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The Potential of Sacha Inchi as a Plant-Based Milk Innovation in Contextual Learning: A Conceptual Review of Science Literacy and Nutritional Awareness

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Abstract
This article presents a conceptual review examining the potential of Sacha Inchi–based plant milk as an innovation in contextual learning to support scientific literacy and nutritional awareness. Drawing on pedagogical and educational technology perspectives, the review synthesizes literature on contextual learning, learning resources, scientific literacy, nutrition education, and food-based innovations. Scientific literacy is positioned as a conceptual construct that develops through learners' engagement with meaningful real-life contexts rather than as a measurable instructional outcome. The synthesis highlights a pedagogical shift from content-centred learning to context-centred learning, in which every day phenomena function as learning resources that mediate conceptual understanding. Within this framework, Sacha Inchi–based plant milk is conceptualized as an authentic and interdisciplinary learning resource connecting science, nutrition, and sustainability. The review emphasizes the role of educational technology in organizing and integrating contextual learning resources through purposeful pedagogical design. Rather than evaluating instructional effectiveness, this article offers a theoretical framework to inform instructional design, curriculum development, and future research in contextual and technology-supported education.

Keywords: Contextual Learning; Learning Resources; Nutritional Awareness; Scientific Literacy

INTRODUCTION

In recent years, the demand for contextual and meaningful learning has become a central concern in science and nutrition education. Learners are increasingly expected not only to acquire conceptual knowledge, but also to develop the ability to relate scientific concepts to real-life situations that are relevant to their social, cultural, and environmental contexts. Within this framework, contextual learning is viewed as an approach that connects academic content with everyday experiences, enabling learners to construct knowledge through authentic and meaningful learning resources. Such an approach is particularly important in fostering scientific literacy and nutritional awareness, which are essential competencies for informed decision-making in contemporary society (Chimalakonda & Nori, 2020; Dhakal, 2023). Scientific literacy extends beyond the mastery of scientific facts and theories. It encompasses the capacity to understand scientific concepts, interpret

evidence, and apply scientific reasoning to address real-world problems (Rüütmann, 2023). Similarly, nutritional awareness is increasingly recognized as an integral component of scientific literacy, as it requires learners to understand the scientific principles underlying food, nutrition, and health. In educational contexts, integrating scientific literacy with nutritional awareness provides learners with opportunities to engage with science as a living and applicable discipline, rather than as abstract knowledge detached from daily life (Guo, 2018).

One pedagogical challenge in achieving this integration lies in the selection of appropriate learning resources. Conventional instructional materials often present scientific concepts in decontextualized forms, limiting learners' opportunities to relate knowledge to authentic situations (Chuks & Nebechi, 2016; Harrison et al., 2022). As a result, there is a growing emphasis on the use of contextual learning resources derived from local environments, cultural practices, and everyday phenomena (Chimalakonda & Nori, 2020; Guo, 2018). These resources allow learners to explore scientific concepts through familiar and meaningful contexts, thereby supporting deeper understanding and reflective learning processes (Dhakal, 2023).

Within this perspective, food-based contexts represent a promising domain for contextual learning in science education. Food is inherently interdisciplinary, involving concepts from biology, chemistry, health, and environmental science (Rüütmann, 2023). When used as a learning resource, food-related topics can bridge scientific concepts with learners' lived experiences, fostering engagement and relevance (Galés & Gallon, 2019). In particular, plant-based food innovations provide rich opportunities to explore scientific principles related to nutrition, sustainability, and health, while simultaneously encouraging critical awareness of food choices and dietary practices (Abeywardena, 2023; Dyer & Kuban, 2024).

Sacha Inchi (Plukenetia volubilis L.), a plant traditionally cultivated in certain regions and increasingly recognized for its nutritional value, offers a distinctive example of such a contextual learning resource (Arias et al., 2022; Andayani et al., 2024; Ramos-Escudero & Alvarado-Ortiz, 2021). As an ingredient used in the development of plant-based milk, Sacha Inchi embodies scientific concepts related to nutrition, food processing, and sustainable food systems (Chen et al., 2021; Li et al., 2022; Wang et al., 2022). From a pedagogical standpoint, the innovation of plant-based milk derived from Sacha Inchi can be conceptualized as a meaningful learning resource that connects scientific knowledge with real-world issues, including dietary diversity, nutritional literacy, and responsible consumption (Kuhnlein & Erasmus, 2019; Tariq & Riaz, 2023).

In the context of contextual learning, Sacha Inchi–based plant milk can be positioned not as an instructional tool in a narrow technical sense, but as a learning resource that mediates learners' engagement with scientific concepts. Through conceptual exploration of its nutritional composition, production processes, and socio-environmental implications, learners can develop a more integrated understanding of science and nutrition (Alemayehu & Getaneh, 2021; Chalvon-Demersay et al., 2023; Martínez et al., 2023). Such an approach aligns with the principles of educational technology and pedagogical design, which emphasize the purposeful selection and utilization of learning resources to support meaningful learning experiences (Chimalakonda & Nori, 2020; Dhakal, 2023).

Despite the growing discourse on plant-based food innovations, there remains limited pedagogical discussion on how such innovations can be systematically positioned as learning resources within contextual learning frameworks (Chuks & Nebechi, 2016; Macrides & Angeli, 2018). Most existing studies focus on nutritional or technological aspects, while their educational implications are often underexplored (Singh & Kaur, 2021; Nielsen & Bøgh, 2021). This gap highlights the need for conceptual analyses that bridge food innovation and pedagogy, particularly in relation to scientific literacy and nutritional awareness (Galés & Gallon, 2019; Rüütmann, 2023).

Therefore, this article aims to present a conceptual review of the potential of Sacha Inchi–based plant milk as an innovation in contextual learning. By synthesizing relevant literature from science education, nutritional education, and educational technology, this review examines how Sacha Inchi can be positioned as a contextual learning resource that supports the development of scientific literacy and nutritional awareness. Rather than evaluating learning outcomes empirically, this article contributes a pedagogical framework that may inform the design of learning experiences, instructional materials, and future research in contextual and technology-enhanced education.

RESEARCH METHODS

This study employed a conceptual review approach to examine the potential of Sacha Inchi–based plant milk as an innovation in contextual learning for the development of scientific literacy and nutritional awareness. A conceptual review was selected because the primary objective of the article was not to evaluate instructional effectiveness or learning outcomes empirically, but to synthesize, interpret, and integrate existing theoretical and scholarly perspectives relevant to pedagogy, educational technology, and contextual learning (Akintayo et al., 2024; Bizami et al., 2022). This approach allows for a critical exploration of concepts and frameworks that can inform educational practice and future research.

Design of the Conceptual Review

The conceptual review was designed as a narrative and integrative synthesis of literature, focusing on the intersection of contextual learning, learning resources, scientific literacy, nutritional awareness, and food-based innovations. Rather than applying systematic review protocols that emphasize quantitative aggregation, this study prioritized thematic coherence and pedagogical relevance, which are central to conceptual inquiry in educational research.

Sources of Literature

The literature reviewed in this study was drawn from reputable national and international academic sources, including peer-reviewed journal articles, scholarly books, and policy-related academic publications. The primary databases consulted included Scopus-indexed journals, Web of Science, and national journals relevant to education, science education, and educational technology. The selection of literature emphasized recent publications as well as foundational theoretical works that contribute to the understanding of contextual learning and learning resource utilization.

Criteria for Literature Selection

Literature was selected based on the following inclusion criteria:

1. Publications that discuss contextual learning, learning resources, or instructional design within science education or related fields.
2. Studies and conceptual papers addressing scientific literacy and nutritional awareness from an educational perspective.
3. Scholarly works examining food-based contexts, plant-based innovations, or local resources with relevance to learning and pedagogy.
4. Articles that provide theoretical, conceptual, or reflective insights rather than purely technical or commercial analyses.

Publications focusing solely on nutritional analysis or food technology without pedagogical implications were used selectively, primarily to support conceptual discussions rather than to serve as empirical evidence of educational outcomes.

Data Analysis and Synthesis

The selected literature was analyzed using thematic analysis and conceptual mapping. Key ideas, concepts, and theoretical positions were identified and grouped into thematic categories, such as contextual learning principles, the pedagogical role of learning resources, the integration of scientific literacy and nutrition education, and the educational relevance of plant-based food innovations. These themes were then synthesized to construct a coherent conceptual narrative that explains how Sacha Inchi–based plant milk can be positioned as a contextual learning resource.

Analytical Framework

The analysis was guided by pedagogical principles from educational technology and constructivist learning theory, particularly those emphasizing learner-centred design, contextualization of content, and meaningful engagement with real-world phenomena. Sacha Inchi and its application in plant-based milk innovation were examined as learning resources that mediate learners' understanding of scientific concepts related to nutrition, sustainability, and food systems. This framework enabled the discussion to remain focused on pedagogical potential rather than instructional outcomes.

Trustworthiness of the Review

To enhance the conceptual rigor of the review, the synthesis process involved continuous cross-referencing among multiple sources to ensure consistency and coherence of interpretations. The integration of perspectives from education, nutrition, and educational technology contributed to a balanced and interdisciplinary understanding of the topic. While this study does not aim for empirical generalization, it seeks to provide theoretical credibility and pedagogical relevance that may serve as a foundation for future instructional design and empirical research.

RESULTS AND DISCUSSION

Conceptual Framework

The conceptual framework of this study is grounded in the premise that contextual learning resources play a crucial role in bridging scientific knowledge with learners' real-life experiences. Within educational technology and pedagogy, learning is understood as an active process in which learners construct meaning through interaction with authentic contexts, rather than through the passive reception of abstract information (Chimalakonda & Nori, 2020; Chirinos et al., 2016). Accordingly, this framework positions Sacha Inchi–based plant milk as a contextual learning resource that mediates the development of scientific literacy and nutritional awareness (Chansuvarn & Panich, 2024; Cordero-Clavijo et al., 2021).

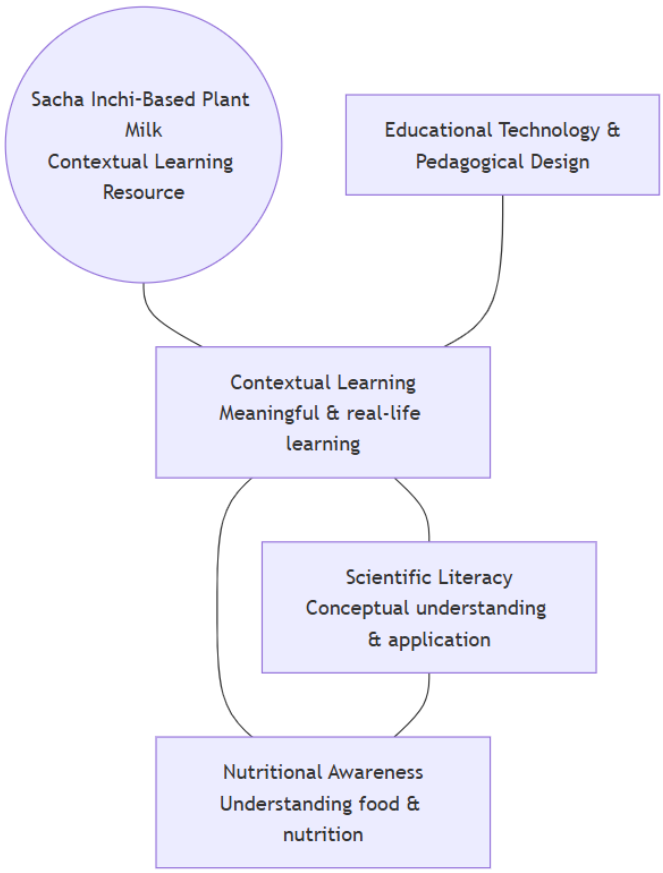

Figure 1. Conceptual Framework of Sacha Inchi–Based Plant Milk as a Contextual Learning Resource

The figure illustrates the conceptual relationships among the key components of the framework. At the center of the model is Sacha Inchi–based plant milk, positioned as a contextual learning resource. This central element connects to contextual learning principles, which frame how real-world contexts support meaningful knowledge construction. Surrounding the central learning resource are two interconnected outcome domains: scientific literacy and nutritional awareness. These domains are

depicted as mutually reinforcing, indicating that understanding scientific concepts and developing awareness of nutrition occur through integrated learning experiences rather than isolated instructional goals.

An outer layer represents educational technology and pedagogical design, which supports the integration of the learning resource into instructional contexts. This layer emphasizes the role of instructional planning, learning environment design, and technology-enhanced approaches in facilitating learners' engagement with contextual resources. Directional arrows in the figure indicate conceptual interaction rather than causality, highlighting that the framework does not propose measurable effects but illustrates pedagogical relationships. The figure as a whole represents a holistic and integrative model for understanding how Sacha Inchi–based plant milk can function as a learning resource within contextual learning to support scientific literacy and nutritional awareness.

Conceptual Positioning of Sacha Inchi–Based Plant Milk in Contextual Learning

The conceptual review reveals a consistent pattern across the analyzed literature regarding the pedagogical use of real-world phenomena as contexts for learning. Rather than positioning learning as the transmission of abstract disciplinary content, the reviewed studies collectively emphasize the role of authentic, everyday phenomena in supporting meaning-making and conceptual understanding (Guo, 2018; Dhakal, 2023; Cárdenas Sierra et al., 2021). Within this pattern, food-based innovations are repeatedly identified as pedagogically rich contexts due to their relevance to learners' daily experiences and their interdisciplinary nature (Galés & Gallon, 2019; Chansuvarn & Panich, 2024).

The synthesis further indicates that Sacha Inchi–based plant milk can be conceptually positioned within this pedagogical trend as a contextual learning resource, rather than as an instructional medium or technological intervention. This positioning represents the primary conceptual result of the review (Chimalakonda & Nori, 2020; Chansuvarn & Panich, 2024).

Table 1. Conceptual synthesis of literature on contextual learning and food-based phenomena

Conceptual Dimension	Synthesis Outcome from Literature	Pedagogical Interpretation
Real-world phenomena	Positioned as authentic contexts for learning	Learning is grounded in meaningful situations
Food-based contexts	Identified as highly relatable and interdisciplinary	Support integration of science and everyday life
Plant-based innovations	Linked to science, nutrition, and sustainability	Enable cross-disciplinary conceptual engagement
Learning orientation	Shift from content-centered to context-centered	Context becomes the driver of learning
Role of learning resources	Serve as mediators of conceptual understanding	Resources support meaning-making, not instruction delivery

Analysis of the literature resulted in the identification of three dominant conceptual themes. First, real-world phenomena are consistently framed as learning contexts that function as anchors for conceptual engagement. The literature suggests that such phenomena enable learners to construct understanding by relating scientific concepts to observable and familiar situations (Guo, 2018; Dhakal, 2023; Kim & Joo, 2019). In this sense, context is not treated as a supplementary illustration, but as an integral component of the learning process (Chimalakonda & Nori, 2020).

Second, food-based contexts are repeatedly described as interdisciplinary learning resources. Studies from science education, nutrition education, and sustainability-oriented pedagogy converge on the idea that food-related phenomena naturally integrate scientific, health-related, and environmental concepts (Galés & Gallon, 2019; Rüütmann, 2023; Craig et al., 2023). This interdisciplinary characteristic positions food innovations as particularly suitable for contextual learning frameworks (Kuhnlein & Erasmus, 2019; Chalvon-Demersay et al., 2023).

Third, the reviewed literature demonstrates a clear pedagogical shift from content-centered learning to context-centered learning. In content-centered approaches, instructional emphasis is placed on disciplinary knowledge as isolated content. In contrast, context-centered learning prioritizes meaningful situations as starting points for inquiry, allowing concepts to emerge through engagement with real-life contexts (Goodrich & Vũ, 2023;). This shift reflects broader developments in educational technology and learner-centered pedagogical design (Chimalakonda & Nori, 2018; Dhakal, 2023).

Integration of Nutritional Awareness within Contextual Science Learning

The conceptual synthesis of the reviewed literature indicates that nutritional awareness is increasingly positioned as an integral dimension of science learning, rather than as a separate or peripheral topic. Across studies in science education and nutrition education, nutritional awareness is framed as learners' conceptual understanding of food, nutrients, and their scientific foundations, coupled with the ability to interpret nutrition-related information in everyday contexts (Sławińska & Olas, 2022). Within contextual learning frameworks, this awareness is developed through engagement with meaningful learning resources that connect scientific concepts to real-life food practices (Taylor et al., 2019; McNamara et al., 2021).

The primary conceptual result of this review suggests that nutritional awareness and scientific literacy are pedagogically interconnected, and that their integration is most effectively supported through contextual learning resources grounded in everyday phenomena. In this regard, Sacha Inchi–based plant milk is conceptually positioned as a food-based learning resource that enables the integration of nutrition-related concepts within science learning (Chimalakonda & Nori, 2020; Chansuvarn & Panich, 2024).

Table 2. Conceptual synthesis of literature on nutritional awareness in contextual science learning

Conceptual Dimension	Synthesis Outcome from Literature	Pedagogical Implications
Nutritional awareness	Conceptualized as understanding of food and nutrition science	Awareness develops through scientific understanding
Relation to science learning	Integrated within scientific concepts and inquiry	Nutrition becomes part of science learning
Food-based contexts	Identified as meaningful and familiar learning resources	Support relevance and engagement
Contextual learning	Enables integration of real-life food phenomena	Facilitates holistic understanding
Learning orientation	Emphasis on conceptual meaning rather than behavior	Supports reflective learning

The analysis of the literature reveals three central conceptual themes related to the integration of nutritional awareness within contextual science learning. First, nutritional awareness is consistently conceptualized as a knowledge-based and interpretive construct, rather than as a behavioral or attitudinal outcome. The reviewed literature emphasizes that nutritional awareness involves understanding the scientific principles underlying food and nutrition, including nutrient functions, food composition, and basic health-related concepts (Taylor et al., 2019; McNamara et al., 2021). This conceptualization aligns nutritional awareness with the cognitive dimensions of scientific literacy (Penagos-Calvete et al., 2019; Rüütmann, 2023).

Second, the literature highlights the importance of food-based contexts in facilitating the integration of nutrition concepts into science learning. Food-related phenomena are described as accessible and familiar contexts that naturally invite discussion of scientific ideas (Kuhnlein & Erasmus, 2019; Chalvon-Demersay et al., 2023). Through such contexts, learners are able to explore nutrition-

related concepts not as abstract information, but as scientifically grounded knowledge embedded in everyday experiences (Chimalakonda & Nori, 2020).

Third, contextual science learning is identified as a pedagogical approach that enables the simultaneous development of scientific understanding and nutritional awareness. Rather than treating nutrition as an additional topic, contextual learning allows nutrition-related concepts to emerge organically from scientific inquiry (Guo, 2018; Dhakal, 2023). This integration supports a holistic view of science learning, in which knowledge is interconnected and relevant to learners' lives (Galés & Gallon, 2019).

Pedagogical Value of Food-Based Learning Resources in Educational Technology

The conceptual synthesis of the reviewed literature highlights the pedagogical value of food-based learning resources within the domain of educational technology. Across studies in instructional design and learning sciences, educational technology is not limited to digital tools or platforms, but encompasses the systematic organization, selection, and integration of learning resources to support meaningful learning (Chimalakonda & Nori, 2020; Khan et al., 2022; Aprilo et al., 2023). Within this broader understanding, food-based phenomena are increasingly recognized as valuable resources that can be purposefully integrated into pedagogical design.

The primary conceptual result of this review indicates that food-based learning resources align strongly with the principles of educational technology, particularly those emphasizing learner-centered design, contextual relevance, and meaningful engagement. In this context, Sacha Inchi–based plant milk is positioned as a learning resource whose pedagogical value lies in its capacity to be integrated into instructional design frameworks rather than in its technological sophistication (Dhakal, 2023; Chansuvarn & Panich, 2024).

Table 3. Conceptual synthesis of literature on food-based learning resources in educational technology

Conceptual Dimension	Synthesis Outcome from Literature	Pedagogical Significance
Educational technology	Encompasses design and integration of learning resources	Focus on purposeful instructional design
Role of learning resources	Shape learners' interaction with content	Resources mediate learning experiences
Food-based resources	Provide authentic and meaningful contexts	Support contextual and learner-centered learning
Instructional design	Emphasizes alignment of context, content, and learners	Enables coherent learning environments
Learning flexibility	Applicable across instructional strategies	Supports adaptability in learning design

The analysis of the literature reveals three key conceptual themes related to the pedagogical value of food-based learning resources in educational technology. First, educational technology literature consistently emphasizes that effective learning design depends on the alignment between learning resources, learning objectives, and learning contexts. Learning resources are viewed as integral components of instructional systems that shape learners' interactions with content (Chimalakonda & Nori, 2020). Food-based resources are identified as particularly suitable for contextualized instructional design because they provide authentic and meaningful reference points for conceptual exploration (Guo, 2018; Dhakal, 2023).

Second, the literature highlights the role of learning resources in supporting learner-centered and inquiry-oriented learning environments. Food-based learning resources encourage learners to engage actively with scientific concepts through observation, questioning, and interpretation (Macrides & Angeli, 2018; Rüütmann, 2023). This engagement aligns with constructivist principles commonly

adopted in educational technology, where learners are positioned as active constructors of knowledge rather than passive recipients of information (Guo, 2018; Chimalakonda & Nori, 2018).

Third, food-based learning resources are conceptually linked to flexible instructional design. The reviewed studies suggest that such resources can be adapted across different learning settings, educational levels, and instructional strategies (Harrison et al., 2022; Galés & Gallon, 2019). Their pedagogical value does not depend on a single mode of delivery, but on their capacity to be embedded within diverse learning designs, including technology-enhanced and blended learning environments (Abeywardena, 2023; Dhakal, 2023).

Synthesis of Conceptual Findings within the Proposed Framework

The synthesis of this conceptual review integrates the key findings from the preceding sections into a coherent pedagogical framework that positions Sacha Inchi–based plant milk as a contextual learning resource. Rather than presenting discrete thematic insights, this synthesis articulates how the identified concepts contextual learning, scientific literacy, nutritional awareness, and educational technology converge within a unified conceptual structure (Abichandani et al., 2022; Chimalakonda & Nori, 2020; Dhakal, 2023). The primary result of this synthesis is the clarification of pedagogical alignment among these domains, demonstrating conceptual coherence rather than causal relationships.

Across the reviewed literature, contextual learning consistently emerges as a foundational pedagogical principle that emphasizes the use of real-life phenomena to support meaning-making. The synthesis indicates that contextual learning provides the pedagogical logic through which learning resources are selected and utilized (Guo, 2018; Rohse & Anderson, 2006). Within this logic, Sacha Inchi–based plant milk is positioned as a real-world phenomenon that enables learners to engage with scientific concepts through familiar and meaningful contexts (Chansuvarn & Panich, 2024; Chimalakonda & Nori, 2020).

Scientific literacy and nutritional awareness, as discussed in earlier sections, are conceptually intertwined within this framework. Scientific literacy is understood as learners' capacity to interpret and apply scientific knowledge, while nutritional awareness represents a domain-specific extension of this capacity in relation to food and nutrition (Rüütmann, 2023; Taylor et al., 2019; Lai et al., 2025). The synthesis demonstrates that both constructs are supported conceptually by contextualized engagement, rather than by isolated content instruction. Learning resources grounded in everyday phenomena function as mediators that connect abstract concepts to lived experiences, thereby supporting integrated understanding (Kuhnlein & Erasmus, 2019; Chalvon-Demersay et al., 2023).

Educational technology serves as the organizing dimension that enables this integration. The literature reviewed emphasizes that educational technology is concerned with the systematic design and integration of learning resources, not merely with the deployment of digital tools (Chimalakonda & Nori, 2018). Within the proposed framework, educational technology provides the pedagogical structure that aligns contextual learning principles with the purposeful use of learning resources (Abeywardena, 2023). This alignment ensures that contextual phenomena, such as Sacha Inchi–based plant milk, are embedded within coherent instructional designs that support conceptual learning.

The synthesized findings align directly with the proposed conceptual framework illustrated in Figure 1. The framework places Sacha Inchi–based plant milk at the center as a contextual learning resource, surrounded by interconnected pedagogical domains. Contextual learning principles frame how the resource is engaged, while scientific literacy and nutritional awareness represent conceptual outcome domains that are mutually reinforcing. Educational technology and pedagogical design function as a supporting layer that facilitates integration without implying causality (Galés & Gallon, 2019; Dhakal, 2023).

Importantly, the synthesis confirms that the framework represents conceptual relationships rather than instructional effects. The interactions depicted are non-linear and non-causal, reflecting pedagogical coherence instead of outcome prediction. This alignment reinforces the validity of the framework as a conceptual contribution rather than an evaluative model (Chimalakonda & Nori, 2020).

CONCLUSION

This conceptual review has positioned Sacha Inchi–based plant milk as a contextual learning resource that holds pedagogical relevance for the development of scientific literacy and nutritional awareness. Rather than framing learning in terms of instructional outcomes or effectiveness, the review emphasizes the importance of conceptual alignment among learning resources, contextual learning principles, and educational technology. The findings suggest that real-world phenomena derived from everyday practices can function as meaningful entry points for science learning when they are purposefully integrated into pedagogical design.

The synthesis highlights a broader pedagogical shift from content-centered instruction toward context-centered learning, in which learning resources mediate learners' engagement with scientific concepts. Within this shift, food-based innovations such as Sacha Inchi–based plant milk exemplify how interdisciplinary contexts can support integrated understanding across science, nutrition, and sustainability domains. Scientific literacy and nutritional awareness are thus conceptualized as interconnected constructs that emerge through contextualized engagement rather than through isolated content delivery.

From the perspective of educational technology, this review underscores the role of learning resource selection and integration as central elements of pedagogical design. Educational technology is framed not merely as the use of digital tools, but as a design-oriented discipline that organizes learning resources to support meaningful learning experiences. The proposed conceptual framework provides a theoretical foundation for educators, instructional designers, and researchers to consider how contextual learning resources can be systematically incorporated into science and nutrition education.

As a conceptual contribution, this study does not offer prescriptive instructional models or empirical validation. Instead, it provides a theoretical lens through which future research may explore the design, implementation, and evaluation of contextual learning resources in diverse educational settings. Subsequent studies may build upon this framework through design-based research or empirical investigations to examine how food-based learning resources function in practice. In this way, the review contributes to ongoing discussions in pedagogy and educational technology by advancing a vision of learning that is contextual, interdisciplinary, and grounded in everyday life.

REFERENCES

Abeywardena, I. (2023). OXREF: Open XR for education framework. *The International Review of Research in Open and Distributed Learning, 24*(3), 185–206. https://doi.org/10.19173/irrodl.v24i3.7109

Abichandani, P., Sivakumar, V., Lobo, D., Iaboni, C., & Shekhar, P. (2022). Internet-of-things curriculum, pedagogy, and assessment for STEM education: A review of literature. *IEEE Access, 10*, 38351–38369. https://doi.org/10.1109/access.2022.3164709

Akintayo, O., Eden, C., Ayeni, O., & Onyebuchi, N. (2024). Evaluating the impact of educational technology on learning outcomes in the higher education sector: A systematic review. *International Journal of Management & Entrepreneurship Research, 6*(5), 1395–1422. https://doi.org/10.51594/ijmer.v6i5.1091

Alemayehu, D., & Getaneh, G. (2021). Nutritional composition and health benefits of plant-based milk alternatives: A review. *Food Science & Nutrition, 9*(5), 2632–2642. https://doi.org/10.1002/fsn3.2234

Andayani, S., Prasetyo, T., Wijaya, A., Sukmasari, M., Umyati, S., & Nainggolan, M. (2024). Prediction model of Sacha Inchi crop development based on technology and farmers' perception of socio-economic factors. *Sustainability, 16*(7), 2680. https://doi.org/10.3390/su16072680

Aprilo, I., Arfanda, P., Mappaompo, M., & Saleh, M. (2023). Technology adaptation in 21st century physical education learning: Literature review. *Jurnal Dunia Pendidikan, 3*(2), 102–107. https://doi.org/10.55081/jurdip.v3i2.858

Arias, L. A., Ramos, D. F., & Andrade, C. (2022). Functional properties of Sacha Inchi (*Plukenetia volubilis* L.) oil and protein in human nutrition. *Journal of Food Biochemistry, 46*(2), e14012. https://doi.org/10.1111/jfbc.14012

Bizami, N., Tasir, Z., & Kew, S. (2022). Innovative pedagogical principles and technological tools capabilities for immersive blended learning: A systematic literature review. *Education and Information Technologies, 28*(2), 1373–1425. https://doi.org/10.1007/s10639-022-11243-w

Cárdenas Sierra, D. M., Gómez Rave, L. J., & Soto, J. A. (2021). Biological activity of Sacha Inchi (*Plukenetia volubilis* Linneo) and potential uses in human health: A review. *Food Technology and Biotechnology, 59*(3), 253–266. https://doi.org/10.17113/ftb.59.03.21.6683

Chalvon-Demersay, T., Azzout-Marniche, D., Arfsten, J., Egli, L., Gaudichon, C., Karagounis, L. G., & Tomé, D. (2023). Plant-based dairy alternatives contribute to a healthy and sustainable diet. *Nutrients, 15*(15), 3393. https://doi.org/10.3390/nu15153393

Chansuvarn, W., & Panich, S. (2024). Nutritional and sensory properties of plant-based milk produced from Sacha Inchi seeds (*Plukenetia volubilis* L.). *Food Science and Applied Biotechnology, 7*(1), 14. https://doi.org/10.30721/fsab2024.v7.i1.303

Chen, H., Huang, J., & Li, S. (2021). Nutritional evaluation of novel plant-based beverages and their role in sustainable diets. *Frontiers in Nutrition, 8*, 654987. https://doi.org/10.3389/fnut.2021.654987

Chimalakonda, S., & Nori, K. (2018). A patterns based approach for design of educational technologies. *arXiv*. https://doi.org/10.48550/arxiv.1802.02663

Chimalakonda, S., & Nori, K. (2020). An ontology-based modeling framework for design of educational technologies. *Smart Learning Environments, 7*(1), Article 15. https://doi.org/10.1186/s40561-020-00135-6

Chirinos, R., Necochea, O., Pedreschi, R., & Campos, D. (2016). Sacha Inchi (*Plukenetia volubilis* L.) shell: An alternative source of phenolic compounds and antioxidants. *International Journal of Food Science & Technology, 51*(4), 986–993. https://doi.org/10.1111/ijfs.13049

Chuks, O., & Nebechi, N. (2016). Comparative study of the impact of instructional materials and technology on traditional and distance education systems. *International Journal for Innovation Education and Research, 4*(2), 71–78. https://doi.org/10.31686/ijier.vol4.iss2.519

Cordero-Clavijo, L. M., Serna-Saldívar, S. O., Lazo-Vélez, M. A., González, J. F. A., Panata-Saquicilí, D., & Briones-Garcia, M. (2021). Characterization, functional and biological value of protein-enriched defatted meals from Sacha Inchi (*Plukenetia volubilis*) and chocho (*Lupinus mutabilis*). *Journal of Food Measurement and Characterization, 15*(6), 5071–5077. https://doi.org/10.1007/s11694-021-01084-5

Craig, W. J., Messina, V., Rowland, I., Frankowska, A., Bradbury, J., Smetana, S., & Medici, E. (2023). Plant-based dairy alternatives contribute to a healthy and sustainable diet. *Nutrients, 15*(15), 3393. https://doi.org/10.3390/nu15153393

Dhakal, B. (2023). Digital pedagogy: An effective model for 21st century education. *Academic Journal of Mathematics Education, 5*(1), 1–9. https://doi.org/10.3126/ajme.v5i1.54534

Galés, N., & Gallon, R. (2019). Integrating education, technology, and SDGs: A three-pronged collaboration. In *Proceedings of the ATEE International Conference* (pp. 10–22). https://doi.org/10.22364/atee.2019.itre.01

Goodrich, A., & Vũ, K. (2023). Engaged pedagogy in teacher education: A literature review. *International Journal of Music Education, 43*(2), 217–228. https://doi.org/10.1177/02557614231198198

Guo, H. (2018). Application of a computer-assisted instruction system based on constructivism. *International Journal of Emerging Technologies in Learning (iJET), 13*(4), 33–44. https://doi.org/10.3991/ijet.v13i04.8468

Harrison, M., Paskevicius, M., DeVries, I., & Morgan, T. (2022). Crowdsourcing the (un)textbook: Rethinking and future thinking the role of the textbook in open pedagogy. *The Open/Technology in Education, Society, and Scholarship Association Journal, 2*(1), 1–17. https://doi.org/10.18357/otessaj.2022.2.1.30

Khan, P., Johl, S., Akhtar, S., Asif, M., Salameh, A., & Kanesan, T. (2022). Open innovation of institutional investors and higher education system in creating open approach for SDG-4 quality education: A conceptual review. *Journal of Open Innovation: Technology, Market, and Complexity*, *8*(1), 49. https://doi.org/10.3390/joitmc8010049

Kim, D.-S., & Joo, N. (2019). Nutritional composition of Sacha Inchi (*Plukenetia volubilis* L.) as affected by different cooking methods. *International Journal of Food Properties, 22*(1), 1235–1241. https://doi.org/10.1080/10942912.2019.1640247

Kuhnlein, H. V., & Erasmus, B. (2019). Indigenous plant-based foods for improved nutrition and sustainable diets. *Global Food Security, 22*, 75–81. https://doi.org/10.1016/j.gfs.2019.01.007

Li, W., Li, Q., Feng, Q., & Luo, H. (2022). Panoramic video in education: A systematic literature review from 2011 to 2021. *Journal of Computer Assisted Learning*, *39*(1), 1–19. https://doi.org/10.1111/jcal.12730

Macrides, E., & Angeli, C. (2018). Investigating TPCK through music focusing on affect. *International Journal of Information and Learning Technology, 35*(3), 181–198. https://doi.org/10.1108/ijilt-08-2017-0081

Martínez, D., Saavedra, G., Flórez-Tuta, N., Quijano, E., & Castañeda, A. (2023). Towards a productive model for the Sacha Inchi value chain: A scientometric approach. *Scientia Agropecuaria, 14*(4), 549–569. https://doi.org/10.17268/sci.agropecu.2023.046

McNamara, J., Mena, N. Z., Neptune, L., & Parsons, K. (2021). College students' views on functional, interactive and critical nutrition literacy: A qualitative study. *International Journal of Environmental Research and Public Health, 18*(3), 1124. https://doi.org/10.3390/ijerph18031124

Nielsen, J. S., & Bøgh, S. A. (2021). Consumer acceptance of plant-based milk: Nutritional and sensory perspectives. *Appetite, 162*, 105177. https://doi.org/10.1016/j.appet.2021.105177

Penagos-Calvete, D., Duque, V., Marimon, C., Parra, D., Restrepo-Arango, S., & Scherf-Clavel, O. (2019). Glycerolipid composition and advanced physicochemical considerations of Sacha Inchi oil toward cosmetic products formulation. *Cosmetics, 6*(4), 70. https://doi.org/10.3390/cosmetics6040070

Ramos-Escudero, F., & Alvarado-Ortiz, C. (2021). Bioactive compounds in Sacha Inchi: Nutritional and therapeutic potential. *Foods, 10*(5), 998. https://doi.org/10.3390/foods10050998

Rüütmann, T. (2023). Engineering pedagogy and engineering educators' competency model for effective teaching and learning STEAM. *Problems of Education in the 21st Century, 81*(4), 531–546. https://doi.org/10.33225/pec/23.81.531

Sławińska, N., & Olas, B. (2022). Selected seeds as sources of bioactive compounds with diverse biological activities. *Nutrients, 15*(1), 187. https://doi.org/10.3390/nu15010187

Singh, R., & Kaur, N. (2021). Nutritional assessment and market trends of plant-based milk alternatives. *Journal of Food Processing and Preservation, 45*(6), e15678. https://doi.org/10.1111/jfpp.15678

Tariq, M., & Riaz, M. (2023). Sustainability of plant-based proteins in combating malnutrition and stunting. *Frontiers in Sustainable Food Systems, 7*, 1102869. https://doi.org/10.3389/fsufs.2023.1102869

Taylor, M., Sullivan, D., Ellerbeck, E., Gajewski, B., & Gibbs, H. (2019). Nutrition literacy predicts adherence to healthy/unhealthy diet patterns in adults with a nutrition-related chronic condition. *Public Health Nutrition, 22*(12), 2157–2169. https://doi.org/10.1017/S1368980019001289

Wang, J., Liu, Q., & Hu, J. (2022). Environmental and nutritional comparison between cow's milk and plant-based alternatives. *Sustainability, 14*(8), 4805. https://doi.org/10.3390/su14084805