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LESSONS FROM EMERGENCY REMOTE TEACHING IN VOCATIONAL NUTRITION HIGHER EDUCATION: A CROSS-SECTIONAL EVALUATION OF STUDENT READINESS, PLATFORM OPTIMIZATION, AND PRACTICAL LEARNING

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ABSTRACT

The emergency transition to remote teaching during the COVID-19 pandemic presented unique pedagogical challenges for vocational nutrition education, which relies heavily on psychomotor skill acquisition and direct laboratory practical learning. This study evaluated the implementation of emergency online learning in the Diploma 3 Nutrition Study Program at Poltekkes Kemenkes Tasikmalaya during the Even Semester of the 2019/2020 Academic Year to inform future blended learning strategies. Utilizing a mixed-methods cross-sectional evaluative design grounded in an integrated Kirkpatrick and CIPP evaluation framework, a census survey was conducted among all active students (N = 116, 100% response rate) using a validated 29-item electronic instrument. Quantitative data were analyzed using descriptive statistics, while open-ended responses underwent thematic analysis. Students exhibited general technological readiness, spending an average of IDR 35,000–41,000 weekly on internet data. However, instructional delivery was sub-optimal for psychomotor laboratory sessions and community field practice supervision. While cognitive knowledge transfer was maintained, practical skill acquisition suffered due to key operational friction: excessive faculty task loads, network instability, and digital fatigue. Students expressed a strong preference for a balanced hybrid model combining synchronous and asynchronous modalities with engaging instructional media. Emergency online teaching preserved theoretical continuity but proved insufficient for psychomotor competency mastery in vocational nutrition education. Strategic action plans must focus on pedagogical re-engineering via an inverted/flipped classroom sequence (National Standard for Indonesia Higher Education compliant), establishing platform selection hierarchies, enhancing faculty "High-Teach" digital capacity, providing data subsidies, and developing dedicated media production studios for practical demonstrations.
Keywords: Blended Learning; Competency-Based Education; Emergency Remote Teaching; Program Evaluation; Vocational Nutrition Education

INTRODUCTION

The global disruption caused by the COVID-19 pandemic triggered an accelerated, irreversible shift toward digital and blended learning modalities across higher health education (Hew et al., 2021). In Indonesia, this transition was legally driven by national and regional health emergency mandates, including Large-Scale Social Restrictions under Tasikmalaya Mayor Decree No. 443/Kep.299-Baghuk/2020, which prompted internal institutional directives (e.g., Poltekkes Kemenkes Tasikmalaya Circular Letter) ordering immediate Work-From-Home (WFH) protocols and emergency remote teaching. During this emergency period, instructional delivery was restructured across three primary digital learning environments: virtual synchronous

(live video lectures), self-paced asynchronous (independent learning management system modules), and collaborative asynchronous modes (online discussion boards and group projects).
However, while theoretical discipline areas transitioned to e-learning with relative technical ease, higher vocational nutrition education presents unique structural and pedagogical characteristics. Unlike general academic education, vocational nutrition programs are explicitly designed around Competency-Based Education (CBE) frameworks to ensure direct workforce readiness (Heitman et al., 2024; O'Donovan et al., 2021). These programs require students to master complex psychomotor and interpersonal skill sets across four core domain pillars are Clinical Dietetics: Nutritional assessment, care planning, and patient counselling,

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However, while theoretical discipline areas transitioned to e-learning with relative technical ease, higher vocational nutrition education presents unique structural and pedagogical characteristics. Unlike general academic education, vocational nutrition programs are explicitly designed around Competency-Based Education (CBE) frameworks to ensure direct workforce readiness (Heitman et al., 2024; O'Donovan et al., 2021). These programs require students to master complex psychomotor and interpersonal skill sets across four core domain pillars are Clinical Dietetics: Nutritional assessment, care planning, and patient counselling,

Community Nutrition Interventions: Fieldwork, population health surveillance, and nutritional program planning, Food Service Systems Management: Large-scale meal planning, menu standardization, and institutional food safety, and Food Science and Nutritional Chemistry: Laboratory-based nutrient analysis, food quality control, and culinary dietetics.

Consequently, ensuring instructional quality and rigorous competency monitoring during emergency remote transitions becomes an urgent institutional mandate to comply with National Standards for Higher Education (*Permendikbud No. 3 Year 2020 / SN-Dikti*). Despite the rapid adoption of digital tools, higher health education institutions face a profound pedagogical tension between facilitating cognitive knowledge acquisition and building practical psychomotor competencies remotely. Empirical studies establish that online learning modalities effectively support theoretical comprehension; digitized repositories, recorded lectures, and self-paced modules allow students to process theoretical nutrition science at their individual pace (García-González et al., 2021; Griffin, 2024).

Conversely, the efficacy of virtual environments in developing complex psychomotor and field-based competencies remains highly problematic (Foronda et al., 2021). Vocational nutrition training and education relies heavily on physical, tactile, and sensory interaction—such as calibrating anthropometric equipment, conducting clinical physical examinations, performing food chemistry titrations, and facilitating face-to-face community counseling. In workplace training, international institutions rely on Entrustable Professional Activities (EPAs) to assess whether students can safely perform clinical tasks independently (Bramley et al., 2022). Replicating these observational, workplace-based assessments in virtual spaces introduces significant friction due to the lack of haptic feedback and real-time physical error correction.

A critical knowledge gap persists in the higher education literature: while extensive research evaluates general student satisfaction during emergency e-learning, studies evaluating vocational nutrition higher education—which demands a specialized blend of laboratory rigor, pedagogical content knowledge, and field supervision—remain scarce (O'Donovan et al., 2021; Torggler et al., 2023). Most available evaluations focus on general university courses or health theory, leaving a lack of empirical evidence regarding how emergency remote teaching affects multi-cohort vocational nutrition students across theoretical, laboratory, and field practice modules.

To systematically analyze the quality, operational delivery, and competency outcomes of emergency remote teaching, this study synthesizes Kirkpatrick's Four-Level Training Evaluation Model (Reaction, Learning, Behavior, Results) with the Context, Input, Process, and Product (CIPP) Evaluation Model (Frye & Hemmer, 2022), while incorporating the Nutritional Technological Pedagogical Content Knowledge (N-TPACK) framework (Torggler et al., 2023).

This study evaluates the emergency online teaching and learning process implemented in the Diploma 3 Nutrition Study Program at Poltekkes Kemenkes Tasikmalaya during the Even Semester of the 2019/2020 Academic Year (evaluating lectures, practicals, midterms, finals, and field practice examinations from meetings 6 to 14). The overarching goal is to generate empirical insights to optimize institutional readiness and refine pedagogical strategies for subsequent academic terms.

MATERIALS AND METHODS

This study employed a mixed-methods cross-sectional evaluative design combining quantitative survey data with qualitative open-ended inquiry (Creswell & Creswell, 2021). The mixed-methods approach was selected to provide a comprehensive evaluation of emergency remote teaching by capturing both numerical satisfaction trends and qualitative contextual nuances regarding practical skill acquisition.

The study was conducted at the Department of Nutrition, Poltekkes Kemenkes Tasikmalaya, West Java, Indonesia. Data collection was carried out electronically over a one-week period from July 7, 2020, to July 15, 2020, evaluating the online teaching and learning process implemented during the Even Semester of the 2019/2020 Academic Year.

The target population comprised all active undergraduate students enrolled in the Diploma 3 Nutrition Study Program at Poltekkes Kemenkes Tasikmalaya during the 2019/2020 Academic Year. A total population sampling (census) technique was utilized to minimize sampling bias and ensure representation across all academic levels (Taherdoost, 2021). Total Sample Size: N = 116 students, achieving a 100% response rate across three cohorts: Level 1 (First Year): n = 39 students, Level 2 (Second Year): n = 39 students, and Level 3 (Third Year): n = 38 students.

Inclusion criteria were 1. Active enrollment in the Diploma 3 Nutrition Study Program, Poltekkes Kemenkes Tasikmalaya, during the Even Semester Academic Year 2019/2020, 2. Participation in online lectures, laboratory practicals, or field practices during meetings 7 through 14, and 3. Willingness to complete the institutional online learning evaluation instrument. Exclusion criteria were 1. Students on official academic

leave or non-active status during the survey administration window and 2. Incomplete or duplicate survey submissions (identified during data cleaning).

The evaluation instrument was developed based on an adapted multi-level evaluation framework integrating Kirkpatrick's Learning Evaluation Model (Levels 1–3) with the CIPP (Context, Input, Process, Product) Model tailored for health vocational education (Frye & Hemmer, 2022; O'Donovan et al., 2021). Key variables were operationalized across three functional levels. Level 1 is Reaction and User Satisfaction (Context & Input Evaluation). Measures student satisfaction, readiness, hardware utilization, internet connectivity sources, weekly financial costs, platform usage frequency vs. comfort (e.g., WhatsApp, Google Classroom, Zoom, Vilep), and lecturer clarity/media quality. Level 2 is Learning Outcomes and Competency Retention (Process Evaluation) Measures student-perceived understanding of theoretical course content (cognitive) versus practical/psychomotor nutrition skills (e.g., anthropometric assessment, food chemistry, culinary dietetics, clinical nutrition counseling, and field practice supervision). Level 3 is Operational Implementation and Behavioral Barriers (Product Evaluation). Evaluates operational execution, schedule compliance, assignment workload distribution, external infrastructure barriers (network/costs), faculty communication factors, and student-proposed recommendations.

Data were collected using a structured electronic questionnaire developed through the modification of the official online learning monitoring and evaluation instrument issued by the Directorate of Poltekkes Kemenkes Tasikmalaya. The questionnaire consisted of 29 items combining closed-ended Likert-scale questions, multiple-choice options, and open-ended qualitative prompts. The instrument was structured into three major sections. Section A is Student Demographics and Technological Infrastructure (domicile, hardware, connection type, network provider, weekly internet expenses, learning readiness). Section B is Online Learning Process Evaluation (schedule compliance, asynchronous vs. synchronous delivery modalities, platform deployment frequency and comfort, instructor clarity, media quality, practical/ field practical satisfaction, assignment frequency). Section C is Operational Barriers and Open Recommendations (faculty-related obstacles, technical infrastructure barriers, internal motivation factors, and open feedback).

The modified quantitative items underwent expert panel review by senior nutrition educators to confirm face and content validity. Internal consistency reliability testing yielded a Cronbach's alpha of alpha = 0.84, indicating high reliability for evaluative survey instruments (Taber, 2021).

The questionnaire was digitized via Google Forms and distributed using an institutional short URL. Formal administration was authorized through an official cover letter issued by the Head of the Nutrition Department on July 7, 2020 (Ref. No: PP.05.03/5.4/0184/2020).

Following data collection, raw survey outputs were exported, recapitulated, and audited during a formal data cleaning phase to verify data integrity and resolve any missing entries. Quantitative data were analyzed using a statistical software. Descriptive Statistics: Frequencies (n), percentages (%), means (ẋ), standard deviations (SD), and ranges (min–max) were computed to describe demographic profiles, platform choices, weekly expenditures, and satisfaction scores across cohort levels. Comparative Cross-Tabulation: Cross-cohort comparisons (Level 1 vs. Level 2 vs. Level 3) were conducted to identify variations in platform preferences, learning readiness, and competency satisfaction.

Qualitative data gathered from open-ended survey items (Section C) were analyzed using Thematic Analysis following the six-phase framework established by Braun and Clarke (Braun & Clarke, 2021). Responses were systematically coded and categorized into primary operational themes using a qualitative analysis software. The coding process focused on identifying recurrent patterns related to faculty teaching practices, infrastructure limitations, student psychological fatigue, and actionable pedagogical recommendations.

This study was conducted in strict compliance with institutional ethical standards for educational research involving human participants. Administrative authorization and ethical clearance were granted under the official letter from the Department of Nutrition, Poltekkes Kemenkes Tasikmalaya (No. PP.05.03/5.4/0184/2020).

Electronic informed consent was embedded on the landing page of the online survey form. Participants were fully informed regarding the academic purpose and voluntary nature of the evaluation survey, the assurance of strict data anonymity and confidentiality, and their right to decline or withdraw from participation without any impact on their academic evaluation or course grades. All collected data were anonymized prior to statistical processing and stored securely in password-protected institutional cloud storage accessible only to the primary research team.

RESULTS AND DISCUSSION

The evaluation of online teaching and learning processes conducted during the Even Semester of the 2019/2020 Academic Year at the Department of Nutrition, Poltekkes Kemenkes Tasikmalaya, yielded comprehensive data regarding student demographics, technological infrastructure, satisfaction levels, competency acquisition, and underlying operational barriers. The results are structured below in accordance with an adapted multi-level evaluation framework tailored for vocational nutrition education.

Demographic Characteristics and Technological Infrastructure

A total of three cohort levels (Level 1, Level 2, and Level 3 students) participated in the evaluation. As detailed in Table 1, living conditions during emergency remote teaching shifted completely to home environments for upper-level students (100% of Level 2 and Level 3 resided with their parents), whereas Level 1 students demonstrated minor residential variance, with a small portion living with relatives or residing in student dormitories/boarding houses (*pesantren*).

Hardware accessibility was dominated by personal laptops/notebooks across all cohorts, supplemented by tablets and smartphones, while desktop computers accounted for only a marginal fraction. Mobile data tethering from personal devices served as the primary internet connection source for most students across all academic years, supplemented by Wi-Fi, LAN, and shared tethering. Provider usage was overwhelmingly dominated by Telkomsel across all three levels, directly driven by institutional data quota subsidies distributed by the Directorate of Poltekkes Kemenkes Tasikmalaya.

Financial expenditure for internet connectivity exhibited substantial variance, ranging from IDR 112 to IDR 200,000 per week per student. Level 1 students recorded the highest average weekly expenditure. In terms of psychological and operational readiness for online learning, the majority of students across all levels categorized themselves as "ready," followed by "less ready," with only small proportions reporting being "very ready" or "unready."

Table 1 Student demographic characteristics and technological access during emergency remote teaching

Demographic and Infrastructure Variable	Level 1 (First Year)	Level 2 (Second Year)	Level 3 (Third Year)
Primary Domicile	Parents' house (majority), relatives, dormitory/pesantren	Parents' house (100%)	Parents' house (100%)
Hardware Utilized	Laptop/Notebook (dominant), Tablet/Smartphone, Desktop PC	Laptop/Notebook (dominant), Tablet/Smartphone	Laptop/Notebook (dominant), Tablet/Smartphone
Internet Connection Source	Personal Mobile Tethering (dominant), Wi-Fi, Shared Tethering	Personal Mobile Tethering (dominant), Wi-Fi, LAN	Personal Mobile Tethering (dominant), Wi-Fi, LAN
Network Provider	Telkomsel (dominant via institutional quota subsidy)	Telkomsel (dominant)	Telkomsel (dominant)
Weekly Connection Cost	Highest average expenditure (Range: IDR 112 – IDR 200,000)	Moderate expenditure (Range: IDR 112 – IDR 200,000)	Moderate expenditure (Range: IDR 112 – IDR 200,000)
Perceived Learning Readiness	Predominantly Ready, followed by Less Ready	Predominantly Ready, followed by Less Ready	Predominantly Ready, followed by Less Ready

Level 1: Student and Educator Reaction (Satisfaction and Engagement)

Student reactions to online learning delivery revealed a notable divergence between pedagogical implementation and user comfort preference. Across all academic levels, students confirmed that online lecture execution adhered strictly to the pre-established semester lesson plans and class timetables. Lecturers' clarity in delivering instructional material was rated as "sufficiently clear" by the majority, while instructional media quality—encompassing infographics, diagrams, animations, and video content—was rated as "good" to "sufficient."

Regarding delivery modalities, a blended learning model (a combination of synchronous and asynchronous methods) was the most frequently implemented model reported by Level 1, Level 2, and Level 3 students. However, Level 3 students reported a significantly higher proportion of purely synchronous learning compared to lower levels, attributable to intensive briefing sessions, student presentations for Public Health Nutrition Field Practice, and final project report defenses. When evaluating student preference, blended learning emerged as the most favored approach across all cohorts, followed by synchronous interaction, with standalone asynchronous learning being the least preferred.

Platform usage analysis demonstrated a mismatch between institutional deployment frequency and student user comfort, as summarized in Table 2. WhatsApp was identified as the most frequently used communication tool by faculty. Among Level 1 and Level 2 students, Google Classroom, Vilep (the institutional LMS of Poltekkes Kemenkes Tasikmalaya), and Google Meet were secondary platforms. For Level 3, Zoom was the most frequently deployed tool due to field practice defenses and final project examinations. However, when ranked by student comfort, Google Classroom was rated as the most comfortable platform by Level 1 and Level 2 students, whereas Zoom was rated highest by Level 3 students. Vilep ranked lowest in perceived user comfort despite being the official institutional portal.

Table 2 Comparison of faculty digital platform implementation and student preference rankings across academic cohorts

Satisfaction and Platform Parameter	Most Frequently Implemented by Faculty	Most Comfortable Platform Rated by Students
Level 1 and Level 2 (Junior Cohorts)	WhatsApp (highest), Google Classroom, Vilep, Google Meet	1. Google Classroom 2. WhatsApp 3. Google Meet 4. Zoom 5. Vilep
Level 3 (Senior Cohort - Field Practices and Final project)	Zoom (highest for Field Practices and Final project), WhatsApp	1. Zoom 2. Google Classroom 3. WhatsApp 4. Google Meet 5. Vilep

Engagement metrics revealed substantial dissatisfaction regarding academic guidance and workload distribution. Level 1 and Level 2 students noted that faculty consistently assigned homework after every online session. While Level 3 students acknowledged that assignments aligned with original course syllabi, a clear majority of students across all three levels expressed dissatisfaction with online guidance and discussion sessions—specifically regarding practical lab consultations for Level 1 and 2, and final project/ field practical supervision for Level 3.

Level 2: Learning Outcomes (Cognitive vs. Psychomotor Competencies)

Evaluation of learning outcomes highlighted a profound disparity between cognitive material comprehension and practical psychomotor mastery. When comparing online learning to traditional face-to-face (luring) instruction, the dominant consensus among students was a marked decline in material comprehension. Only a small minority reported equivalent or improved comprehension under online delivery.

This deficit was most severe in practical skill modules. While theoretical concepts were successfully archived and accessible for repeated review—cited by Level 1 and Level 2 students as the primary advantage of online learning—the transition of laboratory sessions (meetings 7 through 14) and field practice to virtual

formats resulted in widespread dissatisfaction. Vocational nutrition competencies requiring hands-on physical execution—such as nutritional status assessment (anthropometric measurement), clinical dietary counseling, food service management, and culinary nutrition labs—suffered from a severe experiential gap.

Table 3 Evaluation of student perceptions and competency acquisition gaps across cognitive and psychomotor domains

Competency Domain	Target Vocational Skill / Content	Student Perception and Outcome Rating	Identified Competency and Satisfaction Gap
Cognitive Domain	Theoretical nutrition concepts, dietetics principles, lecture materials	Moderate; materials are documented and re-learnable, but overall understanding is lower than offline	Low to Moderate Gap: Theory can be reviewed asynchronously, but passive delivery reduces deep conceptual mastery.
Psychomotor Domain (Junior)	Anthropometric assessment, food chemistry labs, culinary dietetics (Meetings 7–14)	High Dissatisfaction; severe restriction in tactile and laboratory practice	Critical Gap: Inability to practice physical measurements and food preparation in standard laboratory environments.
Psychomotor and Field Domain (Senior)	Community Nutrition Field Practice, clinical dietetic counseling, final project	High Dissatisfaction regarding virtual supervision and virtual field execution	Critical Gap: Simulated community intervention lacks direct patient interaction, real-time feedback, and field immersion.

Level 3: Qualitative Insights on Practical Skill Acquisition and Learning Barriers

Categorization of qualitative data and open-ended student responses revealed three central themes explaining the operational friction and skill deficits observed during emergency online learning. Theme 1: The Challenge of Virtual Food Labs and Culinary Nutrition. Students highlighted that nutrition education relies inherently on psychomotor interaction—such as food portion estimation, sensory evaluation, laboratory chemical testing, and anthropometric tool handling. Transferring laboratory sessions (meetings 7–14) and community field practice to virtual platforms compromised the authenticity of practical skill acquisition. Students noted that watching demonstrations or submitting written reports failed to replace real-time physical practice, resulting in widespread dissatisfaction with practical lab outcomes across all year groups.

Theme 2: Adaptation Strategies and Pedagogical Demands in Skill Training. Open-ended feedback regarding recommendations for online learning improvement centered on two primary student demands: workload recalibration and enhanced instructional media. The most prevalent request across Level 1, Level 2, and Level 3 was for faculty to provide reasonable task submission deadlines and carefully evaluate assignment burdens. The second most frequent recommendation was the explicit integration of asynchronous audio explanations (voiceovers) or instructional video demonstrations accompanying lecture slides, moving away from text-heavy assignment replacements.

Theme 3: Technological, Institutional, and Internal Barriers in Hands-on Learning. An analysis of online learning obstacles categorized barriers into three distinct operational dimensions. 1. Educator/Faculty Factors: The predominant complaint reported by students was the frequent replacement of interactive teaching sessions with passive online assignments, alongside insufficient communicative interaction and limited feedback during practical/final project guidance. 2. Infrastructure and Facility Factors: Network instability was identified as the primary technological barrier, compounded by total lack of coverage in certain rural domiciles, insufficient hardware specifications, data package limitations (despite institutional provider subsidies), and technical difficulty in installing specialized software. Financial disparities were evident in weekly connection costs ranging up to IDR 200,000 per student. 3. Internal Motivation and Cognitive Factors: Reduced student concentration and online fatigue during prolonged screen exposure emerged as the primary psychological barrier, leading to decreased motivation and passive participation.

This study evaluated the implementation of emergency online learning within a higher vocational nutrition education setting, systematically examining student technological readiness, pedagogical execution, platform preferences, and multi-cohort competency acquisition. The empirical findings shed light on the structural, financial, and pedagogical friction that occurs when transitioning applied, hands-on health education into digital environments, while highlighting strategies to integrate institutional research downstreaming into vocational learning ecosystems.

The emergency transition to remote instruction successfully preserved basic academic continuity and schedule adherence across all three academic cohorts (N = 116). However, the remote modality presented substantial pedagogical limitations in facilitating core vocational competencies. While theoretical knowledge delivery remained functional, severe deficits emerged in psychomotor skill acquisition, clinical consultation exercises, laboratory practicals, and community field practice supervision.

Students across all cohorts reported significantly lower material comprehension for practical modules compared to traditional face-to-face instruction. Operational friction further compromised the learning experience, as students faced network instability and an economic burden averaging IDR 35,000 to IDR 41,000 per week for internet data packages. This financial strain was compounded by platform misalignment—such as over-reliance on synchronous video streaming or passive text messaging—and excessive assignment loads, which collectively fueled digital fatigue and reduced motivation among Generation Z learners. At the same time, institutional efforts to downstream functional food innovations into local communities demonstrate how applied research can bridge digital learning gaps by creating authentic, hands-on field ecosystems for vocational training.

Integration with Existing Literature and Institutional Competency Frameworks

Cognitive Knowledge Transfer vs. Psychomotor Competency Deficit

The observed divergence between theoretical comprehension and practical competency acquisition aligns with international literature on health professions and nutrition education during emergency remote teaching. Online learning modalities inherently excel at cognitive knowledge transfer because digital repositories, pre-recorded lectures, and asynchronous slide decks allow students to review theoretical content at their own pace (García-González et al., 2021). Junior cohorts in this study highlighted asynchronous self-paced review as a key advantage, echoing global health education findings where e-learning platforms enhanced self-regulated learning for baseline conceptual topics (Hew et al., 2021).

Institutional Implementation of Competency-Based Education (CBE) in Nutrition

When benchmarked against international institutions, the challenge of measuring and developing core nutrition competencies through remote channels is a widespread phenomenon. In a systematic review of competency-based assessment (CBA) across higher education institutions offering nutrition and dietetics programs, O'Donovan et al. (2021) highlighted that while cognitive outcomes and self-perceived communication skills can be mapped digitally, direct workplace skill verification—such as anthropometric measurement, motivational interviewing, and clinical food service management—demands rigorous observational assessment frameworks. Institutions implementing hybrid Competency-Based Education (CBE) programs in dietetics have increasingly adopted structured workplace evaluations to ensure students achieve professional entry-level benchmarks (Heitman et al., 2024).

To bridge the gap in work-based public health and clinical dietetics competencies during remote or hybrid learning, several leading training institutions have embedded Entrustable Professional Activities (EPAs) into electronic portfolios (e-portfolios) (Bramley et al., 2022). EPAs provide preceptors with a structured mechanism to directly observe, grade, and entrust students with specific nutrition care tasks. The absence of such systematic EPA mechanisms during emergency remote teaching at Poltekkes Kemenkes Tasikmalaya largely explains the high levels of student dissatisfaction regarding virtual practical sessions and field practice supervision.

Pedagogical Strategies, Research Downstreaming, and Technological Integration

In response to digital delivery challenges, institutions globally have pivoted toward active learning paradigms. Griffin (2024) demonstrated that integrating Problem-Based Learning (PBL) within the Community of Inquiry (CoI) framework—balancing social, cognitive, and teaching presences—significantly enhances student critical thinking and practical decision-making during online dietetic coursework. Furthermore, the specialized nature of vocational nutrition education requires faculty to possess domain-specific technological skills. Torggler et al. (2023) established the Nutritional Technological Pedagogical Content Knowledge (N-TPACK) framework for vocational health and nutritional science educators,

emphasizing that faculty must combine nutritional expertise with interactive digital media tools rather than relying on passive document sharing or excessive offline assignments.

Empirical evidence from local institutional initiatives underscores the power of integrating applied research downstreaming with educational interventions. Sumarto et al. (2023) evaluated a community-based nutrition education and downstreaming intervention involving Micro, Small, and Medium Enterprises (MSMEs) in Manonjaya District and Sukajadi Village (Cisayong District, Tasikmalaya Regency). The intervention downstreamed institutional research innovations—specifically instant synbiotic yogurt powder derived from local legumes (green and red beans) and Manonjaya salak fruit (*Salacca zalacca*)—using a combination of structured lectures, interactive discussions, live demonstration methods, and a copyrighted pocketbook (*HKI No. 000389023*). These empirical findings confirm that coupling visual educational media with practical product demonstrations significantly improves cognitive mastery and practical application compared to abstract theoretical delivery alone (Sumarto et al., 2023). In a vocational nutrition curriculum, incorporating institutional research downstreaming—such as assisting MSMEs with local synbiotic food processing, safety regulations, and functional nutrition—provides a tangible, real-world ecosystem where students can participate in field practice, bridging the gap between digital theory and practical community execution (Sumarto et al., 2023).

Psychomotor Obstacles and Operational Friction

Despite pedagogical adaptations, the physical execution of nutrition competencies—including anthropometric equipment calibration, laboratory food chemistry analysis, culinary dietetics, and real-time patient counseling—suffers from an irreplaceable tactile deficit when restricted to virtual formats. Virtual simulations and instructional videos lack haptic feedback and immediate physical error correction, consistent with evaluations in nursing and allied health training (Foronda et al., 2021).

Additionally, the operational friction identified in this study underscores the distinction between planned online learning and emergency remote teaching (Hodges et al., 2020). Heavy faculty reliance on basic instant messaging applications (e.g., WhatsApp) rather than integrated Learning Management Systems (LMS) reflects initial adaptation hurdles common in low- and middle-income country (LMIC) institutions (Pokhrel & Chhetri, 2021), which ultimately exacerbated digital fatigue and reduced motivation among Generation Z students (Dost et al., 2021).

Theoretical, Institutional, and Pedagogical Implications

This study demonstrates that vocational nutrition education cannot adopt a uniform digital strategy across cognitive and psychomotor modules (Varga-Atkins et al., 2023). Based on empirical findings, international benchmarks, and local institutional research downstreaming evaluations (Sumarto et al, 2023), four strategic recommendations are proposed: The first, Inverted / Flipped Classroom Delivery: Course design should reverse traditional lecture-first approaches (Ruiz-Jiménez et al., 2021). Following *SN-Dikti* guidelines (1 credit = 50 min contact, 60 min structured task, and 60 min independent study), students engage first with self-paced asynchronous materials (Space 3: recorded voiceover presentations, short videos), proceed to collaborative discussion boards (Space 4), and utilize synchronous contact hours (Space 2: Google Meet/Zoom) exclusively for clinical case debriefs and complex problem-solving. Learning method must be structurally inverted compared to traditional face-to-face delivery: Step 1 (Self-Paced Asynchronous / Space 3): Students initiate learning independently via pre-recorded materials, short voiceover slides, or reading modules before live sessions. Step 2 (Collaborative Asynchronous / Space 4): Students engage in peer discussions, group case studies, or problem-solving exercises on LMS discussion boards. Step 3 (Synchronous / Space 2): Live contact hours (via Google Meet/Zoom) are reserved exclusively for clarifying complex concepts, conducting clinical case debriefs, and providing targeted feedback.

The second, Hybrid Practicum Architecture and EPA Assessment: Practical modules must adopt a hybrid structure. Cognitive preparation, virtual simulations (such as VR-based nutrition assessment or dietetic software), and protocol reviews should occur remotely, followed by high-density, small-batch face-to-face laboratory bootcamps where student competence is evaluated using Entrustable Professional Activities (EPAs) (Bramley et al., 2022; Heitman et al., 2024). To reduce financial overhead and technical friction while ensuring high accessibility, platforms must be deployed according to a strict priority hierarchy: (1) Synchronous Modalities (Live Interaction): Prioritize Google Meet and Zoom for interactive case discussions and scheduled debriefings. (2) Asynchronous Modalities (Course Management and Collaboration): Prioritize Google Classroom and Vilep (institutional LMS) as the primary learning hubs, supplemented by WhatsApp groups strictly for immediate communication and low-bandwidth updates.

The third, faculty N-TPACK Development and Applied Downstreaming: Institutions must invest in upskilling faculty competencies aligned with the N-TPACK framework (Torggler et al., 2023). Establishing dedicated media production studios, optimizing nutrition laboratory space (*i.e. educational and counselling nutrition laboratory*), and involving vocational students directly in downstreaming patented institutional research (such as instant synbiotic yogurt flour technology) to MSMEs in fostered villages creates authentic, experiential community learning opportunities (Sumarto et el, 2023).

Institutional capacity building must focus on empowering faculty to transition from passive task providers to high-engagement digital facilitators ("High-Teach" model), incorporating an understanding of Generation Z learning behaviors. Short-Term Initiatives: (1) Conduct faculty workshops on integrating embedded audio/voice narration into slide presentations, (2). Standardize the utilization of Google Classroom across all course coordinators, and (3) Disseminate actionable tips for engaging Generation Z learners and adapting to diverse student learning styles in digital spaces.

In Medium-Term Initiatives: Institutional advocacy for internet data subsidies and financial support to offset student costs for home practical materials. The last, but not least, Long-Term Initiatives: Upgrade institutional infrastructure by constructing dedicated digital media production studios and optimizing the Institutional Nutrition Laboratory (*i.e. Nutritional Education and Counselling lab.*) to serve as a video recording studio for high-quality practical demonstrations.

The fourth, Institutional Support and Subsidies: Targeted financial support for internet connectivity and practical material costs is essential to mitigate socioeconomic disparities among nutrition vocational students during remote or blended learning periods (García-González et al., 2021).

Several limitations should be considered when interpreting the results of this study. Self-Reported Data Bias: Student comprehension and practical skill acquisition were evaluated using self-reported survey perceptions rather than objective, standardized clinical skill assessments (e.g., Objective Structured Clinical Examinations / OSCE). Single-Institution Context: Data were collected exclusively from one vocational nutrition institution (Poltekkes Kemenkes Tasikmalaya), which may limit direct generalizability to institutions with different socioeconomic profiles or technological infrastructures. Cross-Sectional Scope: The study captured a single evaluation period during the initial emergency transition (Even Semester 2019/2020), which may not reflect long-term adaptation, technological upgrades, or post-emergency blended learning dynamics (Pokhrel & Chhetri, 2021).

CONCLUSION

Overall, students demonstrated basic technological readiness to engage in remote learning from their respective domiciles, incurring an average weekly internet expenditure of IDR 35,000 to IDR 41,000. However, the instructional process was sub-optimal—particularly for psychomotor laboratory practicals and community field practice supervision. Operational friction was driven by three primary interconnected factors: (1) Faculty-related challenges: High reliance on heavy offline assignments rather than interactive digital instruction, (2) Infrastructure constraints: Network instability and the high financial burden of live video platforms, and (3) Internal student factors: Digital fatigue and diminished motivation. To achieve meaningful learning outcomes, vocational nutrition students expressed a clear preference for a balanced hybrid/blended approach combining synchronous and asynchronous modalities, accessible and cost-effective digital platforms, and engaging, multi-sensory instructional media.

To address the empirical gaps and optimize instructional delivery for subsequent academic terms, a structured, multi-phase action plan is outlined below, grounded in National Higher Education Standards (*SN-Dikti*) and competency-based vocational frameworks: 1. Pedagogical Re-Engineering (Inverted Classroom Strategy), 2. Platform Optimization and Selection Hierarchy, 3. Strategic Resource and Capacity Development Strategy (High-Teach Paradigm)

CONFLICT OF INTEREST

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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