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Development Of A Blended Learning Mathematics Instructional Design Based On Local Wisdom For The Impactful Campus

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Abstract

Mathematics learning in higher education still faces challenges in simultaneously integrating the flexibility of blended learning, local-wisdom context, and social-impact orientation within a single, empirically tested instructional design. This study aimed to develop and examine a blended-learning mathematics instructional design integrated with local wisdom, referred to as the LENTERA model, oriented toward the Impactful Campus (Kampus Berdampak) paradigm. The study used the Educational Design Research approach with the Plomp model, involving two expert validators and 16 students enrolled in an Inferential Statistics course as field-trial subjects, with a validation sheet, a student-response questionnaire, and a pretest-posttest as instruments, analyzed using mean scores and N-Gain. The results showed that the instructional design was categorized as highly valid (mean 3.27), highly practical (mean 3.68), and effective, with a moderate-category improvement in learning outcomes (mean N-Gain 0.60). These findings indicate that the LENTERA model is feasible as an alternative mathematics instructional design that integrates technology, local culture, and social contribution, and offers a practical contribution for lecturers in designing impact-oriented, contextual mathematics instruction in higher education.

Keywords: Blended Learning; Instructional Design; Impactful Campus; Local Wisdom

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INTRODUCTION

Higher education is expected to undergo a fundamental transformation: from institutions that merely transfer knowledge to institutions that produce meaningful learning with real impact on society. This expectation is not merely a local discourse but part of a global paradigm shift in higher education. UNESCO (2021), in *Reimagining Our Futures Together*, asserts that 21st-century education must be directed toward strengthening students' critical thinking, collaboration, and social contribution rather than the passive mastery of content. Similarly, OECD (2020) stresses the importance of education that empowers learners to generate real social impact through the learning processes they undergo, instead of measuring educational success through academic achievement alone.

In Indonesia, this global shift has been translated concretely into the *Merdeka Belajar–Kampus Merdeka* policy and, more specifically, the Impactful Campus (*Kampus Berdampak*) paradigm, which encourages universities to design learning processes oriented toward real contributions to society (Directorate General of Higher Education, 2023; Ministry of Education, Culture, Research, and Technology, 2023). Meke, Astro, and Daud (2022), in their study of the policy's implementation in universities, found that it significantly pushed institutions to redesign their learning processes to be more flexible, contextual, and responsive to the real needs of students and the surrounding community.

One strategy widely adopted by universities to respond to these demands for flexibility and relevance is blended learning, that is, the planned integration of face-to-face and online learning into a coherent and systematic instructional design (Garrison & Kanuka, 2004; Graham, 2006). This approach differs fundamentally from simply adding an online component to conventional instruction; blended learning requires redesigning the entire learning experience, from how materials are delivered and how interaction is structured to how assessment is carried out in each mode. Through a combination of synchronous and asynchronous activities, students gain the flexibility to study independently at their own pace without losing the opportunity to interact directly with lecturers and peers in face-to-face or virtual sessions (Hrastinski, 2008). Several empirical studies report that blended learning is positively associated with improved student engagement, learning motivation, and academic achievement (Dziuban et al., 2004; López-Pérez et al., 2011).

Nevertheless, this potential does not materialize on its own. So and Bonk (2010), in a Delphi study involving experts in computer-supported collaborative learning, emphasized that

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blended learning without systematic instructional design risks becoming a mere combination of two delivery modes without clear pedagogical added value. In other words, the availability of technology and flexible learning time does not guarantee success; what matters is how the two modes are designed to complement each other and form a coherent learning experience. This warning is particularly relevant when blended learning is applied to courses that demand deep and gradual conceptual understanding, such as mathematics.

Mathematics learning in higher education has distinctive characteristics that call for systematic and visual presentation of concepts, which are often poorly connected to students' concrete experiences. Previous studies show that blended learning in mathematics can improve conceptual understanding and student engagement compared with conventional instruction (Borba et al., 2016; Oweis, 2018; Tsai et al., 2018). Global interest in this approach continues to grow, as indicated by recent systematic-review efforts on blended learning in mathematics teacher education (Tong et al., 2023), although the quality and consistency of outcomes vary depending on how learning activities are designed and implemented by instructors (Borba et al., 2016). In line with this, Lyakhova and Joubert (2022), in their study of advanced mathematics learning, found that the success of blended learning is determined not only by the instructional design but also by the extent to which students can regulate themselves and sustain mathematical resilience during independent study. The quality of the synchronous–asynchronous activity design created by lecturers thus becomes a key determinant of successful implementation (Mekhitarian, 2016), in terms of content structure, feedback, and the way students are guided to stay motivated during the independent learning phase.

Another significant challenge arises from the abstract nature of mathematics itself, which often makes it difficult for students to relate the material to everyday life. This inability to connect formal concepts with concrete reality is often the root of low motivation and understanding, regardless of the learning mode used. The ethnomathematics approach, long studied in the mathematics education literature, offers a solution by bridging formal mathematical concepts and local socio-cultural practices (Bishop, 1991; Rosa & Orey, 2011). D'Ambrosio (2006), one of the pioneers of ethnomathematics, argues that mathematics fundamentally arises from human needs to solve real problems in their environment, from measuring and counting to predicting; returning mathematics learning to its contextual roots can therefore strengthen, rather than simplify, the depth of students' conceptual understanding. Gerdes (1996) adds that when mathematical content is linked to real community activities such as farming, trade, traditional

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crafts, or other cultural practices, learners find it easier to make sense of the concepts because they are directly connected to realities they recognize and experience every day. The benefits of integrating local wisdom are also supported by research in the Indonesian context: Rakhmawati and Alifia (2018) reported that integrating local wisdom not only improves conceptual understanding but also strengthens learners' character and cultural identity, while the systematic review by Turmuzi, Sudiarta, and Suharta (2022) shows that this approach consistently helps learners build more meaningful mathematical understanding. Learning based on real problems in the surrounding environment has also been shown to strengthen sustainability competencies and problem-solving skills (Prince & Felder, 2006; Wiek et al., 2011), two competencies aligned with the outcomes expected under the Impactful Campus paradigm.

The problem is that although each of these approaches (blended learning, local wisdom, and social-impact orientation) has strong theoretical foundations and empirical evidence on its own, the three are rarely studied and integrated together in one coherent instructional design. Research on blended learning in mathematics education tends to focus on technological and pedagogical aspects without incorporating local socio-cultural context as part of the activity design (Borba et al., 2016). Conversely, ethnomathematics studies, as synthesized by Turmuzi et al. (2022), are mostly applied in conventional face-to-face instruction, without exploiting the flexibility of blended learning to extend students' contextual exploration beyond class hours. As a result, few mathematics instructional designs in higher education explicitly and systematically integrate the three elements (the blended learning mode, local-wisdom content, and impact-oriented outcomes) in one framework that is developed and tested empirically rather than assembled ad hoc or added as a supplement.

This gap underlies the present study. The study develops a blended-learning mathematics instructional design based on local wisdom, hereafter called the LENTERA model (*LEarning iNtegrated with local wisdom and an impactful campus through blended learning*). The model is organized into nine learning phases within three main stages: an asynchronous pre-learning stage that builds contextual orientation and independent exploration; a synchronous face-to-face stage focused on knowledge construction, concept clarification, and investigation using local data; and a post-learning stage that explicitly directs students to formulate solutions and relate their analysis to real impact on society. The design was developed using the Educational Design Research (EDR) approach of the Plomp model, chosen because it is specifically intended to

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produce instructional solutions whose validity, practicality, and effectiveness are tested through a systematic and iterative process (Plomp, 2013; van den Akker, 2006; Nieveen, 2006).

Based on the above, this study aims to develop and test a blended-learning mathematics instructional design based on local wisdom oriented toward the Impactful Campus paradigm, by comprehensively describing the characteristics of the design produced through the development stages and evaluating the extent to which it is valid, practical, and effective in supporting the quality of mathematics learning in higher education.

METHOD

Type and Design of the Research

This study is a Research and Development (R&D) study using the Educational Design Research (EDR) approach of the Plomp model. The approach was chosen because it is specifically designed to produce instructional products whose validity, practicality, and effectiveness are tested through a systematic and iterative process (Plomp, 2013). The product developed is a blended-learning mathematics instructional design based on local wisdom, the LENTERA model, applied in the Inferential Statistics course on simple and multiple regression.

Research Procedure

The research was carried out in the three main stages of the Plomp model: (1) preliminary research, (2) prototyping, and (3) assessment.

In the preliminary research stage, we analyzed learning needs in mathematics, student characteristics, the curriculum and the Impactful Campus policy, and reviewed the literature on blended learning, mathematics learning, and ethnomathematics. The results formed the basis for the initial specifications and conceptual framework of the LENTERA model.

In the prototyping stage, the LENTERA learning syntax was developed, consisting of nine phases in three main stages (asynchronous pre-learning, synchronous face-to-face learning, and post-learning), together with its supporting tools: the Lecture Plan (*Satuan Acara Perkuliahan*, SAP) and Student Worksheets (*Lembar Kerja Peserta Didik*, LKPD) that integrate South Sulawesi local-wisdom contexts (seaweed farming, woven-textile crafts, palm-sugar production, and traditional culinary businesses). The prototype was then validated by experts before a limited trial.

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In the assessment stage, experts validated the prototype, a field trial was conducted in one class of students, and the practicality and effectiveness of the design were evaluated. Revisions were made iteratively based on the validation and trial results before the design was finalized.

The LENTERA model was implemented over four class meetings. The first meeting introduced simple regression through the seaweed-farming context, covering the pre-learning stage (contextual orientation and independent exploration through a digital module), followed by face-to-face learning to clarify the concept of relationships between variables. The second meeting continued simple regression in the context of palm-sugar production, emphasizing the phases of contextual problem identification and investigation using local data that students collected from provided sources. The third meeting addressed multiple regression in the contexts of traditional culinary businesses and woven-textile products, in which students analyzed and constructed knowledge about the relationship among several predictor variables simultaneously. The fourth meeting focused on the salt and *kerupuk* (cracker) commodity contexts and covered the post-learning stage, namely formulating solutions based on the regression results and disseminating students' work through presentation and reflection.

Each meeting combined an asynchronous mode through a Learning Management System (LMS) for independent exploration and initial reflection, and a synchronous mode through face-to-face or virtual meetings for discussion, concept clarification, and presentation of results. The division of modes was designed proportionally so that students had enough time for independent exploration before engaging in deeper class discussion, consistent with the blended learning principle that synchronous and asynchronous activities be integrated into one unified learning experience (Garrison & Kanuka, 2004).

Research Subjects

The research subjects comprised two groups. The first group was the expert validators, namely two lecturers/experts in mathematics education and/or instructional design, who assessed the validity of the product using a validation sheet. The second group was 16 students enrolled in the Inferential Statistics course at Universitas Negeri Makassar, who served as field-trial subjects to measure the practicality and effectiveness of the instructional design.

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Research Instruments

Three main instruments were used. The expert validation sheet measured the validity of the instructional design and consisted of 26 items covering six aspects: instructional design feasibility, the LENTERA learning model, blended learning, local wisdom, the Impactful Campus, and language and appearance. Each item was rated on a 1–4 scale (1 = invalid, 2 = less valid, 3 = valid, 4 = highly valid).

The student response questionnaire measured the practicality of the instructional design and consisted of 20 items covering five aspects: ease of use, clarity of the learning flow, implementability, student engagement, and usefulness. Each item was rated on a 1–4 scale (1 = strongly disagree, 2 = disagree, 3 = agree, 4 = strongly agree).

The learning outcome test measured the effectiveness of the instructional design, in the form of pretest and posttest items based on local-wisdom contexts (simple and multiple regression) on the topics of seaweed farming, the palm-sugar industry, and traditional culinary businesses.

Instrument Development and Validation

The three instruments were developed by first drafting blueprints based on the theoretical review presented in the Introduction, before elaborating them into statements or test items. The expert validation sheet was based on six aspects reflecting the main components of the LENTERA model: general feasibility of the instructional design, suitability of the model syntax, blended learning principles, integration of local wisdom, Impactful Campus orientation, and language and appearance quality. The student response questionnaire was based on five aspects representing students' learning experience: ease of use, clarity of the learning flow, implementability, engagement, and usefulness. The learning outcome test was based on learning-outcome indicators for simple and multiple regression, with items contextualized using South Sulawesi local-wisdom data to remain consistent with the instructional approach applied.

Before use, all instruments were reviewed conceptually to ensure alignment among the blueprint, indicators, and items, so that the instruments used in the assessment stage matched the constructs they were meant to measure. The validation sheet and the student questionnaire used a four-point Likert scale to avoid the tendency of respondents to choose a neutral answer (central tendency bias), while the learning outcome test was constructed as essay items requiring

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students to show their reasoning and data interpretation explicitly rather than merely give a final answer.

Population and Sampling

The population was students enrolled in the Inferential Statistics course in the study program where the research took place. Sampling for the field trial used purposive sampling, that is, selecting subjects on the basis of specific considerations; in this case, students enrolled in Inferential Statistics in the current semester who were willing to participate fully in all LENTERA learning activities over four meetings. This technique was chosen because the limited-trial stage in development research requires a match between subject characteristics and the context of the product being developed, rather than statistical generalization to a wider population.

Data Collection

Validity data were collected through the validation sheet completed by expert validators before the prototype was tried out in the field. Practicality data were collected through the response questionnaire completed by students after they finished the entire series of LENTERA learning activities. Effectiveness data were collected through a learning outcome test, with a pretest before and a posttest after the learning in the same trial class.

Data Analysis

Validity data were analyzed by calculating the mean score across all validators for each aspect and for the overall score, which was then converted into validity categories using interval criteria adapted from Akbar (2013): 3.25–4.00 (highly valid), 2.50–3.24 (valid), 1.75–2.49 (less valid), and 1.00–1.74 (invalid). Practicality data were analyzed by calculating the mean student response score for each aspect and overall, using the same interval categories (Akbar, 2013).

Effectiveness data were analyzed by calculating the difference between pretest and posttest scores using the Normalized Gain (N-Gain) formula developed by Hake (1998), to determine the magnitude of improvement in students' understanding after taking LENTERA-based learning. N-Gain scores were categorized as high ($g \geq 0.7$), moderate ($0.3 \leq g < 0.7$), and low ($g < 0.3$) (Hake, 1998).

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RESULTS AND DISCUSSION

Characteristics of the LENTERA Instructional Design

The blended-learning mathematics instructional design based on local wisdom produced in this study is called the LENTERA model (*LEarning iNtegrated with local wisdom and an impactful campus through blended learning*). The model combines online and offline learning with the use of local wisdom, is oriented toward the Impactful Campus paradigm, and emphasizes the integration of concept mastery, contextual understanding grounded in the local environment, and students' capacity to make real contributions to society. The LENTERA model consists of nine learning phases organized in three main stages, as presented in Table 1.

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Table 1. Learning Syntax of the LENTERA Model

Stage	Phase	Student Activity	Mode
Pre-learning (Asynchronous)	1. Contextual orientation based on local wisdom	Observing and responding to a local phenomenon as a trigger	Asynchronous
	2. Independent exploration through blended learning	Studying the material independently through videos, modules, and digital materials	Asynchronous
	3. Initial reflection and formulation of conjectures	Sharing initial ideas, questions, and conjectures about the concept	Asynchronous
Face-to-face learning (Synchronous)	4. Interaction and concept clarification	Discussing, asking questions, and responding to the lecturer's clarification	Synchronous
	5. Identification and formulation of contextual problems	Determining variables and formulating contextual problems	Synchronous
	6. Investigation based on local data	Collecting and organizing data from the local context	Blended
	7. Analysis and knowledge construction	Analyzing data and constructing understanding	Synchronous
Post-learning (Application & Impact)	8. Solution formulation and impact implementation	Formulating solutions based on the analysis and relating them to real impact	Asynchronous/ Synchronous
	9. Dissemination and reflection	Presenting results and reflecting on the learning process	Synchronous/ Asynchronous

The pre-learning stage takes place asynchronously and builds students' contextual orientation by presenting local phenomena, followed by independent exploration using digital learning resources and an initial reflection that activates prior knowledge and identifies potential misconceptions before synchronous learning begins. The face-to-face stage takes place synchronously and focuses on knowledge construction through four sequential phases (concept

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clarification, contextual problem identification, investigation based on local data, and analysis and knowledge construction) that collectively form the core of the LENTERA learning process. The post-learning stage is what distinguishes the LENTERA model from blended learning designs in general, because it explicitly directs students to formulate solutions based on their analysis and relate them to real implementation for society, before ending with the dissemination of results and metacognitive reflection on the whole learning process.

The nine-phase structure is conceptually grounded in the theoretical review in the Introduction. The pre-learning stage, which places contextual orientation based on local wisdom as the opening phase, reflects the ethnomathematics principle that mathematics learning becomes more meaningful when it starts from real phenomena familiar to students rather than from abstract concepts (Bishop, 1991; D'Ambrosio, 2006). The face-to-face stage, which emphasizes interaction, problem identification, investigation, and analysis, reflects the principle of collaborative knowledge construction through synchronous activities, in line with the argument that the success of blended learning depends on the quality of the interaction design created by lecturers rather than on the availability of technology alone (So & Bonk, 2010). The post-learning stage, which explicitly directs students to formulate solutions and disseminate their work, reflects the principle of learning based on real problems oriented toward sustainability competencies and social contribution (Prince & Felder, 2006; Wiek et al., 2011), and is the main distinguishing element of the LENTERA model from conventional blended learning models that generally stop at cognitive evaluation without continuing to impactful application.

The nine-phase structure was implemented over four class meetings in the Inferential Statistics course on simple and multiple regression, set out in the Lecture Plan (SAP) and accompanied by Student Worksheets (LKPD) based on South Sulawesi local wisdom, including data on seaweed farming, palm-sugar production, traditional culinary businesses, woven-textile products, and salt and *kerupuk* commodities. The varied contexts at each meeting were intended to enrich students' contextual experience while avoiding repetition of the same context across simple and multiple regression.

Validity of the Instructional Design

The validity of the LENTERA design was obtained from the assessment of two mathematics-education expert validators using a validation sheet of 26 items on six aspects. The results from both validators are presented in Table 2.

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Table 2. Validation Results of the LENTERA Instructional Design

Aspect	Validator 1	Validator 2	Mean	SD	Category
Instructional design feasibility	3.20	3.60	3.40	0.28	Highly valid
LENTERA learning model	3.00	3.00	3.00	0.00	Valid
Blended learning	3.25	3.50	3.38	0.18	Highly valid
Local wisdom	2.75	3.25	3.00	0.35	Valid
Impactful Campus	3.25	3.75	3.50	0.35	Highly valid
Language and appearance	3.25	3.50	3.38	0.18	Highly valid
Overall mean	**3.12**	**3.42**	**3.27**	**0.22**	**Highly valid**

Table 2 shows that the validity category for each aspect ranges from valid to highly valid, with an overall mean of 3.27, which is categorized as highly valid (interval 3.25–4.00; Akbar, 2013). The highest-scoring aspect was Impactful Campus (3.50), indicating that both validators consistently judged the design capable of guiding students toward solutions and real contributions to society. This finding is in line with the emphasis of problem-based learning on building sustainability competencies and problem-solving skills (Prince & Felder, 2006; Wiek et al., 2011), and suggests that the main strength of the LENTERA model in the validators' eyes lies in its clear impact orientation.

The lowest-scoring aspects, although still in the valid category, were the LENTERA Learning Model and Local Wisdom (3.00 each), which indicates room for improvement in the clarity of the model's theoretical basis and in the depth of integration of the local context into the learning content. A plausible reason is that these two aspects assess relatively new elements, namely the nine-phase syntax, which has few precedents in the literature. Consistent with the iterative nature of EDR, product quality at the early prototype stage is not expected to reach its maximum and remains open to refinement through subsequent validation and revision cycles (Nieveen, 2006); a score of 3.00 on these aspects is therefore an area for improvement rather than a fatal weakness.

The difference in scores between the two validators is also informative. Validator 1 gave an overall mean of 3.12, whereas Validator 2 gave 3.42, a relatively small difference of 0.30, even though each assessed independently. The largest differences occurred in the Impactful Campus

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and Local Wisdom aspects (0.50 each), followed by Instructional Design Feasibility (0.40). Both validators placed every aspect within the valid or highly valid range, so the overall category does not depend on the more lenient validator alone. However, because only two validators were involved and no formal inter-rater agreement coefficient was computed, this consistency should be read as indicative only.

These findings are consistent with similar development research in higher education. Ranti (2022), who developed local-wisdom-based mathematics learning tools for a Basic Statistics course, also reported validation results in the valid category. Similar findings were reported by Badriyah, Zulkarnain, and Noorbaiti (2023) in developing a local-wisdom-based teaching module for statistics, which obtained a validation result of 87.30% and was categorized as highly valid. Together, these studies suggest that mathematics instructional designs based on local wisdom for statistics topics, including the regression topics in this study, can meet high validity standards.

Practicality of the Instructional Design

The practicality of the LENTERA design was obtained from a response questionnaire completed by 16 students in the field trial, consisting of 20 items on five aspects. The mean score for each aspect is presented in Table 3.

Table 3. Student Responses to the LENTERA Instructional Design

Aspect	Number of Items	Mean	Category
Ease of use	4	3.81	Highly practical
Clarity of the learning flow	4	3.64	Highly practical
Implementability	4	3.61	Highly practical
Student engagement	4	3.63	Highly practical
Usefulness	4	3.70	Highly practical
Overall mean	**20**	**3.68**	**Highly practical**

Table 3 shows that all practicality aspects were categorized as highly practical, with an overall mean of 3.68 (interval 3.25–4.00; Akbar, 2013). The highest-scoring aspect was Ease of Use (3.81), indicating that students found the instructions and activity flow of LENTERA learning easy to understand and follow. This finding supports Hrastinski's (2008) argument that combining synchronous and asynchronous activities in blended learning gives students the flexibility to

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understand instructions and follow the learning flow at their own pace. The high level of practicality is also consistent with Ningsih and Deswita (2023), who developed a blended-learning-based calculus e-module in higher education and concluded that the product was valid and practical in students' eyes, suggesting that combining face-to-face and online modes in higher education is generally well received by students when systematically designed.

The aspect with the relatively lowest score, although still highly practical, was Implementability (3.61), suggesting that a small number of students encountered difficulties in completing tasks or managing the time of learning activities. This is in line with So and Bonk's (2010) caution that combining face-to-face and online modes remains vulnerable to technical constraints or time limitations for some participants, so that implementability tends to be more sensitive to field conditions than aspects tied to general perceptions of the design. The slight variation is also understandable because the LENTERA model requires students to manage their independent study time during the asynchronous stage with discipline, a demand that, according to Lyakhova and Joubert (2022), depends heavily on each student's self-regulation ability. Overall, the high practicality scores on all aspects indicate that integrating local-wisdom content into the LKPD did not add complexity to the learning process but supported students' ease in following instructions because the contexts used were already familiar to them, in line with the argument that local wisdom works as a cognitive bridge rather than an additional burden in learning (Rosa & Orey, 2011).

These practicality findings should also be read in light of the characteristics of the subjects, who were mathematics education students and are likely to have had digital literacy and prior experience with online learning platforms. This may have contributed to the high practicality scores, since students did not need to adapt to new technology and could focus fully on the learning substance. Applying the LENTERA model to students with different levels of digital literacy may therefore produce different levels of practicality, and students' technological readiness should be considered when the model is applied in other contexts.

Effectiveness of the Instructional Design

The effectiveness of the LENTERA design was measured by comparing pretest and posttest scores of the 16 students in the field trial, analyzed using the N-Gain formula (Hake, 1998). Each student's pretest, posttest, and N-Gain results are presented in Table 4.

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Table 4. Students' Pretest, Posttest, and N-Gain Results

Code	Pretest	Posttest	N-Gain	Category
S1	65	85	0.57	Moderate
S2	70	90	0.67	Moderate
S3	75	90	0.60	Moderate
S4	65	85	0.57	Moderate
S5	80	95	0.75	High
S6	77	92	0.65	Moderate
S7	65	85	0.57	Moderate
S8	65	85	0.57	Moderate
S9	85	95	0.67	Moderate
S10	20	50	0.38	Moderate
S11	65	85	0.57	Moderate
S12	70	90	0.67	Moderate
S13	65	85	0.57	Moderate
S14	70	90	0.67	Moderate
S15	50	65	0.30	Moderate
S16	80	95	0.75	High
Mean	**66.69**	**85.12**	**0.60**	**Moderate**

Table 4 shows that the students' mean score increased from 66.69 (pretest) to 85.12 (posttest), with a mean N-Gain of 0.60, categorized as moderate (the mean of the individual N-Gain values). Of the 16 students, 14 (87.5%) were in the moderate improvement category and 2 (12.5%) in the high category, and none was in the low category. This indicates that the LENTERA design consistently supported improvement in students' understanding of simple and multiple regression, although there was variation among students, such as S10, whose pretest score was far below the class average and who improved but did not reach the high category.

The moderate, rather than high, improvement can be explained by several interrelated factors. First, as Lyakhova and Joubert (2022) found, the success of blended learning in mathematics is also influenced by students' self-regulation during the independent learning phase, which varies across individuals. This is visible in S10, who began with a pretest score far below the class average (20) yet showed the largest absolute improvement of all subjects (30

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points), although the N-Gain reached only the moderate category because N-Gain takes into account the proportion of available room for improvement. Second, integrating local-wisdom contexts (seaweed farming, palm sugar, and traditional culinary businesses) into the simple and multiple regression LKPD appears to have contributed to better conceptual understanding, in line with D'Ambrosio (2006) and Gerdes (1996), who argue that linking mathematical content to real community activities helps learners make sense of the concepts. This also reinforces ethnomathematics findings in the Indonesian context (Rakhmawati & Alifia, 2018; Turmuzi et al., 2022). Third, because the tested topics, simple and multiple regression, require fairly complex algebraic prerequisites and data-interpretation ability, a moderate N-Gain within one limited learning cycle (four meetings according to the SAP) is a proportionate outcome, in line with the gradual nature of mathematics learning (Borba et al., 2016).

The distribution of pretest scores in Table 4 shows that most students began with scores in the 65–80 range, indicating that most subjects already had reasonably adequate prerequisite understanding before LENTERA was applied. This relatively good starting point also affects the N-Gain obtained: students with high pretest scores have, mathematically, less room for improvement (a ceiling effect) than students with low pretest scores, so N-Gain tends to fall in the moderate rather than high category even though the raw score gain, a mean of 18.44 points, is fairly large. For comparison, S9, who had the highest pretest score (85), still improved to 95, suggesting that the LENTERA design may also benefit students whose initial ability is already high. This pattern confirms that N-Gain should not be interpreted separately from the distribution of pretest scores but together with each subject's initial ability, as is inherent in the N-Gain metric itself (Hake, 1998).

These findings are consistent with Haeruman, Wijayanti, and Meidianingsih (2021), who reported improved learning outcomes with an N-Gain of 0.53 (moderate category) for LMS-based blended learning in mathematics. This agreement suggests that a moderate improvement is a reasonable and realistic outcome for blended learning in mathematics in a single limited-trial cycle, and that outcomes vary depending on the design of the learning activities used (Borba et al., 2016).

Implications and Limitations

Taken together, the three findings (highly valid, highly practical, and moderately effective) indicate that the LENTERA design is feasible as an alternative mathematics learning approach that

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integrates blended learning, local wisdom, and the Impactful Campus orientation, thereby addressing the gap described in the Introduction, namely the limited number of designs that integrate the three elements simultaneously in one empirically tested framework.

The observed pattern, with validity and practicality in very high categories and effectiveness in the moderate category, is also common in development research in mathematics education. Nieveen (2006) explains that the three quality criteria of EDR products (valid, practical, and effective) do not necessarily increase linearly and equally within one development cycle: validity and practicality are largely determined by design quality and user perceptions, whereas effectiveness is also influenced by external factors such as individual student characteristics, implementation duration, and material complexity, so reaching a consistently high category may require more than one development cycle.

This study has limitations that should be considered in future research. The field trial was conducted in only one class of 16 students without a comparison group, so the generalization of the findings to a wider student population or to different local-wisdom contexts still requires further testing. In particular, the pretest–posttest gain cannot be attributed solely to the LENTERA design in the absence of a control group, and the claim of effectiveness should be understood as limited to this small trial. Following the Plomp model, the relevant next step is to extend the trial to the dissemination stage by involving more classes and a variety of local-wisdom contexts to strengthen the external validity of the design (Plomp, 2013).

In terms of policy implications, the findings contribute to achieving the Key Performance Indicators (*Indikator Kinerja Utama*, IKU) of higher education, particularly in improving student-centered learning quality through innovative and contextual blended learning design, strengthening lecturers' capacity to design technology- and local-wisdom-based learning, and strengthening the role of universities as Impactful Campuses that produce meaningful learning relevant to community needs.

CONCLUSION

This study produced a blended-learning mathematics instructional design based on local wisdom, called the LENTERA model, developed through the Educational Design Research approach of the Plomp model to support the realization of the Impactful Campus paradigm in higher education. The model consists of nine learning phases in three stages (asynchronous pre-learning, synchronous face-to-face learning, and post-learning oriented toward application and

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real impact) and integrates South Sulawesi local-wisdom content into the Inferential Statistics course on simple and multiple regression. The LENTERA design met the criteria of validity, practicality, and effectiveness: validation by two experts showed a highly valid category with a mean score of 3.27; the student response questionnaire showed a highly practical category with a mean score of 3.68; and the pretest–posttest analysis showed an improvement in students' understanding with a mean N-Gain of 0.60 in the moderate category. These findings address the gap described in the Introduction, namely the limited number of mathematics instructional designs that explicitly integrate the blended learning mode, local-wisdom content, and impact-oriented outcomes in one empirically developed and tested framework, and they offer a practical contribution in the form of a ready-to-use instructional design for lecturers and a theoretical contribution in strengthening the argument that integrating local wisdom into blended learning can be done systematically through development research procedures.

The study is limited by a field trial of only one class of 16 students without a comparison group, so generalization requires further testing with more diverse populations and local-wisdom contexts. Future research is advised to extend the trial to the dissemination stage by involving more classes, study programs, and regional local-wisdom contexts, and to examine more deeply the cognitive mechanisms behind the improvement in students' understanding through the integration of local wisdom. For lecturers of similar courses, the LENTERA model can serve as a reference for designing mathematics learning oriented not only toward content mastery but also toward strengthening students' contextual awareness and social contribution, with a nine-phase syntax that can be adapted to other mathematics courses by adjusting the local-wisdom context to the region where the university is located.

REFERENCES

Akbar, S. (2013). *Instrumen perangkat pembelajaran* [Instruments for learning tools]. PT Remaja Rosdakarya.

Badriyah, L., Zulkarnain, I., & Noorbaiti, R. (2023). Pengembangan modul ajar kurikulum merdeka berbasis kearifan lokal Pasar Ahad Kertak Hanyar pada materi statistika kelas X [Development of a Merdeka curriculum teaching module based on the local wisdom of Pasar Ahad Kertak Hanyar for grade X statistics]. *Jurmadikta, 3*(3), 33–43.

Bishop, A. J. (1991). *Mathematical enculturation: A cultural perspective on mathematics education*. Kluwer Academic Publishers. https://doi.org/10.1007/978-94-017-1916-8

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Borba, M. C., Askar, P., Engelbrecht, J., Gadanidis, G., Llinares, S., & Sánchez, M. (2016). Blended learning, e-learning and mobile learning in mathematics education. *ZDM Mathematics Education, 48*(5), 589–610. https://doi.org/10.1007/s11858-016-0798-4

D'Ambrosio, U. (2006). *Ethnomathematics: Link between traditions and modernity*. Sense Publishers. https://doi.org/10.1007/978-94-6091-539-1

Directorate General of Higher Education. (2023). *Panduan implementasi Kampus Berdampak di perguruan tinggi* [Guidelines for implementing the Impactful Campus in universities]. Ditjen Dikti Kemendikbudristek.

Dziuban, C., Hartman, J., & Moskal, P. (2004). Blended learning. *Educause Center for Applied Research Bulletin, 7*, 1–12.

Garrison, D. R., & Kanuka, H. (2004). Blended learning: Uncovering its transformative potential in higher education. *Internet and Higher Education, 7*(2), 95–105. https://doi.org/10.1016/j.iheduc.2004.02.001

Gerdes, P. (1996). Ethnomathematics and mathematics education. CIEAEM.

Graham, C. R. (2006). Blended learning systems: Definition, current trends, and future directions. In C. J. Bonk & C. R. Graham (Eds.), *The handbook of blended learning: Global perspectives, local designs* (pp. 3–21). Pfeiffer.

Haeruman, L. D., Wijayanti, D. A., & Meidianingsih, Q. (2021). Efektivitas blended learning berbasis LMS dalam pembelajaran matematika [The effectiveness of LMS-based blended learning in mathematics learning]. *Jurnal Riset Pembelajaran Matematika Sekolah, 5*(1), 80–84. https://doi.org/10.21009/jrpms.051.10

Hake, R. R. (1998). Interactive-engagement versus traditional methods: A six-thousand-student survey of mechanics test data for introductory physics courses. *American Journal of Physics, 66*(1), 64–74. https://doi.org/10.1119/1.18809

Hrastinski, S. (2008). Asynchronous and synchronous e-learning. *Educause Quarterly, 31*(4), 51–55.

López-Pérez, M. V., Pérez-López, M. C., & Rodríguez-Ariza, L. (2011). Blended learning in higher education: Students' perceptions and their relation to outcomes. *Computers & Education, 56*(3), 818–826.

Lyakhova, S., & Joubert, M. (2022). Post-16 Further Mathematics blended learning: Learner self-regulation, mathematical resilience and technology. *Teaching Mathematics and Its Applications, 41*(1), 51–68. https://doi.org/10.1093/teamat/hrab005

Copyright at authors some right reserved this work is licensed under a Creative Commons Attribution-ShareAlike 4.0 International License

Meke, K. D. P., Astro, R. B., & Daud, M. H. (2022). Dampak kebijakan Merdeka Belajar Kampus Merdeka (MBKM) pada perguruan tinggi swasta di Indonesia [The impact of the Merdeka Belajar Kampus Merdeka (MBKM) policy on private universities in Indonesia]. *Edukatif: Jurnal Ilmu Pendidikan, 4*(1), 675–685.

Mekhitarian, S. (2016). *Effective instruction in the blended learning classroom* [Doctoral dissertation, Loyola Marymount University].

Ministry of Education, Culture, Research, and Technology. (2023). *Kebijakan Kampus Berdampak: Transformasi pendidikan tinggi untuk pembangunan berkelanjutan* [Impactful Campus policy: Transforming higher education for sustainable development]. Kemendikbudristek.

Nieveen, N. (2006). Prototyping to reach product quality. In J. van den Akker, K. Gravemeijer, S. McKenney, & N. Nieveen (Eds.), *Educational design research* (pp. 125–135). Routledge.

Ningsih, F., & Deswita, R. (2023). Developing an e-module on blended learning-based calculus courses. *Mosharafa: Jurnal Pendidikan Matematika, 12*(3), 429–440. https://doi.org/10.31980/mosharafa.v12i3.817

OECD. (2020). *Education for sustainable development: Empowering learners for social impact*. OECD Publishing. https://doi.org/10.1787/02c4c6f5-en

Oweis, T. I. (2018). Effects of using a blended learning method on students' achievement and motivation. *Education Research International, 2018*, 1–7. https://doi.org/10.1155/2018/7425924

Plomp, T. (2013). Educational design research: An introduction. In T. Plomp & N. Nieveen (Eds.), *Educational design research* (pp. 11–50). SLO.

Prince, M., & Felder, R. (2006). Inductive teaching and learning methods: Definitions, comparisons, and research bases. *Journal of Engineering Education, 95*(2), 123–138. https://doi.org/10.1002/j.2168-9830.2006.tb00884.x

Rakhmawati, I. A., & Alifia, N. N. (2018). Kearifan lokal dalam pembelajaran matematika sebagai penguat karakter siswa [Local wisdom in mathematics learning as a strengthener of student character]. *Jurnal Elektronik Pembelajaran Matematika, 5*(2), 186–196.

Ranti, M. G. (2022). Pengembangan perangkat pembelajaran matematika bilingual berbasis kearifan lokal Kalimantan Selatan [Development of bilingual mathematics learning tools based on South Kalimantan local wisdom]. *Jurnal Pendidikan Matematika (JPM), 8*(1), 27–36. https://doi.org/10.33474/jpm.v8i1.14922

Copyright at authors some right reserved this work is licensed under a Creative Commons Attribution-ShareAlike 4.0 International License

Rosa, M., & Orey, D. C. (2011). Ethnomathematics: Cultural assertions and challenges towards pedagogical action. *For the Learning of Mathematics, 31*(1), 2–6.

So, H. J., & Bonk, C. J. (2010). Examining the roles of blended learning approaches in computer-supported collaborative learning (CSCL) environments: A Delphi study. *Educational Technology & Society, 13*(3), 189–200.

Tong, D. H., Uyen, B. P., & Ngan, L. K. (2023). The application of blended learning in mathematics teacher education: Protocol for a systematic review. *PLoS ONE, 18*(9), e0292244. https://doi.org/10.1371/journal.pone.0292244

Tsai, T. P., Lin, J., & Lin, L. C. (2018). A flipped blended learning approach for ePUB3 eBook-based course design. *Eurasia Journal of Mathematics, Science and Technology Education, 14*(1), 123–144. https://doi.org/10.12973/ejmste/77903

Turmuzi, M., Sudiarta, I. G. P., & Suharta, I. G. P. (2022). Systematic literature review: Etnomatematika kearifan lokal budaya Sasak [Systematic literature review: Ethnomathematics of Sasak cultural local wisdom]. *Jurnal Cendekia: Jurnal Pendidikan Matematika, 6*(1), 397–413.

UNESCO. (2021). *Reimagining our futures together: A new social contract for education*. UNESCO Publishing. https://doi.org/10.54675/ASRB4722

van den Akker, J. (2006). Principles and methods of development research. In J. van den Akker, K. Gravemeijer, S. McKenney, & N. Nieveen (Eds.), *Educational design research* (pp. 1–14). Routledge.

Wiek, A., Withycombe, L., & Redman, C. L. (2011). Key competencies in sustainability: A reference framework for academic program development. *Sustainability Science, 6*(2), 203–218. https://doi.org/10.1007/s11625-011-0132-6

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