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Web-Based E-Module on Student-Centered Learning (SCL) Models: A Digital Tool for Transforming Primary School Teachers' Motivation and Pedagogical Competence

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ABSTRACT

In the digital era, transforming education requires equipping educators with pedagogical skills and motivation to foster adaptive, student-centered learning environments. This study investigates the efficacy of TeachLib, an innovative web-based e-module designed to catalyze this transformation by strengthening teachers' adoption of Student-Centered Learning (SCL). The module is structured around four integrated strands, including learning approaches, learning models (featuring project-based and cooperative learning), guided model implementation, and assessment & feedback. A quasi-experimental *pretest-post test* design was employed with 38 primary school teachers. Data was collected through a validated motivation questionnaire, analytics on platform engagement across all strands, and user feedback. Quantitative analysis (using descriptive statistics, Pearson correlation, and simple linear regression with α=0.05) revealed a very strong positive correlation between TeachLib engagement and increased teaching motivation ($r = 0.934$, $p < .001$). Regression analysis indicated that module use significantly predicted motivational gains ($R^2 \approx 0.87$), with post-test scores shifting markedly toward higher bands. Teachers highly valued the authentic project exemplars, interactive exercises, video tutorials, and collaborative discussion forum. To triangulate these findings, semi-structured interviews were conducted with five school principals. Qualitatively, all principals reported observable improvements in teacher motivation, evidenced by more proactive and collaborative lesson planning, a voluntary sharing of SCL strategies, a greater uptake of project-based and cooperative activities in classrooms, and a significant reduction

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in lecture-only instruction. These changes coincided with increased student participation and engagement. The findings demonstrate that a digitally mediated, structured professional development package like TeachLib can significantly enhance teacher motivation and competency in implementing SCL.

1. INTRODUCTION

To prepare global citizens who can adapt and compete in the digital age, teachers need to provide lessons that encourage pupils to build their own knowledge, work together, and solve real-world problems. As Indonesia's curriculum changes, primary teachers are expected to stop using lectures and start using Student-Centered Learning (SCL) that makes use of digital tools (Hassel & Satria, n.d.). But a lot of teachers still don't know how to accomplish this every day in a clear and useful way (Abidin et al., n.d.; Delita et al., 2022). A web-based professional learning module with analytics is a great potential since it is always available, is part of the workplace, and can show how involvement affects teachers' motivation and teaching skills (Deci & Ryan, 2000; Hes & Reider, 1985).

This research is based on constructivist principles. Learners develop new understandings by combining experiences with existing knowledge (Piaget et al., 1952), gain from scaffolding that diminishes as their competence grows (Bruner, 1974), and progress through social interaction within the Zone of Proximal Development, where language, tools, and collaboration facilitate learning (Stone & Hart, 2019). The principles suggest an instructional approach that is centered on problems, rich in inquiry, and dialogue, providing opportunities for exploration, feedback, and reflection. SCL models implement these mechanisms: Project-Based Learning (PjBL) contextualizes knowledge within authentic projects that necessitate inquiry and public outputs (Bell, 2010; Thomas et al., 2000), whereas Cooperative Learning (CL) establishes positive interdependence and individual accountability, thereby enhancing understanding through peer explanation (Slavin, 2019; Winkleman, 2025). When implemented with explicit modeling, scaffolded steps, and formative assessment, project-based learning (PjBL) and collaborative learning (CL) are consistently linked to improvements in engagement, higher-order thinking, collaboration, and transfer, which are the competencies emphasized for 21st-century education (Darling-hammond et al., 2008; Desimone, 2009; Hmelo-Silver, 2004).

Translating these principles to teacher learning requires constructivist professional development (PD). Adult learning research indicates that PD is most motivating when it is relevant, problem-centered, and supports autonomy and competence (Stone & Hart, 2019). Effective PD also provides concrete classroom exemplars, opportunities to practice with feedback, and sustained peer interaction (Darling-hammond et al., 2008; Desimone, 2009). In digital environments, design choices that manage cognitive load (e.g., signaling, segmentation) and use worked examples further enhance learning (Braun & Clarke, 2006; Clark & Mayer, 2016). Despite this theoretical clarity, much PD for primary teachers remains episodic and tool-centric rather than pedagogy-centric, rarely offers step-by-step guidance for PjBL/CL in local contexts, and seldom links usage analytics to outcomes. Consequently, systems lack evidence on whether and how engagement with a digital, constructivist PD module is associated with measurable shifts in teachers' motivation and SCL competence, particularly in real-world district settings beyond major urban centers.

We address these gaps by introducing and evaluating TeachLib, a web-based e-module that operationalizes constructivism for teacher learning through four integrated strands: learning approaches; learning models emphasizing PjBL and CL; guided model implementation; and assessment and feedback. TeachLib activates prior knowledge, structures authentic classroom-anchored tasks, enables social learning via collaborative discussion, and provides iterative, criteria-referenced feedback to build self-efficacy. Methodologically, we employed a quasi-experimental pretest–posttest design with 38 primary teachers, collecting SCL competence tests, a validated motivation questionnaire,

and TeachLib engagement analytics across strands, complemented by user feedback and brief leader interviews; quantitative analyses included descriptive statistics, Pearson correlation, and simple linear regression at $\alpha = 0.05$ also corroborated by principals (Field, 2017; Sanusi et al., 2024).

By aligning theory, design, and analytics, TeachLib offers systems a concrete pathway to translate policy aspirations about "transforming education in the digital era" into daily practice that develops students' critical thinking, collaboration, creativity, and communication. Guided by this purpose, the study asks whether participation in TeachLib improves teachers' SCL pedagogical competence from pre- to post-test and increases their motivation to implement SCL; it further examines how the level of TeachLib engagement relates to motivation and competence, and how teachers perceive the practicality and usefulness of TeachLib's strands project-based learning, cooperative learning, guided implementation, and assessment and feedback for sustaining SCL in their classrooms (Black & Wiliam, 1998; Clark & Mayer, 2016; Deci & Ryan, 2000).

Research questions are

(i) RQ1 (Competence Gain): To what extent does participation in TeachLib improve teachers' SCL pedagogical competence (pre- vs post-test)?
(ii) RQ2 (Motivational Gain): To what extent does TeachLib participation increase teachers' motivation to implement SCL?
(iii) RQ3 (Usage–Motivation): What is the relationship between TeachLib engagement level and teachers' motivation to implement SCL?
(iv) RQ4 (Usage–Competence): What is the relationship between TeachLib engagement level and teachers' SCL pedagogical competence?

2. METHODS

This study examined whether and how a web-based e-module TeachLib transforms primary teachers' motivation and pedagogical competence in Student-Centered Learning (SCL). Consistent with the study aim and abstract, we used a quantitative-dominant, mixed-methods strategy with a quasi-experimental pretest–posttest design and brief qualitative interviews. The design is appropriate for authentic school settings where random assignments are impractical (Jhon W. Creswell, 2021).

Setting and participants. The research took place in Gugus IV, Kecamatan Boawae, Kabupaten Nagekeo, Provinsi Nusa Tenggara Timur (NTT), Indonesia. Participants were 38 primary school teachers from public schools in the cluster. Eligibility required a current classroom assignment and willingness to complete all TeachLib strands and instruments. Participation was voluntary.

Intervention and facilitation. The intervention was TeachLib, a web-based e-module organized into four integrated strands: (1) learning approaches (constructivist underpinnings and SCL orientation), (2) learning models with emphasis on Project-Based Learning (PjBL) and Cooperative Learning (CL), (3) guided implementation (step-by-step enactment, planning templates, and classroom checklists), and (4) assessment & feedback (formative tools, rubrics, and exemplars). The platform combined videos, interactive tasks, downloadable lesson artefacts, and a discussion forum through e-form. Importantly, teachers were accompanied by trained facilitators during the training period. Facilitators oriented participants to the module, supported navigation and task completion, prompted reflection aligned with SCL principles, and provided on-the-spot coaching during school-based sessions. Their role was supportive rather than evaluative

and focused on fidelity of implementation (not on supplying answers to assessments). Server-side analytics logged each teacher's activity (strand visits, task completions, quiz attempts, forum participation, and time-on-task), aggregated to strand-level and overall engagement indices.

Measures. Outcomes comprised: (a) an SCL pedagogical competence test administered pre- and post-intervention (blueprinted to SCL, PjBL, CL, and formative assessment indicators); (b) a validated motivation questionnaire (Likert-type items for interest/enjoyment, perceived competence, and intention to implement SCL); (c) TeachLib engagement analytics per strand and overall; and (d) a brief user-feedback form on perceived usefulness and practicality. To corroborate classroom-level changes, semi-structured interviews were held with five school principals regarding observable shifts in practice (e.g., collaborative planning, reduced lecture-only instruction, and uptake of PjBL/CL).

Procedure. After administrative approvals and consent, teachers completed baseline (pretest) measures for competence and motivation, then received access to all four TeachLib strands. Learning activities occurred in a school-based training format in Boawae, with facilitators present during face-to-face sessions and available for support during self-paced work. Upon completion of the module, teachers undertook post tests and submitted feedback; principal interviews followed. Platform logs were exported and merged with survey and test data using unique study IDs.

Data analysis. We produced descriptive statistics and visualized pre/post distributions to examine shifts in central tendency and spread. For inference, we computed gain scores (post−pre) for competence and motivation, estimated Pearson correlations between engagement indices and gains, and ran simple linear regressions to test whether TeachLib engagement predicted motivational and competence gains ($\alpha = 0.05$). Model assumptions (linearity, normality of residuals, homoscedasticity, and outliers) were checked before inference (Field, 2017). Interview notes were analyzed with a brief thematic analysis to triangulate quantitative patterns, emphasizing convergent evidence for changes in SCL practice (Braun & Clarke, 2006).

Ethical considerations. Participation was voluntary with the right to withdraw; data were anonymized for analysis. Permissions were obtained from school leaders and local authorities in Gugus IV, Boawae, Nagekeo (NTT). All procedures adhered to minimal-risk standards for educational research.

3. RESULTS AND DISCUSSION

RQ1. Competence Gain *(pre- vs post-test)*

Teachers' SCL pedagogical competence rose markedly after completing TeachLib. The mean score increased from 83.03 (SD = 13.38) at pre-test to 92.50 (SD = 8.68) at post-test, a gain of +9.47 points (≈ +11.41%) with visibly reduced dispersion on Table 1. A paired sample test confirmed the improvement was statistically significant, t (38) = 3.389, p = .0017, with a medium effect (Cohen's *d*_z ≈ 0.55).

Tabel 1. Statistic Descriptive & Paired Sample T-Test Analysis

Statistik Descriptive		**Paired Sample T-Test Analysis**	
Pre-Test	*Post-Test*		
38	38		
83.026316	92.5	Mean Pre-Test	83.03
13.383101	8.679737	Mean Post-Test	92.5
40	70	Mean Difference	9.47
76.25	90	Pre-Test Standard Deviation	13.38
85	95	Post-Test Standard Deviation	8.68
90	100	t-statistic	-3.389
100	100	p-value	0.0017

The boxplots on **Figure 1** show the entire distribution shifting upward: the pre-test interquartile range (≈ 76.25–90) moved to 90–100 at post-test, while the lower whisker improved from 40 to 70 (Figure 1). This pattern indicates not only higher central tendency but also compression toward mastery, consistent with teachers consolidating core SCL knowledge and assessment concepts after engaging with the four TeachLib strands.

Figure 1. Comparison of Pre-Test and Post-Test Distributions

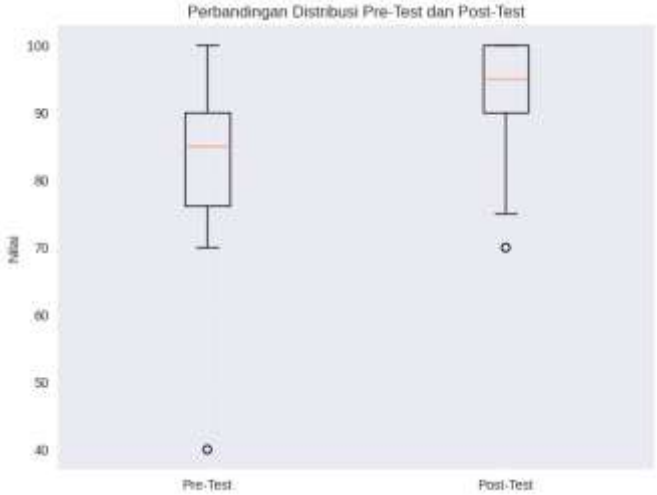
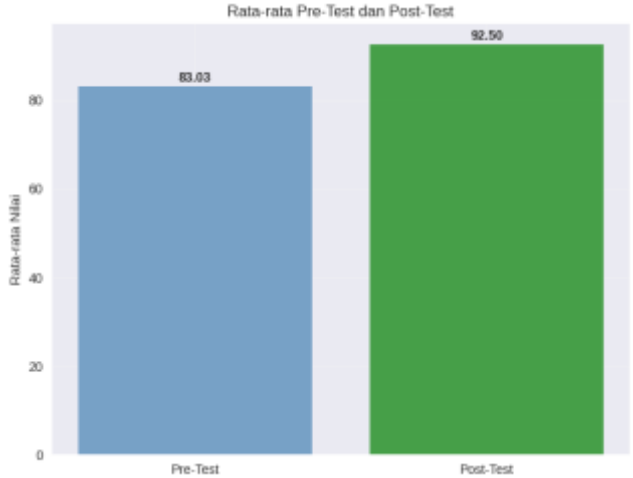


Figure 2. Comparison of Pre-Test and Post-Test



Within a constructivist framing, these gains are expected: teachers encountered authentic design tasks, analyzed exemplary, received formative feedback, and

collaborated during facilitated sessions in Gugus IV, Boawae (Nagekeo, NTT) conditions that mirror scaffolding, social mediation, and schema reorganization. The narrowing dispersion suggests that TeachLib's step-by-step enactment and rubrics helped weaker participants "catch up," a hallmark of scaffolded learning.

RQ2. Motivational gain

Motivation to implement SCL increased in tandem with module participation, as indicated by the upward trend in questionnaire scores and by the strong association between TeachLib engagement and motivation. Although the descriptive pre/post-motivation table is statistically shown, the model-based evidence on **Figure 3** shows that greater engagement was linked to higher motivation, a robust indicator that the intervention functioned as a catalyst for teachers' intentions and confidence to use SCL.

In line with self-determination and adult-learning principles, TeachLib supported autonomy (self-paced tasks and choice of exemplars), competence (clear criteria, practice with feedback), and relatedness (facilitator accompaniment and peer discussion). These design levers typically produce sustained motivational gains precisely what the analytics–outcome linkage suggests here.

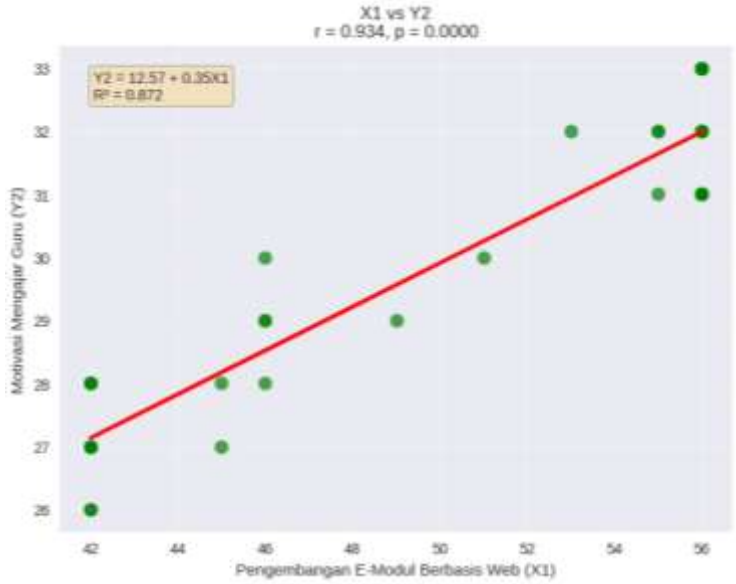
RQ3. Usage–Motivation Relationship *(regression focus)*

Simple linear regression on **Figure 3** showed that TeachLib engagement significantly predicted motivation to implement SCL:

$$Y = 12.57 + 0.35X_1$$

Engagement, with $R^2 = 0.872$, $r = 0.934$, $p < .001$. Interpreting the slope within the observed range, moving from a relatively low engagement level (X = 42) to a high level (X = 56) corresponds to an expected increase of ≈ 4.9 points in motivation (27.27 → 32.17 on the study's motivation scale). The high R^2 indicates that about 87% of the variance in motivation was accounted for by differences in engagement with TeachLib.

Figure 3. Regression Analysis of X dan Y



This very strong usage motivation linkage aligns with a constructivist PD mechanism: the more teachers interacted with authentic tasks, exemplars, and feedback, the more

they reported interest, perceived competence, and intention to enact SCL. The presence of trained facilitators is likely amplified relatedness and timely scaffolding, which helps explain the steep slope and large explained variance. Practically, the result underscores a clear policy level: ensure sufficient time-on-task and guided participation in digital PD to realize motivational returns.

RQ4. Usage–Competence relationship

TeachLib engagement was also very strongly associated with teachers' SCL competence (Figure 3): $r = 0.926$, $p < .001$ ($R^2 \approx 0.857$). While we do not interpret a competence regression model here, the correlation alone indicates that higher engagement levels co-occurred with higher competence scores. Taken together with the significant pre/post gains, this pattern suggests that TeachLib's guided implementation and assessment & feedback strands functioned as effective scaffolds for consolidating SCL knowledge. In constructivist terms, repeated cycles of plan act reflect with concrete artefacts (lesson plans, rubrics, student-work exemplars) likely enabled accommodation of new schemas for PjBL/CL design and assessment (Al-araibi et al., 2019; Evenddy et al., 2023; Kokotsaki et al., 2016).

User feedback and five principal interviews converged on the view that the web-based e-module is both helpful and usable for improving teachers' pedagogical knowledge. Principals reported that teachers became more proactive and collaborative in lesson planning, increasingly replaced lecture-only segments with PjBL and CL activities, and drew more explicitly on formative assessment tools from the module to monitor student understanding. They highlighted the guided implementation strand as especially valuable for translating abstract SCL ideas into stepwise classroom practice and noted that the assessment & feedback strand clarified success criteria and improved feedback quality. Facilitator accompaniment was described as "crucial" for troubleshooting, promoting reflective dialogue, and keeping momentum during school-based sessions features that made the e-module practical in real conditions of Gugus IV, Boawae. Overall, leaders viewed TeachLib as a scalable PD solution that raised both confidence and know-how to implement SCL.

These perceptions triangulate the quantitative results: high engagement was not accidental but driven by perceived value, and the reported classroom shifts reflect the constructivist transfer from teacher learning activities to student learning design. The usability feedback also points to sustainability: when teachers can find ready-to-use exemplars and clear rubrics inside a single platform plus facilitator support adoption costs drop, and fidelity increases (Blumberg, 2016; Kaufman & Ireland, 2016; Qurotul Aini, n.d.).

4. CONCLUSION

Considering the above findings, this study sets out to examine whether a web-based e-module, TeachLib, can transform primary teachers' motivation and pedagogical competence in Student-Centered Learning (SCL) within a real district context Gugus IV, Boawae, Nagekeo (NTT) with facilitators accompanying teachers during training. Anchored in constructivism, TeachLib integrates four strands (learning approaches; PjBL/CL models; guided implementation; assessment & feedback) to provide authentic tasks, scaffolding, social interaction, and formative feedback.

Theoretically, the study demonstrates how a constructivist design for teacher learning not only student learning translates into measurable gains and perceived classroom utility. Practically, it offers a scalable PD pathway for systems seeking to operationalize 21st-century skills: protect engagement time, pair modules with facilitation, and foreground guided enactment and assessment resources.

Limitations include the quasi-experimental design without random assignment, a single cluster sample (n=38), reliance on self-report for motivation, and short-term follow-up. Future work should test durability of effects, incorporate classroom observation rubrics, compare facilitation models, and examine strand-level contributions and cost-effectiveness.

In sum, TeachLib functions as an effective digital lever for pedagogical change: higher and more consistent SCL competence, strong engagement–motivation linkage, and positive stakeholder perceptions together show that constructivist, analytics-enabled e-modules paired with facilitator accompaniment can help transform day-to-day teaching in primary schools.

5. AUTHORS' NOTE

The authors declare that there is no conflict of interest regarding the publication of this article. Authors confirmed that the paper was free of plagiarism.

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