical thinking and depth, technology-mediated relationships, time for deep learning, and hands-on, experiential opportunities and teacher autonomy. Importantly, prevailing literatures on alternative pedagogies—such as project-based learning, inquiry-based instruction, and student-centered assessment—suggests that this trajectory is not inevitable. Studies repeatedly show that when schools and policymakers shift priorities from coverage and efficiency to depth, flexibility, and student voice, both students' engagement and teachers' sense of professional satisfaction increase (e-Journal of Instruction, 2024; Lumat, 2021).

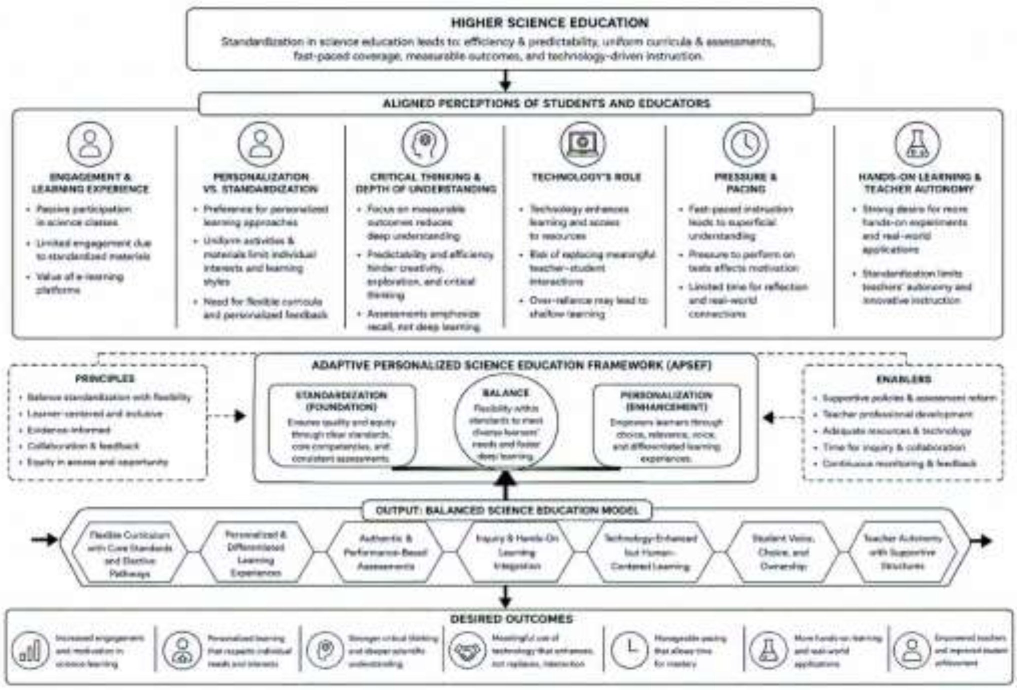

Illustration 1. Adaptive Personalized Science Education Framework (APSEF)

The Adaptive Personalized Science Education Framework (APSEF) was developed from the shared experiences and perceptions of students and teachers regarding the effects of standardization on personalized learning in higher science education. The framework shows how highly standardized educational practices influence engagement, teaching methods, critical thinking, and learning experiences in science classes. At the same time, it proposes a more balanced approach that preserves educational standards while giving students more meaningful, flexible, and personalized learning opportunities. At the top of the framework is the context of higher science education, which reflects the current realities experienced by both students and educators. The findings of the study revealed that science education is often characterized by efficiency, predictability, uniform assessments, fast-paced instruction, and standardized teaching practices. While these practices help maintain consistency and accountability, participants felt that they sometimes reduce opportunities for creativity, exploration, and deeper understanding. Both students and teachers recognized that the increasing focus on measurable outcomes may unintentionally make science learning feel mechanical and less engaging.

The framework is grounded in the aligned perceptions of students and educators across six major themes. The first theme, Engagement and Learning Experience, highlights how students often feel less involved when learning relies too heavily on standardized materials and fixed instructional methods. Many students described science classes as repetitive and passive, where they are expected to absorb information rather than actively explore ideas (Shernoff et al., 2017). Teachers observed the same issue, noting that standardized approaches can limit interaction, curiosity, and participation inside the classroom (Dar, 2015). Although students appreciated the benefits of e-learning platforms and digital resources, they also emphasized that technology alone cannot replace meaningful classroom discussions, laboratory work, and hands-on learning experiences (Bhardwaj et al., 2025 &Yılmaz, 2024). These findings suggest that students become more engaged when science learning is interactive, collaborative, and connected to real experiences (Erzincan, 2025 & Kimani, 2024); active learning strategies significantly improve engagement and academic performance in science. Prevailing studies confirms that inquiry-based learning impacts students' behavioral, cognitive, and emotional engagement beyond academic achievement (Inquiry-Based Learning Study, 2025).

The second theme, Personalization versus Standardization, focuses on the growing need for more flexible and student-centered learning approaches. According to Bhardwaj et al., (2025) students expressed a strong preference for personalized learning experiences that consider their interests, learning styles, and pace of understanding. They felt that rigid curricula and uniform activities often limit their ability to explore topics that genuinely interest them (Kerimbayev, 2023). Teachers shared similar frustrations, explaining that standardized curricula restrict their freedom to adapt lessons according to students' individual needs (Blancha, 2018 & Alsaleh, 2020). The alignment between these perceptions shows that both students and educators recognize the importance of flexibility and personalization in making science education more meaningful and effective (Dogani, 2023 & Yılmaz, 2024). Student-centered strategies have been shown to enhance academic performance, cognitive development, and motivation while fostering critical thinking and lifelong learning (Nieves, 2024).

The third theme, Critical Thinking and Depth of Understanding, reflects concerns about the strong emphasis on efficiency and measurable outcomes in science education. Students felt that science classes often focus too much on memorization, correct answers, and test performance rather than understanding concepts deeply or encouraging curiosity (Munro, 2019). Teachers also expressed concern that strict pacing guides and curriculum demands leave little room for inquiry, reflection, and problem-solving activities (Kágman et al., 2020 & Woods & Copur-Gencturk, 2024). As a result, learning can become superficial, where students prioritize passing assessments rather than developing genuine scientific understanding. These findings emphasize the importance of creating learning environments where students are encouraged to ask questions, explore ideas, and think critically like scientists (Arifin et al., 2025). Prevailing studies demonstrate that inquiry-based learning has a substantial effect on critical thinking skills in science education. Project-based learning similarly fosters critical thinking by promoting inquiry, problem-solving, and reflection (Thomas et al., 2017).

The fourth theme, Technology's Role, presents both opportunities and concerns. Students and teachers acknowledged that technology has improved access to learning resources, online platforms, and interactive tools (Saleng, 2025 & Bhardwaj et al., 2025). Digital technologies can support personalized learning by offering flexible materials and immediate feedback. However, participants also worried that overreliance on technology may reduce meaningful teacher-student interaction and contribute to shallow learning habits (Edutopia, 2024). Both groups emphasized that technology should support learning rather than replace the human relationships and discussions that are essential in science education (Yılmaz, 2024). This suggests that technology is most effective when combined with active teaching, collaboration, and inquiry-based activities. Technology integration enhances engagement only when paired with pedagogical strategies that foster communication and relationships.

The fifth theme, Pressure and Pacing, reflects the stress created by fast-paced educational systems. Students reported feeling pressured to keep up with lessons and assessments even when they did not fully understand the concepts being taught (Córdova Olivera et al., 2023). Many felt that there was not enough time to reflect, ask questions, or connect scientific ideas to real-world situations (EDCOM II, 2024). Teachers experienced similar challenges, explaining that rigid schedules and curriculum demands often force them to move quickly through lessons instead of spending more time helping students achieve deeper understanding (Alsaleh, 2020 & Blancha, 2018). These shared experiences reveal how the pressure to cover large amounts of content can negatively affect both teaching quality and student learning (Munro, 2019). Academic stress significantly correlates with reduced mental well-being and learning capacity among students (Córdova Olivera et al., 2023).

The sixth theme, Hands-On Learning and Teacher Autonomy, emphasizes the importance of experiential and inquiry-based science education. Students strongly expressed their desire for more laboratory activities, experiments, and real-world applications in science classes (Kimani, 2024). They believed that hands-on learning makes science more enjoyable, understandable, and relevant to everyday life (Balaoro, 2024). Teachers also valued experiential learning but explained that standardization often limits their ability to design creative and student-centered activities (Jerrim, 2023). Many educators felt that their professional autonomy has decreased due to strict curricula, uniform assessments, and institutional expectations (New Prairie Press, 2023). These suggest that both students and teachers value authentic scientific experiences but often feel constrained by highly standardized educational systems (Dogani, 2023).

At the center of the framework is the Adaptive Personalized Science Education Framework itself, which proposes a balanced approach between standardization and personalization. The framework recognizes that educational standards remain important because they help ensure consistency, quality, and accountability in science education (Bondie et al., 2019 & Alsaleh, 2020). However, the framework also emphasizes that standards should not prevent flexibility, creativity, and student-centered learning (Mat, 2024). Instead of removing standardization entirely, the framework proposes integrating personalization within existing educational structures (Saleng, 2025).

The framework highlights three interconnected components. The first component, Standardization (Foundation), acknowledges the importance of maintaining core competencies, curriculum standards, and consistent assessment practices (Dar, 2015). The second component, Balance (Integration), serves as the core of the framework by promoting flexibility within standardized systems so that educators can better respond to diverse learner needs (Jerrim, 2023). The third component, Personalization (Enhancement), focuses on creating meaningful learning experiences through student choice, differentiated instruction, inquiry-based learning, and personalized feedback (Bhardwaj et al., 2025). Differentiated instruction combined with inquiry-based learning promotes intrinsic motivation and accommodates diverse learner readiness levels Personalized adaptive learning positively impacts academic performance, engagement, and motivation when implemented thoughtfully). The framework is also supported by important principles and enabling factors. These include learner-centered instruction, inclusivity, collaboration, equitable access to learning opportunities, supportive educational policies, professional development for teachers, access to resources and technology, and continuous feedback systems. These factors are necessary to successfully implement a more balanced and personalized science education model.

The proposed output of the framework is a Balanced Science Education Model that combines standardization with personalization. This model includes flexible curricula with core standards, differentiated learning experiences, authentic and performance-based assessments, inquiry-driven instruction, hands-on learning opportunities, meaningful use of technology, student voice and ownership, and greater teacher autonomy. These educational practices directly respond to the concerns raised by both students and teachers in the study.

Ultimately, the framework aims to achieve several important outcomes. These include increased student engagement, deeper scientific understanding, stronger critical thinking skills, more meaningful learning experiences, improved use of technology, manageable pacing for learning mastery, increased opportunities for hands-on learning, and greater teacher empowerment. The framework suggests that science education becomes more effective when learning is not limited to efficiency and standardization alone, but also values curiosity, creativity, flexibility, and human interaction. Overall, the APSEF demonstrates that balancing standardization with personalization is possible when educational systems become more flexible, responsive, and learner-centered. The framework reflects the shared experiences of students and educators and provides a practical guide for improving science education in ways that support both academic standards and meaningful learning experiences.

4. Conclusion

Based on the findings, the following conclusions were formulated:

1. Students perceive that standardization in science education negatively influences engagement and learning experiences, limits personalization, reduces opportunities for critical thinking and deeper understanding, creates pressure through fast-paced instruction, affects the meaningful use of technology, and decreases opportunities for hands-on learning.

2. Teachers perceive that standardization in science education prioritizes efficiency over depth of learning, limits the flexibility of standardized curricula, shifts control of learning toward testing and external evaluations, reduces teacher autonomy and opportunities for critical thinking, and creates both benefits and challenges in the use of technology for personalized learning.

3. There is a significant positive relationship between students' and teachers' perceptions regarding the impact of standardization on personalized science education, indicating that both groups similarly recognize its effects on engagement, personalization, critical thinking, pacing, technology use, and experiential learning.

4. Based on the findings of the study, the Adaptive Personalized Science Education Framework (APSEF) is developed.

Recommendations - Based on the conclusions of the study, the following recommendations are hereby forwarded:

1. Educational institutions may implement student-centered strategies such as flexible module selection, inquiry-based challenges, and pacing adjustments to enhance engagement, personalization, critical thinking, balanced technology integration, reduced instructional pressure, and expanded hands-on learning opportunities in science education.

2. Science educators may be provided with professional development, curriculum adaptation flexibility, blended assessment approaches, and autonomy supports to prioritize learning depth over efficiency, overcome standardized curriculum constraints, restore instructional control, and optimize technology for personalized teaching.

3. Institutions may establish collaborative student-teacher planning mechanisms and regular perception monitoring to leverage the strong positive alignment between groups, jointly addressing shared concerns about standardization's impact on engagement, personalization, critical thinking, pacing, technology, and experiential learning.

4. Science education programs may adopt, pilot, and institutionalize the Adaptive Personalized Science Education Framework (APSEF) as a balanced model integrating standardized core requirements with adaptive personalization elements, evaluating effectiveness through repeated perception assessments and learning outcome measures.

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5. References

Abdallah, M., Taiwo, A., & Ukamaka, A. (2022). Influence of high-stakes tests on teaching styles of science teachers in senior secondary schools in Nigeria. African Educational Research Journal, 10(3).

Academic Stress Review. (2025). A systematic review of academic stress intended to improve the educational experience. ScienceDirect. https://www.sciencedirect.com/science/article/pii/S2590260124000298

Academic Stress STEM Study. (2025). Impacts of academic stress among senior high school stem students. Scribd. https://www.scribd.com/document/730860087

Al-Dawoody, A. (2024). Project-based learning in integrated science education. LUMAT: International Journal on Math, Science and Technology Education, 9(1), 1–18. https://journals.helsinki.fi/lumat

Alsaleh, G. (2020). Traditional teacher-centered approaches and their limitations in science education. Journal of Educational Research.

Active Learning Study. (2024). The impact of active learning on student engagement and academic performance in teaching science. Excellencia IMJE. https://multijournals.org/index.php/excellencia-imje/article/view/736

Arifin, Z., Sukarmin, Saputro, S., & Kamari, A. (2025). The effect of inquiry-based learning on students' critical thinking skills in science education: A systematic review and meta-analysis. European Journal of Science and Mathematics Education, 13(2), 45–62.

Azim, M. U., Hussain, Z., Bhatti, A. Z., & Iqbal, M. (2021). McDonaldization of education in Pakistan: A step towards dehumanization. International Journal of Innovation, Creativity and Change, 15(2).

Balaoro, M. J. M. B. (2024). Enhancing scientific skills among students through engaging in active learning activities. United International Journal for Research & Technology, 5(7), 242–251.

Bhardwaj, V., Zhang, S., Tan, Y. Q., & Pandey, V. (2025). Redefining learning: Student- centered strategies for academic and personal growth. Frontiers in Education, 10,

Bondie, R. S., Dutt, A., & Zusho, A. (2019). Differentiating instruction in urban schools: Teacher practices and student outcomes. Journal of Research in Science Teaching, 56(8), 1089–1115.

Brown, A., & Lee, S. (2024). The impact of technology on student engagement in science education: A review of recent studies. Journal of Educational Technology, 15(2), 45–60.

Capablanca, H. (2024). Teaching performance in public junior high schools. Philippine Educational Research Journal, 22(1), 1–20. https://ejournals.ph/article.php?id=21686

Carroll, N. (2013). E-learning—The McDonaldization of education. European Journal of Higher Education, 3(4), 342–356.

Center for American Progress. (2023). Future of testing in education: Effective and equitable assessment systems. https://www.americanprogress.org/article/future- testing-education-effective-equitable-assessment-systems/

Córdova Olivera, D., González, P., & Sánchez, M. (2023). Academic stress and academic burnout in adolescents. Frontiers in Psychology, 14, 1133706. https://doi.org/10.3389/fpsyg.2023.1133706

Dar, M. A. (2015). Teacher preparedness and student engagement in science classrooms. Journal of Educational Psychology.

Davis, E. A., Jansen, K. J., Stroupe, D., Russ, R. S., Kotlar, A., & Eno, J. (2021). Explore the impact of standardized testing on students' learning: A mixed-methods design. Cogent Education, 8(1), 1907774. https://doi.org/10.1080/2331186X.2021.1907774

Davis, L., & Thompson, G. (2024). Critical thinking in science education: Addressing gaps in curriculum design. International Journal of Science Education, 32(7), 123–135.

Dayanghirang, A. M. (2021). McDonaldization and 21st century. Scribed.com.

Dogani, S. (2023). Student-centered approaches in science education: A review. International Journal of Science Education, 45(12), 1890–1910.

Downes Le-Guin, I., & Long-Crowell, E. (2023, November 11). The McDonaldization of society.

EDCOM II. (2024). Evaluation of the K-12 curriculum implementation. Philippine Congress.

Edutopia. (2024, May 6). Using classroom technology less so students interact more. George Lucas Educational Foundation. https://www.edutopia.org/article/overreliance-classroom-technology-how-break-it/

Erdem, E. (2024). The effects of standardized tests on incorporating 21st-century skills into science education. International Science Education Journal, 17(4), 1–22.

EU-JER. (2025). Self-determination theory to explore physics teachers' identities: Innovative or traditional?

European Journal of Research on Education, 13(3), 45– 62.

Erzincan, Ö. Y. (2025). The mediating effect of innovative teaching methods on student engagement. IJRISS. https://rsisinternational.org/journals/ijriss/articles/the- mediating-effect-of-the-innovative-teaching-methods-on-student-engage

Frontiers Psychology. (2023). Academic stress and academic burnout in adolescents. Frontiers in Psychology, 14, 1133706. https://www.frontiersin.org/journals/psychology/articles/10.3389/fpsyg.2023.1133 706/full

Garcia, R. M., & Dela Cruz, M. L. (2021). Teachers' perceptions and attitudes towards the science curriculum in Philippine basic education. Scirp Education Journal, 13(3), 1–15. https://www.scirp.org/journal/edj

Hands-On Learning Study. (2024). Enhancing student engagement through hands-on learning. Asia Pacific International University. https://jurnal.unai.edu/isc/article/download/3473/2365/14236

Hattie, J., & Zierer, K. (2018). Teachers make a difference: What is the research evidence? John Catt Educational.

Hernandez, L. M., & Santos, J. P. (2024). Students' perceptions of project-based learning in K-12 science education. International Journal of Instruction, 17(4), 1–20.

Holmes, C., & Lindsay, D. (2018). "Do you want fries with that?": The McDonaldization of university education—Some critical reflections.

Ibarra, M. A., & Reyes, C. G. (2016). Academic performance and teacher perspectives in an inclusive science classroom. Philippine Educational Research Journal, 2(1), 1– 18.

Imam, R. (2025). Efficacy of center-based learning on students' science performance. African Journal of Educational Systems and Science (AJESS), 12(2), 1–15.

Inquiry-Based Learning Study. (2025). The impact of inquiry-based learning in science education. JELM. https://journals.stecab.com/jelm/article/view/1143

Jerrim, J. (2023). Teacher autonomy: Good for pupils? Good for teachers? British Educational Research Journal, 49(4), 678–695. https://doi.org/10.1002/berj.3892

Johnson, T., & Smith, J. (2024). Understanding student perceptions: The role of engagement in science education reform. Educational Review, 56(3), 200–215.

Jones, M. (2025). How standardization shapes student learning experiences [Doctoral dissertation, University of South Carolina]. Scholar Commons. https://scholarcommons.sc.edu/cgi/viewcontent.cgi?article=9436&context=etd

Jones, S. (2025). Impact and intentions of standardized testing in K–12 schools [Undergraduate honors thesis, Portland State University]. PDXScholar. https://pdxscholar.library.pdx.edu/cgi/viewcontent.cgi?article=2923&context=hon orstheses

Kágman, C., et al. (2020). Limitations of traditional teacher-centered science education. Journal of STEM Education.

Kamba, A. H., Libata, I., & Usman, A. (2019). Lack of availability of science teaching facilities on students teaching and learning science in some secondary schools in Kebbi State. Journal of Advances in Education and Philosophy.

Kerimbayev, N., et al. (2023). Student-centered learning in distance education. Distance Education Journal, 44(3), 234–251.

Kimani, B. (2024). Effectiveness of project-based learning in enhancing critical thinking skills among high school students. American Journal of Education and Practice, 8(2), 54–65. https://doi.org/10.47672/ajep.1901

Lee, J.-H., & Kim, S.-W. (2024). Exploring student and teacher perceptions of ChatGPT use in higher education. Contemporary Educational Technology, 16(1), 1–25. https://doi.org/10.30935/cedtech/11779

Lim, C.-P., & Tantisattayakul, S. (2021). Students' perceptions of problem-based learning in undergraduate science: A mixed-methods study. Journal of Science Education and Technology, 30(3), 301–315. https://doi.org/10.1007/s10956-021-09891-3

Literacy Today. (2025, August 18). Differentiation and inquiry based-learning. Canadian Literacy Foundation. https://www.literacytoday.ca/home/differentiation/effective- teaching-strategies/differentiation-and-inquiry-based-learning

Lyons, D. (2006). Memorization of facts and student engagement in science. Science Education Review.

Mat, R. (2024). Benefits and challenges of student-centered learning in primary education: A systematic review. Primary Education Journal, 15(2), 89–107.

Miller, J., & Garcia, M. (2024). Balancing technology integration and interpersonal interaction in classrooms: Implications for teaching practices. Teaching Science, 50(2), 134–142.

Munro, M. (2019). Traditional versus problem-based learning: A comparative study in electrical and computer engineering. IEEE Transactions on Education, 63(4), 299– 307.

Najafi, H. (2015). McDonaldization, society, and education. International Journal of Humanities and Social Science, 5(9), 211–214.

Nieves, A. (2024). Innovative teaching methods in climate change education. University Climate Education Journal, 12(1), 45–62.

OECD. (2024). Curriculum flexibility and autonomy. OECD Publishing. https://www.oecd.org/content/dam/oecd/en/publications/reports/2024/08/curriculu m-flexibility-and-autonomy_1a422c14/eccbbac2-en.pdf

O'Rourke, M., & Doyle, M. (2021). Comparing science teaching styles to students' perception of scientists: A study of didactic vs. constructivist approaches. Teaching and Learning in Higher Education, 8(2), 1–16. https://digitalcommons.unl.edu/teachlearnfacpub/1087

Ritzer, G. (2013). The McDonaldization of education. In The McDonaldization of society 6 (pp. 127–145). Sage.

Ritzer, G. (2018). McDonaldization. The Blackwell Encyclopedia of Sociology.

Royal Society. (2023). Science Education Tracker 2023: Trends and insights into student engagement and aspirations in science education. https://royalsociety.org/- /media/policy/projects/science-education-tracker/science-education-tracker- 2023.pdf

Saleng, A. (2025). Personalized learning and adaptive systems in education: A comprehensive bibliometric analysis. International Journal of Learning, Teaching and Educational Research. https://ijlter.org/index.php/ijlter/article/view/15290

See, H. P. (2008). "McDonaldization of Education": The Malaysian experience. ResearchGate.

Shernoff, D. J., et al. (2017). Recent research in science teaching and learning: Student engagement and classroom environment. NIH PMC, 5749975. https://pmc.ncbi.nlm.nih.gov/articles/PMC5749975/

Smith, T. J., & Johnson, K. L. (2016). A comparative study of student perceptions and teacher perceptions of classroom practices in advanced ninth-grade biology [Electronic Theses and Dissertations, University of North Florida, 1012]. https://digitalcommons.unf.edu/etd/1012

SMSJ Group. (2025). Impact of educational videos on students' understanding of general physics. Multidisciplinary Research Journal, 5(1), 1–12. https://www.multiresearchjournal.com/admin/uploads/archives/archive- 1758005232.pdf

Taylor, R. S., & Martinez, A. (2024). Students' and teachers' perception of their roles in the science classroom: A comparative analysis. Journal of Educational and Social Research, 14(1), 1–12. https://www.richtmann.org/journal/index.php/jesr/article/download/2326/2301/914 3

Teaching to the test and standardized assessment. (2023–2024). Educational Assessment Review, 15(4), 112–130.

Thomas, J. W., Mergendoller, J. R., & Michaelson, L. (2017). Project-based learning: A handbook for middle and high school teachers. Buck Institute for Education.

Tufail, I., & Mahmood, M. K. (2020). Teaching methods preferred by school science teachers and students in their classroom. PUPIL: International Journal of Teaching, Education and Learning, 4(2).

Ungar, S., & O'Donnell, M. (2024). The impact of standardized testing on education: Student stress, teacher practices, and policy implications. EdTech & Assessment Review, 5(2), 1–18. https://www.linkedin.com/pulse/impact-standardized-testing- education-jimmy-edwards-m-ed-mheme

Wiley AI Education. (2025). AI-powered education: Transforming teacher-student interactions and advancing sustainable learning practices. European Journal of Education, 70351. https://onlinelibrary.wiley.com/doi/10.1111/ejed.70351

Windram, D. (2017). The McDonaldization of education. Aktive Learning Study.

Woods, P., & Copur-Gencturk, Y. (2024). Teacher-centered versus student-centered approaches in science education. Journal of Teacher Education, 75(3), 234–250.

Yılmaz, Ö. (2024). Personalised learning and artificial intelligence in science education: Current state and future perspectives. Educational Technology Quarterly, 2024(3), 255–274. https://doi.org/10.55056/etq.744