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# The DRIVE model: supporting classroom technology integration through evidence-informed faculty development

**Charito Garcia Ong**
Department of Teaching Languages, University of Science and Technology of Southern Philippines, Cagayan de Oro, Philippines

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**ABSTRACT**

The integration of digital technologies in higher education remains inconsistent despite sustained faculty development efforts. This study investigated whether a structured implementation framework could enhance the transfer of professional learning into sustained classroom practice. A 5-stage process consisting of diagnostic needs analysis, responsive planning, instructional validation, verification, and evaluation was introduced to operationalize implementation sequencing within an evidence-informed cycle. Using a convergent mixed-methods descriptive design, data were collected from 35 undergraduate instructors participating in blended professional development over one academic semester. Quantitative self-assessments were triangulated with focus group discussions, instructional artifacts, and reflective narratives. Findings revealed measurable increases in digital competence (16.67%), frequency of technology use (16.67%), and instructional confidence (9.38%). Participants implemented digital assessments (68.57%), multimedia strategies (80%), formative feedback tools (82.86%), flipped instruction (57.14%), and collaborative technologies (51.43%). Although faculty reported barriers such as tool complexity and time constraints, staged implementation supported persistence across phases. Results indicate that structured sequencing, rather than competence enhancement alone, strengthens behavioral transfer and pedagogical alignment. The framework offers higher education institutions a replicable, process-oriented approach for achieving measurable and sustainable instructional improvement.



***Corresponding Author:***

Charito Garcia Ong
Department of Teaching Languages, University of Science and Technology of Southern Philippines
Cagayan de Oro, Philippines
Email: charito.ong@ustp.edu.ph

## 1. INTRODUCTION

The rapid expansion of digital technologies in higher education has transformed expectations for teaching and learning, yet the effective integration of these technologies into classroom practice remains inconsistent across institutional contexts [1]–[4]. While universities have invested substantially in digital infrastructure and faculty training initiatives, research continues to report disparities between faculty attitudes toward technology and their actual pedagogical implementation [5]–[8]. These inconsistencies indicate that technology adoption extends beyond issues of access or technical skill, encompassing pedagogical alignment, institutional culture, and structured implementation processes [9]–[12].

Contemporary scholarship highlights the importance of technological pedagogical content knowledge and digital competence frameworks in guiding meaningful integration of digital tools into instructional practice [13]–[16]. However, systematic reviews suggest that many professional development initiatives prioritize exposure to tools rather than sustained instructional transformation [17]–[19]. As a result, faculty frequently engage in short-term experimentation without achieving long-term behavioral transfer into classroom practice [20]–[22]. This persistent implementation gap underscores the need for structured frameworks that explicitly connect diagnostic analysis, responsive planning, instructional validation, classroom verification, and reflective evaluation within an iterative improvement cycle [23]–[25].

Grounded in principles of design-based implementation research and implementation-oriented professional development, this study introduces a structured five-stage framework designed to strengthen the transfer of faculty learning into observable classroom practice. Unlike competence-based models that emphasize knowledge acquisition, the proposed approach operationalizes implementation sequencing through clearly defined stages that guide instructors from contextual needs identification to reflective evaluation of instructional outcomes. By embedding procedural scaffolding and verification checkpoints, the framework seeks to reduce the fragmentation often associated with technology training initiatives and to promote sustained pedagogical alignment.

The DRIVE framework is conceptually grounded in three complementary bodies of scholarship: implementation science, design-based implementation research, and professional development transfer theory. Implementation science emphasizes the systematic translation of knowledge into sustained practice through structured processes that guide adoption, adaptation, and evaluation in real-world settings. Within educational contexts, implementation-oriented models highlight the importance of staged processes, contextual alignment, and iterative feedback mechanisms to ensure that innovations introduced through professional development are effectively enacted in classroom practice. The DRIVE framework adopts this perspective by structuring technology integration as a sequential process moving from diagnostic analysis to reflective evaluation, thereby emphasizing procedural implementation rather than knowledge acquisition alone.

In addition, the framework aligns with principles of design-based implementation research, which advocates iterative cycles of design, enactment, analysis, and refinement within authentic educational environments. Such approaches emphasize collaboration, contextual responsiveness, and continuous improvement, ensuring that pedagogical innovations evolve through interaction between theory and practice. At the same time, DRIVE reflects insights from professional development transfer theory, which argues that meaningful instructional change occurs when learning opportunities are explicitly connected to classroom application and supported by verification and reflection mechanisms. From this perspective, the DRIVE framework is not intended to replace digital competence or technological pedagogical content knowledge models, but rather to operationalize them through a structured implementation process that supports the translation of these competencies into observable instructional practice.

To address this gap, the present study was guided by four interrelated research questions examining the influence of a structured implementation framework on classroom technology integration. Specifically, it investigates how participation in a staged implementation process affects faculty integration of digital technologies; what measurable instructional changes emerge following its application; how faculty perceive shifts in student engagement, assessment practices, and instructional organization; and what implementation barriers arise, including how structured stages influence persistence during instructional complexity. By situating the framework within international scholarship on digital competence and professional development transfer, this study contributes an implementation-focused model intended to enhance pedagogical alignment and measurable instructional impact in higher education settings.

## 2. METHOD

### 2.1. Research design

This study employed a convergent mixed-methods descriptive design to examine the implementation and instructional impact of a structured faculty development framework. Mixed-methods approaches are recommended in educational technology research to capture both measurable instructional shifts and contextualized faculty experiences [17]–[19]. The integration of quantitative and qualitative strands allows triangulation and strengthens validity, particularly in implementation-focused studies [18], [19]. The design was appropriate because prior research indicates that faculty technology integration often reflects discrepancies between reported attitudes and observable instructional practice [2], [6]. Therefore, combining survey indicators with artifact analysis and focus group data enabled cross-validation of reported instructional transformation.

### 2.2. Participants and context

Participants included 35 undergraduate instructors from a higher education institution who voluntarily enrolled in blended faculty development activities focused on technology-enhanced instruction. Faculty represented multiple disciplinary backgrounds. Research consistently shows that faculty digital competence varies across disciplines and institutional contexts [1], [7], [10]. Therefore, a multi-disciplinary participant group allowed examination of implementation across varied instructional environments. The implementation period spanned one academic semester, consistent with recommendations that sustained professional development cycles are necessary for meaningful pedagogical change [11], [15].

### 2.3. Implementation procedure: the five-stage framework

The structured framework was operationalized through five sequential stages aligned with principles of design-based implementation research and structured professional development cycles [18], [19]. Stage 1 was diagnostic needs analysis. Faculty completed a structured needs assessment examining current technology use, pedagogical challenges, and digital competence levels. Establishing baseline instructional practices aligns with recommendations for competence-based faculty development [1], [7]. Stage 2 was responsive planning. Participants developed integration plans aligning digital tools with course learning outcomes. Pedagogical alignment is central to technological pedagogical content knowledge theory [5], [24]. Stage 3 was instructional validation. Proposed strategies were peer-reviewed to ensure feasibility and pedagogical coherence. Collaborative validation processes are associated with higher professional development effectiveness [11]. Stage 4 was verification. Faculty implemented planned strategies in live courses. Instructional artifacts were collected to verify classroom application, addressing concerns that faculty training often fails to translate into observable practice [20]. Stage 5 was evaluation. Participants engaged in structured reflection and group discussion to assess instructional effectiveness. Reflective evaluation aligns with iterative improvement models in design-based research [17], [19]. Each stage informed the subsequent phase, ensuring structured progression rather than isolated technology adoption.

### 2.4. Instruments and data collection

Multiple instruments were employed to enhance methodological rigor and ensure triangulation across data sources.

#### 2.4.1. Structured survey instrument

A structured questionnaire using a five-point Likert scale was administered to measure perceived digital competence, instructional confidence, and frequency of technology integration. The instrument included items aligned with established digital competence dimensions in higher education [1], [7]. Prior to deployment, the survey underwent content validation by two educational technology experts to ensure clarity and alignment with instructional integration constructs. The instrument was administered at the conclusion of the implementation period to capture perceived instructional changes.

#### 2.4.2. Focus group discussions

Semi-structured focus group sessions were conducted to gather in-depth insights into faculty experiences during implementation. Guiding questions explored instructional alignment, student engagement, assessment adaptation, and encountered challenges. Qualitative inquiry has been shown to provide contextual understanding of technology integration processes and institutional barriers [8], [9].

#### 2.4.3. Instructional artifacts

To verify classroom application, participants submitted instructional materials including revised lesson plans, digital assessments, multimedia instructional resources, and course integration plans. Artifact analysis served as an objective indicator of instructional modification and helped mitigate self-report bias commonly associated with professional development research [11], [20].

#### 2.4.4. Reflective narratives

Participants were asked to submit structured reflective accounts documenting instructional adjustments, student responses, and implementation challenges. Reflective documentation is recommended in implementation-focused studies to capture practitioner insight and iterative adaptation [17], [19]. Data collection occurred over one academic semester, allowing sufficient time for planning, classroom application, and reflective evaluation.

### 2.5. Data analysis procedures

Quantitative data were analyzed using descriptive statistics, including frequency distributions and percentage changes in reported instructional practices. Descriptive indicators are appropriate for implementation-based evaluation studies examining instructional shifts [11], [14]. Qualitative data were analyzed using thematic analysis. Open coding identified recurrent patterns related to pedagogical alignment, student engagement, and implementation barriers. Thematic categorization aligns with established qualitative analysis procedures in educational research [17], [19]. Triangulation was conducted by cross-validating survey results, qualitative themes, and instructional artifacts, strengthening credibility and reducing mono-method bias [18].

### 2.6. Validity and trustworthiness

Several strategies were implemented to enhance the validity and credibility of the study. Methodological Triangulation. Data were collected from multiple sources, including surveys, focus group discussions, instructional artifacts, and reflective narratives. Triangulation across quantitative and qualitative strands strengthened credibility by verifying consistency across independent data sources [18], [19].

#### 2.6.1. Content validation of instruments

The survey instrument underwent expert review by specialists in educational technology and instructional design to ensure alignment with digital competence and instructional integration constructs [1], [7]. Revisions were made based on expert feedback prior to administration.

#### 2.6.2. Artifact-based verification

To reduce reliance on self-reported data, instructional artifacts were analyzed to corroborate reported changes in classroom practice. Artifact triangulation has been recommended in professional development evaluation studies to enhance confirmability [11], [20].

#### 2.6.3. Audit trail and procedural transparency

Documentation was maintained throughout each stage of implementation, including needs assessment results, planning documents, workshop feedback, and evaluation summaries. Maintaining an audit trail strengthens dependability in implementation-oriented research [17], [19].

#### 2.6.4. Reflexive reporting of challenges

Participants were encouraged to document not only successful outcomes but also barriers and implementation difficulties. Explicit acknowledgment of challenges enhances confirmability and reduces positive-reporting bias [8], [9]. Together, these measures support the credibility, dependability, and confirmability of the findings within the institutional context examined.

## 3. RESULTS AND DISCUSSION

### 3.1. Measurable changes in faculty digital integration

Table 1 presents the pre- and post-implementation self-assessment scores for participating faculty (n=35). Digital competence increased by 16.67%, while frequency of technology use demonstrated a comparable 16.67% increase. Instructional confidence improved by 9.38%. Importantly, the parallel growth in competence and frequency suggests that the framework supported behavioral transfer rather than isolated conceptual awareness. This distinction is critical, as prior research frequently reports discrepancies between faculty confidence and actual classroom implementation [26], [27].

Table 1. Pre- and post-implementation self-assessment scores (n=35)

| Variable | Pre-mean | Post-mean | Mean difference | Percentage increase (%) |
|---|---|---|---|---|
| Digital competence | 30 | 35 | 5 | 16.67 |
| Instructional confidence | 32 | 35 | 3 | 9.38 |
| Frequency of technology use | 30 | 35 | 5 | 16.67 |

### 3.2. Adoption of technology-supported instructional practices

As shown in Table 2, formative feedback tools (82.86%) and multimedia-supported instruction (80.00%) were the most frequently implemented instructional practices following participation in the structured faculty development framework. Digital assessments were adopted by 68.57% of participants, while flipped instructional strategies were implemented by 57.14%. Collaborative tools demonstrated the lowest adoption rate (51.43%), though still reflecting majority uptake.

These findings indicate that faculty prioritized engagement-oriented and feedback-driven technologies over more structurally demanding pedagogical redesign approaches. The strong adoption of formative feedback tools is particularly noteworthy, as digital feedback systems have been associated with improved learner engagement, responsiveness, and instructional adjustment when systematically embedded within course design [27], [28]. Similarly, multimedia-supported instruction has been shown to enhance conceptual clarity and student motivation when aligned with learning objectives [25]. Meta-analytic evidence further indicates that multimedia technology can positively influence learners' creative performance [29].

These adoption rates exceed levels reported in professional development initiatives that lack structured verification and staged implementation processes [30], [31]. The structured progression from diagnostic needs analysis to responsive planning appears to have strengthened alignment between selected technologies and instructional objectives, thereby mitigating the common issue of technology-tool mismatch [31]. By requiring faculty to explicitly link digital tools to identified instructional challenges before classroom application, the framework may have supported more intentional and sustained implementation.

Table 2. Adoption of technology-supported instructional practices

| Practice category | Frequency (n) | Percentage (%) |
|---|---|---|
| Formative feedback tools | 29 | 82.86 |
| Multimedia integration | 28 | 80.00 |
| Digital assessments | 24 | 68.57 |
| Flipped instruction | 20 | 57.14 |
| Collaborative tools | 18 | 51.43 |

### 3.3. Triangulated classroom effects

Faculty-reported improvements clustered around student engagement, lesson organization, assessment efficiency, and instructional confidence. Artifact verification confirmed that reported practices were embedded within lesson plans and learning management system structures. Triangulation strengthens interpretive validity, as artifact-supported findings reduce reliance on perception-based reporting [31], [32]. This is particularly relevant given widespread concerns regarding self-report bias in professional development evaluation research [33]. The integration of artifact verification within the framework differentiates the DRIVE model from many competence-based approaches that measure perception without requiring observable instructional confirmation [26].

### 3.4. Implementation challenges and structural barriers

As shown in Table 3, faculty reported significant implementation barriers despite the positive outcomes. Tool complexity (97.14%) and time constraints (85.71%) were the most frequently cited challenges. Student access issues (57.14%) and alignment difficulties (42.86%) were also reported. These findings align with international research identifying workload and cognitive overload as persistent barriers to sustained digital integration [27], [34]. However, the coexistence of high barrier frequency and high adoption rates suggests that structured staging may moderate resistance and reduce abandonment during early implementation phases. Rather than eliminating constraints, the framework appears to provide procedural scaffolding that supports faculty persistence through complexity.

Table 3. Implementation challenges in classroom technology integration

| Challenge category | Frequency (n) | Percentage (%) |
|---|---|---|
| Tool complexity | 34 | 97.14 |
| Time constraints | 30 | 85.71 |
| Student access issues | 20 | 57.14 |
| Instructional alignment difficulties | 15 | 42.86 |

### 3.5. Non-obvious contribution of the framework

The primary innovation of this study lies not in introducing new digital tools, but in operationalizing implementation sequencing as a structured accountability mechanism. Existing frameworks such as technological pedagogical content knowledge conceptualize the intersection of technology, pedagogy, and content; however, they do not specify procedural staging that ensures classroom enactment. Similarly, digital competence models emphasize capability development without embedding verification checkpoints that require observable instructional application.

The proposed framework advances the field by integrating diagnostic baseline analysis, peer-supported validation, artifact-based classroom verification, and reflective evaluation within a continuous cycle. This sequencing transforms professional development from a knowledge-delivery event into a monitored implementation process. The non-obvious contribution is therefore procedural rather than conceptual, as structured staging moderates' abandonment during complexity and strengthens behavioral transfer. By embedding verification and evaluation as integral phases, the model addresses the documented gap between faculty confidence and observable classroom practice. This process-oriented refinement extends digital competence literature by foregrounding implementation integrity as a necessary condition for sustained instructional transformation.

### 3.6. The DRIVE model: a framework for classroom technology integration

The findings of this study contribute to the literature on faculty professional development by demonstrating that structured, cyclical processes can facilitate the transfer of professional learning into classroom practice. The DRIVE model extends beyond traditional technology training approaches by incorporating five interconnected stages that explicitly link diagnostic analysis, responsive planning, instructional validation, classroom verification, and reflective evaluation. Such cyclical models align with design-based and evidence-informed frameworks in educational research [17], [19]. The DRIVE model illustrates a structured five-stage process linking diagnostic analysis, planning, validation, classroom verification, and reflective evaluation to support sustainable classroom technology integration. As illustrated in Figure 1, the DRIVE model functions as an iterative instructional design cycle in which each stage systematically informs subsequent pedagogical decisions and classroom implementation strategies.

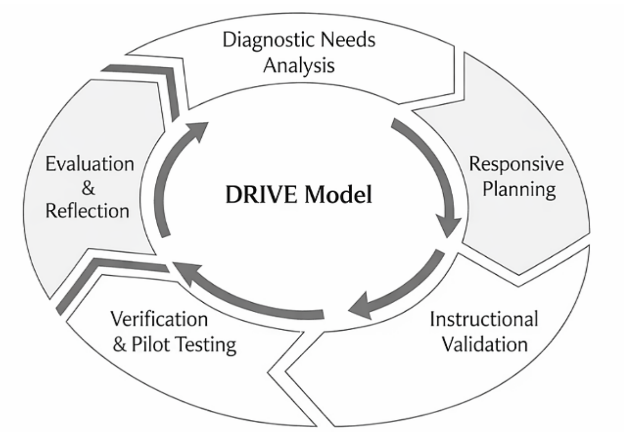


Figure 1. The DRIVE model: a cyclical framework for classroom technology integration

#### 3.6.1. Diagnostic needs analysis

The diagnostic needs analysis stage focuses on identifying instructional challenges, classroom contexts, and pedagogical goals that influence technology use. Rather than assessing technical skill deficits alone, this stage emphasizes understanding how instructors teach, the learning difficulties students encounter, and the instructional outcomes faculty aim to achieve. Research indicates that professional development is more effective when it begins with authentic instructional needs and contextual analysis [15], [17]. In this study, diagnostic activities enabled faculty to reflect on classroom engagement and assessment patterns, which corresponded with the measurable increases in digital competence and frequency of technology use reported in Section 3.1.

#### 3.6.2. Responsive planning

Responsive planning involves the design of faculty development activities that align with identified instructional needs and classroom realities. Training content is intentionally structured around pedagogical strategies such as digital assessment, collaborative learning, flipped instruction, and formative feedback. Prior studies highlight that professional learning experiences grounded in instructional design principles are more likely to result in sustained classroom implementation [10], [18]. In the present study, responsive planning supported faculty in selecting and adapting technologies that aligned with their instructional objectives and contributed to the adoption patterns presented in Section 3.2.

#### 3.6.3. Instructional validation

Instructional validation emphasizes the pedagogical soundness of proposed instructional strategies before classroom implementation. Faculty engage in peer feedback, guided reflection, and design review to examine whether technology-supported activities align with learning outcomes and instructional principles. Validation processes are consistent with design-based and reflective models of teacher learning, which stress iterative refinement of instructional practice [19], [23]. This stage ensured that technology integration focused on enhancing learning rather than merely adopting digital tools.

#### 3.6.4. Verification

Verification refers to the pilot implementation of technology-supported strategies in actual classroom settings. Faculty apply redesigned lessons, assessments, and learning activities in blended undergraduate courses and observe student responses and instructional flow. Verification aligns with research emphasizing experimentation and situated practice as key mechanisms for pedagogical change [16], [31]. In this study, faculty verification activities included implementing online discussions, digital feedback mechanisms, and flipped classroom elements, which supported increased student participation and engagement.

#### 3.6.5. Evaluation

The evaluation stage involves systematic reflection on instructional effectiveness and classroom outcomes. Faculty assess the extent to which technology integration supported student engagement, interaction, lesson organization, and assessment efficiency. Evaluation draws on self-reflection, student feedback, and instructional artifacts to inform continuous improvement. Consistent with evidence-informed professional development models, this stage reinforces reflective practice and iterative enhancement of teaching strategies [27], [35]. Evaluation findings inform subsequent cycles of diagnostic analysis, reinforcing the cyclical nature of the DRIVE model. Collectively, these five stages demonstrate how structured implementation sequencing transforms professional development from a knowledge-delivery activity into a pedagogically embedded change process. This iterative structure ensures that diagnostic insights continuously inform subsequent planning and instructional refinement.

## 4. CONCLUSION

This study introduced and empirically examined the DRIVE model as a structured, cyclical framework for strengthening the transfer of professional development into classroom technology integration. Through diagnostic analysis, responsive planning, instructional validation, classroom verification, and reflective evaluation, the model addressed the gap between faculty training and actual instructional implementation. Findings from 35 university instructors showed increased use of technology-supported strategies, including digital assessments, collaborative tools, multimedia resources, flipped instruction, online discussions, and formative feedback mechanisms. Faculty also reported improvements in student engagement, classroom interaction, lesson organization, assessment efficiency, and instructional confidence.

The study contributes to the literature by moving beyond generic technology training and proposing an implementation-oriented framework that links faculty development directly to classroom enactment. For higher education institutions, the DRIVE model offers a replicable and adaptable process for translating digital competence and pedagogical knowledge into sustained technology integration. Future research should examine long-term implementation, direct student learning outcomes, and cross-institutional scalability.


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| Name of Author | C | M | So | Va | Fo | I | R | D | O | E | Vi | Su | P | Fu |
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C : **C**onceptualization
M : **M**ethodology
So : **So**ftware
Va : **Va**lidation
Fo : **Fo**rmal analysis
I : **I**nvestigation
R : **R**esources
D : **D**ata Curation
O : Writing - **O**riginal Draft
E : Writing - Review & **E**diting
Vi : **Vi**sualization
Su : **Su**pervision
P : **P**roject administration
Fu : **Fu**nding acquisition

## CONFLICT OF INTEREST STATEMENT

The author declares no financial, professional, or personal conflict of interest.

## INFORMED CONSENT

All participants gave written informed consent before data collection.

## ETHICAL APPROVAL

The study was approved by the Institutional Research Ethics Review Board of the University of Science and Technology of Southern Philippines.

## DATA AVAILABILITY

The data supporting this study are available from the corresponding author upon, [CGO], reasonable request, subject to confidentiality and institutional policies.

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## BIOGRAPHY OF AUTHOR

**Charito Garcia Ong** is professor VI at the University of Science and Technology of Southern Philippines. She holds a doctorate in Instructional Systems Design and specializes in technology-enhanced learning, instructional innovation, faculty development, and higher education transformation. Her research integrates design-based implementation frameworks, communicative language pedagogy, and digital instructional alignment. She has presented peer-reviewed research in international conferences across Asia, Europe, Australia, and North America, including her recent presentation at an international conference in Washington, D.C., and has authored numerous scholarly publications. She has held senior academic leadership roles and actively contributes to professional research networks and quality assurance initiatives. She can be contacted at email: charito.ong@ustp.edu.ph.