



Mentoring the Development of Sociology Teaching Modules Based on Learning Management Systems (LMS) and QR Codes as an Innovation for Impactful Learning in Senior High Schools

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ARTICLE INFO	ABSTRACT
Keywords: Digital Literacy; Impactful Learning; Odoo LMS; QR Code; Sociology Teaching Modules	Digital transformation in secondary education depends not only on access to technology but also on teachers' capacity to convert digital tools into pedagogically meaningful resources. This community engagement program supported teachers at SMA Amanah Nusantara Makassar in developing Sociology teaching modules that integrated the Odoo Learning Management System (LMS) and QR Codes. The program used participatory mentoring that included needs identification, a pre-test, workshops, guided practice, module development, QR Code integration, classroom simulation, consultation, a post-test, and monitoring. Teacher competence was assessed through five constructs: Digital Literacy, LMS Competence, QR Code Integration, Teaching Module Development, and Impactful Learning Readiness. Descriptive comparisons showed higher post-test means across all constructs, with the largest proportional changes in QR Code Integration (124.62%) and LMS Competence (110.85%). The available PLS-SEM results also showed positive associations along the proposed sequence from Digital Literacy to LMS Competence, QR Code Integration, Teaching Module Development, and Impactful Learning Readiness. These findings suggest that practice-oriented mentoring can help teachers translate general digital familiarity into more specific instructional capabilities. Because the program was conducted in a single partner school without a comparison group, the observed changes should be interpreted as program-associated descriptive improvements rather than causal effects.
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INTRODUCTION

Digital transformation has expanded the range of resources available for teaching, but access to digital tools does not automatically produce meaningful changes in classroom practice. Research increasingly distinguishes between basic technology use and the professional digital competence required to select, adapt, and integrate digital resources for specific pedagogical purposes (Hämäläinen et al., 2021; Wohlfart & Wagner, 2023; Børte et al., 2023). Recent reviews similarly show that teachers' digital competence involves interconnected knowledge, skills, attitudes, and instructional decisions rather than isolated technical ability (Basilotta-Gómez-Pablos et al., 2022; Domínguez-González et al., 2025). This distinction is particularly important in secondary schools, where teachers must organize curriculum content, learning activities, communication, and assessment within increasingly hybrid learning environments. Digital innovation is therefore most educationally relevant when teachers can connect technology to disciplinary goals and student learning processes rather than merely adding devices or applications to existing routines.

Evidence from different educational systems shows that teachers' digital competence varies substantially according to prior experience, professional learning, institutional support, and the contexts in which technology is used. Studies of in-service and vocational teachers have found that personal and contextual factors shape both confidence and the practical use of digital tools (Lucas et

al., 2021; Cattaneo et al., 2022; Myyry et al., 2022). Similar variation has been reported among basic-education teachers, indicating that familiarity with everyday digital technology may coexist with limitations in pedagogical integration (Hurtado-Mazeyra et al., 2022; Suzer & Koc, 2024). These findings challenge the assumption that teachers who can operate digital devices are necessarily prepared to design technology-supported instruction. For school-based digital transformation, professional development must therefore address the transition from general digital literacy to purposeful instructional design.

Learning Management Systems provide one mechanism for making that transition because they can bring learning materials, communication, assignments, and assessment into a common digital environment. Research on LMS adoption shows that sustained use depends on more than system availability; perceived usefulness, user competence, support, and the quality of the digital environment influence whether teachers incorporate an LMS into routine practice (Al-Nuaimi & Al-Emran, 2021; Alturki & Aldraiweesh, 2021). Reviews of LMS use likewise indicate that adoption is shaped by interacting technological, organizational, and user-related conditions (Sulaiman, 2024). More recent evidence on digital education management systems also emphasizes the contribution of self-efficacy and user expectations to continued adoption (Zhang, 2025). In a school context, an LMS is therefore most valuable when teachers can use it as an instructional workspace rather than merely as a storage location for files.

QR Codes can complement an LMS by connecting printed teaching materials with online resources that students can access through mobile devices. Research has shown that QR-enabled resources can simplify access to digital content and support interaction when the linked materials are usable and instructionally relevant (Hernando & Macías, 2023; Minard, 2024). In educational settings, QR Codes have also been used to connect textbooks or activities with augmented or supplementary resources, although the pedagogical design surrounding the code remains more important than the code itself (AlNajdi, 2022). Their practical value is consistent with evidence that QR-based access can reduce procedural barriers when learners need to reach digital forms or resources quickly (Masih, 2022). Accordingly, integrating QR Codes into teaching modules is best understood as a bridge between physical and digital learning materials, not as an instructional innovation in isolation.

The capacity to build such connections can be strengthened through professional learning that combines explanation, guided practice, feedback, and opportunities to apply technology to teachers' own instructional materials. Coaching-based and practice-oriented professional development has been associated with stronger teacher confidence and more sustained engagement with digital teaching tasks than one-off exposure to tools (Zimmer & Matthews, 2022; Grierson et al., 2024). Systematic reviews also emphasize active learning, collaboration, expert support, and reflection as recurring features of technology-enabled teacher professional development (Huang et al., 2024; Ventista & Brown, 2023). Online professional-learning communities can further extend access to peer knowledge when the technological environment supports interaction and resource sharing (Jin et al., 2024). These patterns suggest that mentoring is particularly suitable when teachers must move from conceptual understanding to the production and classroom use of concrete digital resources.

Existing literature provides substantial evidence on teacher digital competence, LMS adoption, blended learning, and technology-focused professional development, but these strands are often examined separately or in contexts different from school-based Sociology instruction. Studies of digital competence describe what teachers need to know and do (Fernández-Batanero et al., 2022; Revuelta-Domínguez et al., 2022), while blended-learning research emphasizes the design of coherent relationships between online and face-to-face activities (Heilporn et al., 2021; Müller & Mildemberger, 2021). Other work shows that professional development outcomes depend on teachers' prior experiences and the specific opportunities they receive to practice technology integration (Bond et al., 2021; Charania et al., 2024; Yang et al., 2024). What remains less visible is how a school-based mentoring program can connect these elements in a single workflow: developing

Sociology modules, organizing them through an LMS, and using QR Codes to link printed and digital resources. This integrated problem frames the contribution of the present community engagement program.

At SMA Amanah Nusantara Makassar, initial observations and discussions with school personnel indicated that classroom instruction still relied largely on printed materials, an LMS had not been systematically embedded in teaching, and teachers had limited experience integrating QR Codes into instructional modules. The program therefore focused on practical needs already present in the partner school rather than introducing technology as an abstract innovation. Its primary objective was to strengthen teachers' competence in Digital Literacy, LMS Competence, QR Code Integration, Teaching Module Development, and Impactful Learning Readiness through participatory mentoring. The program combined Odoo LMS training with the development of Sociology teaching modules and QR-linked digital resources, followed by simulation and consultation. Practically, this approach was intended to provide the school with a connected workflow for preparing, organizing, and delivering technology-supported Sociology materials; conceptually, it examined how general digital competence related to more specific implementation and instructional-design competencies within the same mentoring process.

METHOD

This community engagement program used a participatory mentoring design with pre-test and post-test measurement to document changes in teachers' competencies and an exploratory structural model to examine associations among the measured constructs. The program was implemented at SMA Amanah Nusantara Makassar and focused on the development of Sociology teaching modules integrating Odoo LMS and QR Codes. Classroom observations, documentation, reflective discussions, and interviews were used to contextualize the quantitative results, while the reported numerical comparisons were based on the questionnaire data. The design was selected because the program combined professional development, production of instructional materials, and evaluation within the same school-based intervention.

Program Design and Context

The activities were organized around the partner school's existing instructional conditions. Initial coordination with the school principal and participating teachers was used to identify learning needs, current use of digital resources, and practical constraints related to LMS implementation, QR Code use, and digital module development. The program proceeded from needs identification to baseline assessment, mentoring and product development, classroom simulation, post-test assessment, and monitoring.

Participants

Participants were teachers from SMA Amanah Nusantara Makassar who joined the mentoring activities and completed the program evaluation procedures. They took part in the baseline assessment, guided training, module-development activities, classroom simulation, post-test assessment, and monitoring. The quantitative results reported below retain the original means, standard deviations, percentage changes, and structural-model coefficients.

Instruments and Measures

Teacher competence was assessed using a structured five-point Likert questionnaire administered before and after the mentoring activities, with response options ranging from 1 (strongly disagree) to 5 (strongly agree). The questionnaire represented five constructs used consistently throughout the program: Digital Literacy (DL), LMS Competence (LC), QR Code Integration (QI), Teaching Module Development (TMD), and Impactful Learning Readiness (ILR). DL referred to the use of digital technologies in educational settings; LC captured knowledge and skills for operating an LMS; QI represented the ability to incorporate QR Codes into teaching modules; TMD

addressed the design of interactive digital Sociology modules; and ILR represented readiness to implement innovative, student-centered, technology-supported learning.

The same questionnaire was administered at pre-test and post-test so that construct means could be compared descriptively across the two measurement points. The five constructs were retained consistently across both administrations.

Implementation Procedure

The implementation followed a learning-by-doing sequence. After coordination and needs identification, teachers completed the pre-test. The mentoring team then introduced digital transformation and impactful learning, provided technical guidance for installing and operating Odoo LMS, and supported teachers in organizing Sociology learning materials within the platform. Teachers subsequently developed technology-supported Sociology teaching modules, embedded QR Codes linking printed materials to digital resources, and practiced the resulting learning activities through classroom simulations.

Individual consultation accompanied the practical stages so that technical and pedagogical problems could be addressed while teachers were developing their own materials. Following the mentoring and simulation activities, teachers completed the post-test using the same instrument. Monitoring activities included observation, review of documentation, reflective discussion, and interviews with teachers and school administrators to capture implementation experiences and practical challenges. The sequence is summarized in Figure 1.

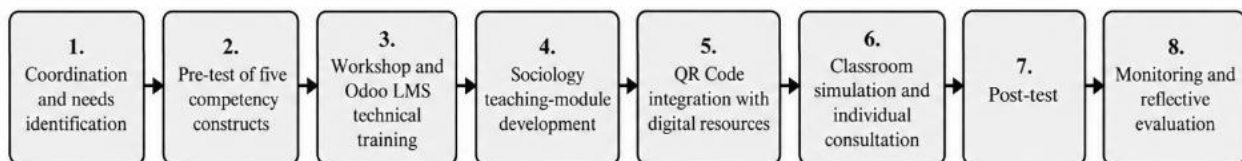


Figure 1. Flow of the Community Engagement and Mentoring Program

The flowchart presents the sequence used to connect needs identification, competence assessment, guided technology practice, module production, simulation, and evaluation within the same mentoring process.

Data Analysis

Pre-test and post-test scores were summarized using means and standard deviations. The proportional change reported for each construct was calculated from the difference between the post-test and pre-test means relative to the pre-test mean. Because the reported analysis did not include a paired inferential test of the pre-test-post-test difference, the percentage changes are interpreted as descriptive indicators rather than evidence of causal program effects.

Structural Model and Interpretive Boundaries

The structural analysis was conducted using Partial Least Squares Structural Equation Modeling (PLS-SEM) in SmartPLS 4.0. PLS-SEM can be used to estimate relationships among multiple constructs when the analytical objective is prediction and explanation of a specified model (Hair & Alamer, 2022). The reported structural statistics comprised standardized path coefficients (β), t-values, p-values, effect sizes (f^2), and coefficients of determination (R^2). Bootstrapping with 5,000 resamples was used, with statistical significance evaluated at $t > 1.96$ and $p < 0.05$.

The PLS-SEM findings are interpreted as exploratory associations rather than as evidence of causal pathways. Qualitative observations, documentation, reflective discussion, and interviews were used to contextualize the implementation process rather than as a separately coded thematic dataset.

RESULTS AND DISCUSSION

Initial Conditions and Teachers' Digital Competence

Initial observations showed that digital learning at SMA Amanah Nusantara Makassar was not yet organized as an integrated instructional system. Teaching relied primarily on printed materials, Odoo LMS had not been systematically incorporated into classroom routines, and QR Codes were not routinely used to connect printed modules with digital learning resources. Teachers were familiar with common digital devices and online resources, but their experience in managing an LMS, developing interactive digital modules, and embedding QR-linked materials remained limited.

The pre-test provided a baseline profile across the five program constructs. Digital Literacy recorded a mean of 2.68 (SD = 0.54) and Impactful Learning Readiness a mean of 2.74 (SD = 0.56), both categorized as moderate in the original scoring interpretation. The lower means were found for LMS Competence (M = 2.12, SD = 0.49), QR Code Integration (M = 1.95, SD = 0.47), and Teaching Module Development (M = 2.36, SD = 0.51). The pattern indicates that general readiness to use technology was higher than competence in the specific tools and design tasks targeted by the program.

Figure 2 documents the administration of the baseline assessment, while Table 1 summarizes the pre-test scores used to identify the main competency gaps.



Figure 2. Pre-test Administration Before the Mentoring Program

The descriptive pre-test results are presented in Table 1.

Table 1. Teachers' Baseline Competence Before the Mentoring Program

Competence	Mean	SD	Category	Interpretation
Digital Literacy (DL)	2.68	0.54	Moderate	Teachers had basic digital skills but limited confidence in pedagogical technology integration.
LMS Competence (LC)	2.12	0.49	Low	Teachers reported limited prior experience using an LMS for learning activities.
QR Code Integration (QI)	1.95	0.47	Low	Teachers reported limited prior use of QR Codes in teaching modules.
Teaching Module Development (TMD)	2.36	0.51	Low	Teaching modules were predominantly print-based with limited digital integration.
Impactful Learning Readiness (ILR)	2.74	0.56	Moderate	Teachers showed readiness for innovation but limited implementation experience.

Note. Mean scores were calculated from the pre-test questionnaire.

The lowest baseline score was observed for QR Code Integration, followed by LMS Competence and Teaching Module Development. These results identify the most immediate targets of the mentoring program: operating a structured digital learning environment, linking printed materials

to digital resources, and transforming existing Sociology content into more interactive modules. Digital Literacy and Impactful Learning Readiness were comparatively higher, but their moderate levels also indicated room for development.

Taken together, the baseline profile suggests a gap between general familiarity with digital technology and the ability to apply that technology within a coherent instructional design. The mentoring activities were therefore organized around practical production tasks rather than additional conceptual explanation alone.

Implementation of the Mentoring Program

The mentoring program combined conceptual orientation with direct practice. Teachers first examined the role of digital tools in student-centered Sociology learning and then worked with Odoo LMS to organize learning materials and activities. They subsequently converted existing Sociology content into structured modules containing learning objectives, contextual material, activities, supplementary resources, and assessment components. QR Codes were embedded as access points to videos, readings, presentations, online activities, and other digital resources.



Figure 3. Implementation of the Mentoring Program

Classroom simulation and individual consultation provided an opportunity to test the practical connection between the printed modules, QR-linked resources, and LMS environment. Teachers could revise technical and pedagogical elements while the mentoring team observed implementation problems and provided feedback. The process therefore moved from orientation to tool use, product development, and simulated instructional application rather than treating LMS and QR Code training as separate activities.

The documentation of these activities indicates that the program produced a connected instructional workflow in which digital resources were organized through the LMS and made accessible from printed Sociology modules through QR Codes.

Post-test Results and Descriptive Change

Post-test means were higher than pre-test means for all five constructs. Digital Literacy increased from 2.68 to 4.41, LMS Competence from 2.12 to 4.47, QR Code Integration from 1.95 to 4.38, Teaching Module Development from 2.36 to 4.44, and Impactful Learning Readiness from 2.74 to 4.52. The largest proportional changes were reported for QR Code Integration (124.62%) and LMS Competence (110.85%), followed by Teaching Module Development (88.14%), Impactful Learning Readiness (64.96%), and Digital Literacy (64.55%). These values describe the magnitude of change within the participating group; they do not by themselves establish that the program caused the observed differences.



Figure 4. Post-test Administration After the Mentoring Program

Table 2 presents the pre-test and post-test means and the corresponding descriptive percentage changes.

Table 2. Comparison of Pre-test and Post-test Results

Competence	Pre-test Mean	Post-test Mean	Mean Difference	Improvement (%)	Post-Mentoring Category
Digital Literacy (DL)	2.68	4.41	1.73	64.55	High
LMS Competence (LC)	2.12	4.47	2.35	110.85	Very High
QR Code Integration (QI)	1.95	4.38	2.43	124.62	Very High
Teaching Module Development (TMD)	2.36	4.44	2.08	88.14	High
Impactful Learning Readiness (ILR)	2.74	4.52	1.78	64.96	Very High

Structural Model and Relationships among Competencies

The exploratory structural model examined whether the five competencies followed the sequence proposed in the mentoring framework. Table 3 shows positive and statistically significant paths for DL → LC ($\beta = 0.786$, $p < 0.001$), LC → QI ($\beta = 0.842$, $p < 0.001$), QI → TMD ($\beta = 0.884$, $p < 0.001$), TMD → ILR ($\beta = 0.801$, $p < 0.001$), and DL → ILR ($\beta = 0.218$, $p = 0.037$). Among the reported paths, QR Code Integration to Teaching Module Development had the largest standardized coefficient, whereas the direct path from Digital Literacy to Impactful Learning Readiness was the smallest.

Table 3. Exploratory Structural Model Results

Hypothesis	Structural Relationship	β	t-value	p-value	f ²	Decision
H1	DL → LC	0.786	5.214	<0.001	1.617	Supported
H2	LC → QI	0.842	7.136	<0.001	2.432	Supported
H3	QI → TMD	0.884	8.427	<0.001	3.593	Supported
H4	TMD → ILR	0.801	6.318	<0.001	1.792	Supported
H5	DL → ILR	0.218	2.087	0.037	0.119	Supported

Digital Literacy was positively associated with LMS Competence ($\beta = 0.786$; $t = 5.214$; $p < 0.001$), indicating that teachers with higher digital-literacy scores also tended to report stronger competence in using the LMS. LMS Competence, in turn, was positively associated with QR Code Integration ($\beta = 0.842$; $t = 7.136$; $p < 0.001$). These two paths are consistent with the program sequence, in which general digital capability preceded the use of a structured digital environment and the integration of linked resources.

The largest path coefficient connected QR Code Integration with Teaching Module Development ($\beta = 0.884$; $t = 8.427$; $p < 0.001$). This association suggests that the ability to connect printed modules

with digital resources was closely related to teachers' reported competence in developing technology-supported Sociology modules. Teaching Module Development was also positively associated with Impactful Learning Readiness ($\beta = 0.801$; $t = 6.318$; $p < 0.001$), linking instructional product development with readiness to use more student-centered, technology-supported practices.

The direct relationship between Digital Literacy and Impactful Learning Readiness was positive but comparatively smaller ($\beta = 0.218$; $t = 2.087$; $p = 0.037$). Within the proposed model, this pattern is consistent with the idea that general digital competence may be related to readiness both directly and through more task-specific competencies. The result should nevertheless be interpreted as an association within the available dataset rather than evidence of a causal mediation process.

The reported R^2 values were 0.618 for LMS Competence, 0.709 for QR Code Integration, 0.781 for Teaching Module Development, and 0.746 for Impactful Learning Readiness. In the specified model, these values indicate that the predictor constructs accounted for substantial portions of variance in the endogenous constructs. Because complete measurement-model statistics and a verified analytic sample size were not available, these explanatory values are treated as exploratory.

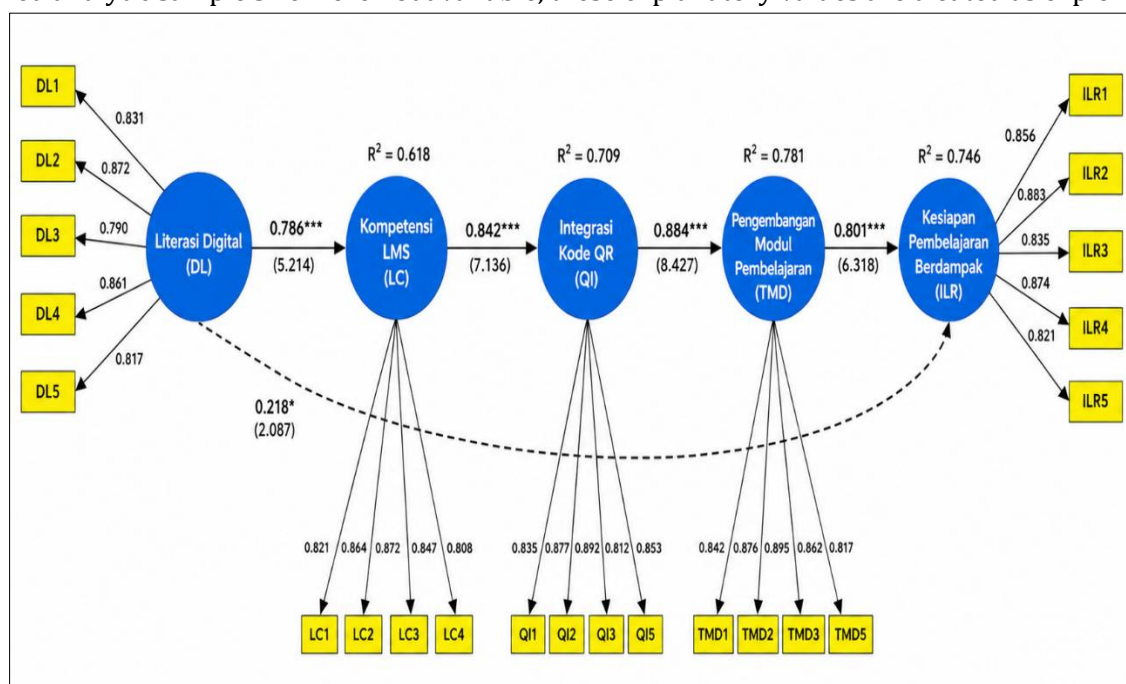


Figure 5. PLS-SEM Structural Model of Digital Literacy, LMS Competence, QR Code Integration, Teaching Module Development, and Impactful Learning Readiness

Figure 5 visualizes the reported structural relationships and R^2 values. The model should be read as an exploratory representation of associations among the five competencies after the mentoring program, not as a causal sequence established by the program design.

Discussion

The baseline profile is informative because it separates general digital familiarity from competencies required for instructional integration. Teachers entered the program with moderate Digital Literacy and Impactful Learning Readiness, yet LMS Competence, QR Code Integration, and Teaching Module Development were lower. Similar distinctions appear in research showing that teachers can possess everyday digital skills while still needing support to use technology for pedagogical design and classroom orchestration (Hämäläinen et al., 2021; Lucas et al., 2021; Cattaneo et al., 2022). Studies based on DigCompEdu likewise report uneven competence across domains and emphasize that professional digital competence develops through specific educational tasks rather than generic device use (Hurtado-Mazeyra et al., 2022; Suzer & Koc, 2024). In this program, the baseline gap justified a mentoring focus on concrete instructional workflows instead of assuming that basic digital literacy would transfer automatically to LMS use or module design.

The largest descriptive changes occurred in QR Code Integration and LMS Competence, the two areas in which baseline means were especially low. This pattern is plausible given that the mentoring program provided repeated hands-on practice with Odoo LMS, QR Code creation, module linking, and direct consultation. Coaching and practice-oriented professional development can strengthen teachers' confidence when new technologies are learned through authentic tasks rather than isolated demonstrations (Zimmer & Matthews, 2022; Grierson et al., 2024). Broader reviews of teacher professional learning similarly identify active participation, collaboration, expert support, and sustained feedback as conditions associated with more productive technology learning (Ventista & Brown, 2023; Huang et al., 2024). The present results are consistent with that literature, although the absence of a comparison group means that the observed pre-test-post-test differences cannot be attributed solely to the mentoring program.

The improvement in Teaching Module Development is particularly relevant because it represents the point at which technical skills were converted into an instructional product. QR Codes were used to connect printed Sociology modules with videos, readings, presentations, activities, and assessments, while Odoo LMS provided a structured environment for organizing those resources. Research on QR-enabled learning indicates that the technology is useful when it reduces access barriers and connects learners efficiently to relevant digital content, but its educational value depends on how the linked resources are designed and used (Hernando & Macías, 2023; Minard, 2024). Evidence from QR-supported educational materials also shows benefits when the code is embedded within a broader learning design rather than treated as a standalone novelty (AlNajdi, 2022). This helps explain why the program linked QR Code practice directly to module development rather than presenting QR generation as an independent technical skill.

The structural model adds a second layer of interpretation by showing that the task-specific competencies were positively associated in the sequence represented by the program. Digital Literacy was associated with LMS Competence, LMS Competence with QR Code Integration, QR Code Integration with Teaching Module Development, and Teaching Module Development with Impactful Learning Readiness. Research on LMS adoption has similarly shown that user competence and perceptions of the digital environment are closely connected to actual or intended system use (Al-Nuaimi & Al-Emran, 2021; Alturki & Aldraiweesh, 2021; Zhang, 2025). Technology-acceptance research also indicates that digital competence can shape beliefs about the usefulness and manageability of educational technologies (Antonietti et al., 2022). Within this study, the structural pattern therefore appears consistent with a staged transition from general competence to platform use and then to instructional design, although the cross-sectional structural estimates do not establish that one competence caused the next.

The strongest reported path, from QR Code Integration to Teaching Module Development, suggests that resource-linking competence was closely associated with teachers' ability to develop digitally enriched modules. This is conceptually consistent with recent work defining professional digital competence as the capacity to select, create, organize, and adapt digital resources for teaching rather than simply access them (Heine et al., 2023; Revuelta-Domínguez et al., 2022). The strong association between Teaching Module Development and Impactful Learning Readiness also indicates that readiness was more closely connected to a concrete pedagogical product than to general digital literacy alone. Blended-learning research similarly emphasizes coherent design between digital resources, activities, teacher roles, and learning objectives (Heilporn et al., 2021; Müller & Mildenberger, 2021). For the Sociology teachers in this program, module development functioned as the practical space in which LMS organization and QR-linked resources were brought together for intended classroom use.

The comparatively smaller direct path from Digital Literacy to Impactful Learning Readiness reinforces the distinction between knowing how to use technology and being prepared to redesign instruction with it. Reviews of teacher digital competence consistently describe professional competence as multidimensional and context dependent (Basilotta-Gómez-Pablos et al., 2022;

Fernández-Batanero et al., 2022; Domínguez-González et al., 2025). High-school research also shows that institutional support, perceived ease of use, and access conditions shape teachers' technology integration beyond individual skill alone (Sellami et al., 2024). More recent evidence links digital professional development and professional learning communities with stronger instructional integration when schools are prepared to support digital practice (Amemasor et al., 2025). These findings support the program's emphasis on mentoring, consultation, and a common LMS environment instead of treating digital literacy as a sufficient endpoint.

The program's practical contribution lies in integrating teacher mentoring, Odoo LMS use, QR-linked resources, and Sociology module development within one school-based workflow. This integrated configuration addresses a gap between literature that measures digital competence and literature that examines particular tools or professional-development formats separately (Wohlfart & Wagner, 2023; O'Brien, 2025). At the same time, the findings require cautious interpretation because the program was implemented in a single partner school and no comparison group was reported. The descriptive pre-test-post-test analysis also does not establish statistical change, while complete item-level instrument information and PLS-SEM measurement-model diagnostics are not reported in the available analysis. Future evaluations should document these elements explicitly and use an appropriate paired pre-test-post-test analysis when inferential claims about change are intended. With those limitations recognized, the present evidence is most useful as a context-specific account of how participatory mentoring can organize several digital competencies around the production of usable Sociology teaching materials.

CONCLUSIONS

The mentoring program was associated with higher post-test scores across Digital Literacy, LMS Competence, QR Code Integration, Teaching Module Development, and Impactful Learning Readiness. The largest descriptive changes occurred in QR Code Integration and LMS Competence, while the exploratory structural model showed positive associations among the five competencies, with the strongest reported path linking QR Code Integration to Teaching Module Development. These results suggest that school-based mentoring can help teachers connect general digital capability with platform use, resource linking, and instructional-material development when the activities are organized around authentic teaching tasks. The findings should not be interpreted as causal evidence because the program involved a single school without a comparison group, and the structural results remain exploratory. The practical implication is that digital-transformation initiatives may be more meaningful when training is organized around a connected instructional workflow rather than around separate technologies.

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