Rapid digital competence development through emergency remote teaching: a three-wave analysis of teacher training during COVID-19

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Abstract

The COVID-19 pandemic necessitated immediate digital transformation in education, revealing critical gaps in teachers' technological competencies. This study examines a rapid-response professional development program implemented across three waves during March-April 2020, engaging 1,500 registered Ukrainian educators. The five-day intensive course addressed essential cloud-based teaching competencies through Google Workspace tools. Data analysis reveals a 54.4% completion rate among the 1,029 active participants, with subsequent implementation tracking showing marked improvement in technology adoption. Post-training surveys (n=263) demonstrate a shift from 11.8% independent task management to 82.5% conducting synchronous online classes by 2021. The research identifies critical implementation challenges including technical literacy barriers, collaborative document management difficulties, and participant engagement patterns. Two additional face-to-face cohorts (n=91) provided comparative data on instructional modality effectiveness. Longitudinal assessment indicates sustained behavioral change, with 56.7% of teachers adopting previously unused digital tools. These findings inform emergency professional development design, suggesting optimal participant cohort sizes, prerequisite assessment protocols, and structured deadline management. The study contributes empirical evidence on rapid competency development under crisis conditions, with implications for resilient educational system design.

Keywords

emergency remote teaching, teacher professional development, digital competence, cloud-based learning, COVID-19 education response, Google Workspace for Education

1. Introduction

The global COVID-19 pandemic created unprecedented disruption in educational systems worldwide, forcing an immediate transition from traditional classroom instruction to emergency remote teaching [1]. This sudden shift exposed significant disparities in educators' digital competencies [2, 3, 4] and their preparedness to deliver quality instruction through online modalities [5, 6, 7, 8, 9, 10]. Ukrainian educational institutions faced particular challenges, as teachers had minimal preparation time to adapt pedagogical practices developed over decades for face-to-face instruction.

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The "Procedure for the professional development of pedagogical and scientific-pedagogical workers" identifies distance learning as an approved professional development modality, specifically emphasizing information and communication technology integration and digital competence development as priority areas [11]. This regulatory framework provided the foundation for rapid deployment of professional development initiatives during the quarantine period.

Prior research demonstrates varying levels of digital literacy among educators before the pandemic [12, 13]. While some institutions had initiated technology integration programs, systematic preparation for fully online instruction remained limited. The pandemic accelerated a digital transformation that might otherwise have taken years to implement, compressing adoption timelines from months to days [14].

This study examines the design, implementation, and outcomes of an intensive professional development program delivered to Ukrainian educators during the initial pandemic response period. The research addresses three primary questions: (1) What instructional design features facilitate rapid competency development under crisis conditions? (2) How do participant engagement patterns differ between distance and face-to-face modalities? (3) What sustained behavioral changes result from emergency professional development interventions?

2. Theoretical framework

Digital competence encompasses technical skills, pedagogical knowledge, and adaptive capacity required for effective technology integration in teaching and learning processes [15]. The European Framework for the Digital Competence of Educators (DigCompEdu) identifies six competence areas: professional engagement, digital resources, teaching and learning, assessment, empowering learners, and facilitating learners' digital competence [16].

Emergency remote teaching differs fundamentally from planned online learning in design time, preparation, and support structures [17]. While planned online courses undergo systematic instructional design processes, emergency remote teaching requires rapid adaptation of existing materials and methods. This distinction has significant implications for professional development approaches.

Cloud-based platforms provide scalable, accessible infrastructure for educational delivery [18, 19]. Google Workspace for Education emerged as a widely adopted solution during the pandemic, offering integrated tools for communication, collaboration, content creation, and classroom management [20]. Research indicates that successful cloud technology adoption requires both technical proficiency and pedagogical recontextualization [21, 22, 23].

Previous implementations of cloud-based learning environments demonstrate the importance of scaffolded support and gradual complexity increases [15, 24]. However, pandemic conditions eliminated opportunities for such gradual adoption, necessitating compressed training timelines and simultaneous skill development across multiple competency areas.

Crisis-driven professional development differs from traditional models in urgency, scope, and evaluation criteria [25, 26]. Effective emergency training programs share several characteristics: focused objectives, practical application emphasis, peer support mechanisms, and immediate implementation opportunities [27, 28].

Adult learning principles suggest that relevance, experience integration, and problem-centered approaches enhance engagement and retention [29, 30]. These principles become particularly salient when participants face immediate application requirements and high-stakes implementation contexts.

3. Methodology

3.1. Course design and development

The certificate educational program "Information systems and cloud technologies in the educational process" was developed within specialty 126 "Information systems and technologies" at Zhytomyr

Polytechnic State University [31]. The course "Cloud technologies in the educational process in quarantine" adapted existing content for emergency deployment [32].

Course objectives focused on practical competencies: (1) understanding cloud service models and architectures; (2) utilizing Google Workspace tools for instruction; (3) creating and managing digital content; (4) implementing online assessment strategies; (5) establishing virtual classroom environments.

Content delivery employed an asynchronous model with structured daily modules. Each module included theoretical materials, video demonstrations, practical exercises, and collaborative activities. Assessment relied on task completion rather than traditional testing, emphasizing application over memorization.

3.2. Participant recruitment and demographics

Three implementation waves occurred: March 30-April 3, 2020 (Wave 1), April 6-10, 2020 (Wave 2), and April 13-17, 2020 (Wave 3). Registration utilized online forms distributed through educational networks and official channels.

Participants represented diverse educational sectors: general secondary education (n=499), preschool education (n=16), higher education (n=70), vocational education (n=82), educational administration (n=94), and other roles (n=55). Geographic distribution included all Ukrainian regions, with 40 higher education institutions represented.

3.3. Data collection and analysis

Multiple data sources informed the analysis:

1. Registration and completion records (n=1,500 registered, n=816 completed).
2. Task submission timestamps and interaction logs.
3. Post-course evaluation surveys.
4. Follow-up surveys with first-year university students (n=263) regarding their secondary school experience.
5. Comparative data from face-to-face implementations (n=91).

Quantitative analysis employed descriptive statistics and completion rate calculations. Qualitative data from open-ended survey responses underwent thematic analysis to identify implementation challenges and success factors.

4. Results

4.1. Participation and completion patterns

Table 1 presents participation statistics across implementation waves.

Table 1
Participation and completion rates by implementation wave.

Metric	Wave 1	Wave 2	Wave 3	Total
Registered participants	500	600	400	1,500
Active participants	367	381	281	1,029
Course completers	296	274	246	816
Completion rate (%)	80.7	71.9	87.5	79.3

The 31.4% attrition between registration and active participation resulted primarily from technical issues: incorrect email addresses (n=113), inability to access platforms, and external time constraints. Among active participants, the overall completion rate of 79.3% exceeded typical MOOC completion rates, suggesting high motivation and perceived relevance.

4.2. Implementation challenges

Analysis identified five primary challenge categories:

1. *Technical literacy barriers:* Participants struggled with basic digital tasks including screenshot capture, file uploads, and navigation between platforms. Despite step-by-step instructions, repeated questions about identical procedures consumed significant instructor time.
2. *Collaborative document management:* Tasks requiring shared editing generated confusion and occasional conflicts. Participants inadvertently modified others' content or deleted existing work, particularly in group presentation exercises where all participants edited simultaneously.
3. *Time management:* Asynchronous deadlines created cascading delays when participants failed to complete prerequisite tasks. Late submissions affected collaborative exercises, reducing learning opportunities for punctual participants.
4. *Instructional clarity:* Despite comprehensive written materials, participants frequently requested clarification on previously explained concepts. This pattern suggests cognitive overload or insufficient processing time for complex technical information.
5. *Attribution understanding:* Academic collaboration concepts proved challenging, with participants interpreting peer editing as criticism rather than constructive engagement.

4.3. Learning outcomes and artifacts

Participants produced diverse learning artifacts demonstrating concept application:

- Mind maps covered subject-specific topics including mathematics, biology, language learning, and computer science. Visual quality and structural sophistication varied, but all demonstrated basic competency with collaborative tools (figure 1).

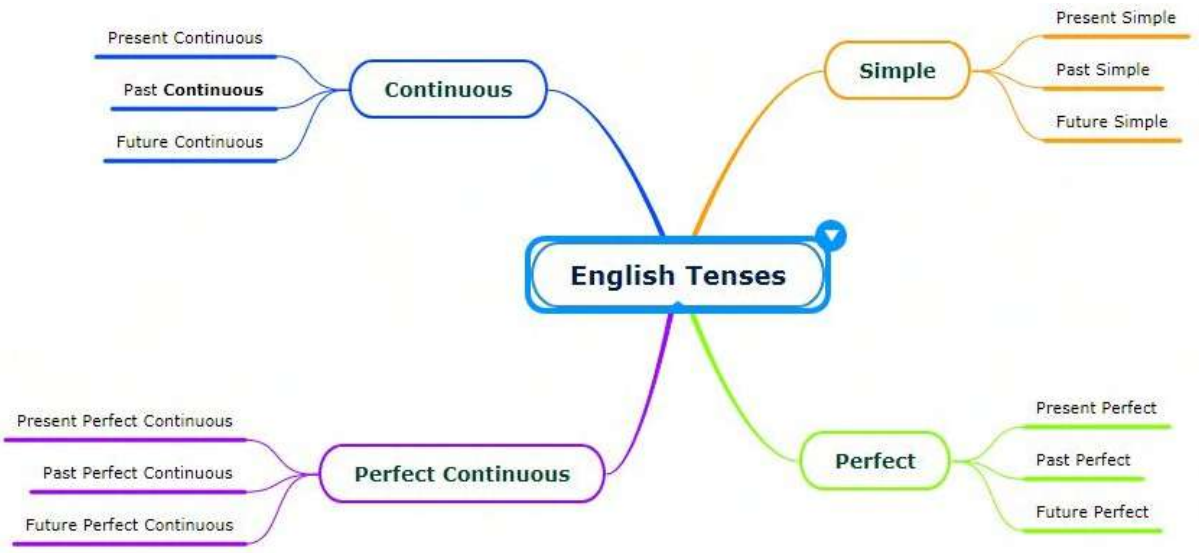

Figure 1: An example of a mind map for learning foreign languages, created by students during a distance learning course.

- Presentations utilized various cloud-based platforms, with content ranging from lesson introductions to complete instructional modules (figure 2). Technical proficiency improved markedly between initial and final submissions.
- Website creation exercises yielded functional educational sites, though design sophistication varied considerably. Most participants achieved basic functionality requirements.

Figure 2: Example of a presentation created by students during a distance learning course.

4.4. Comparative analysis: distance versus face-to-face delivery

Two face-to-face implementations (August 25-28, 2020; September 14-18, 2020) with 91 participants provided comparative data. Face-to-face participants demonstrated similar challenge patterns: inattention to instructions, difficulty with screen capture procedures, and collaborative task confusion.

However, face-to-face delivery enabled immediate clarification and peer support, reducing time to task completion. Physical presence also increased accountability and reduced attrition rates.

4.5. Long-term impact assessment

Follow-up surveys with university freshmen (September 2021) assessed sustained changes in secondary school instruction. Results indicate substantial shifts in instructional delivery methods:

- March-April 2020 (pre-intervention):
  - Independent task completion: 11.8%
  - Material distribution via messaging apps: 35.7%
  - Synchronous online instruction: 52.5%
- September 2020-May 2021 (post-intervention):
  - Independent task completion: 3.8%
  - Material distribution via messaging apps: 13.7%
  - Synchronous online instruction: 82.5%

The data reveal a 30 percentage point increase in synchronous online instruction, suggesting successful technology adoption and sustained behavioral change.

5. Discussion

The compressed timeline necessitated design decisions prioritizing immediate applicability over comprehensive coverage. Task-based assessment proved effective for skill demonstration while reducing evaluation burden. Collaborative exercises, despite implementation challenges, provided authentic practice opportunities mirroring actual teaching contexts.

Success factors included clearly defined daily objectives, multimedia instructional materials, and flexible support mechanisms. The registration-to-completion pipeline revealed critical failure points requiring targeted interventions in future implementations.

High completion rates among active participants suggest strong intrinsic motivation driven by immediate professional needs. The pandemic context created authentic urgency absent in traditional professional development programs. Participants recognized direct connections between course content and daily teaching challenges.

However, engagement patterns revealed concerning behaviors including insufficient attention to instructions and repeated requests for previously provided information. These patterns suggest cognitive overload or inadequate metacognitive strategies for managing complex technical learning.

The three-wave implementation demonstrated both scalability potential and resource limitations. Instructor workload increased exponentially with participant numbers, particularly given repetitive support requests. Future implementations should incorporate automated support systems and peer mentoring structures.

Sustained behavioral change evidenced in follow-up data validates the intervention's effectiveness. However, long-term support mechanisms remain necessary for continued skill development and adaptation to evolving technologies.

Several design principles emerge from this analysis:

1. Modular content architecture – self-contained daily modules accommodate varying participation patterns and technical difficulties.
2. Progressive complexity – initial tasks should establish baseline competencies before introducing collaborative elements.
3. Redundant communication channels – multiple information delivery methods account for varying learning preferences and technical limitations.
4. Embedded assessment – task completion as assessment reduces additional cognitive burden while providing authentic performance evidence.
5. Community support structures – peer networks sustain motivation and provide distributed support capacity.

6. Limitations

Several limitations constrain generalizability. Self-selection bias affects participant composition, as motivated educators were more likely to register and complete the course. The Ukrainian educational context may not reflect conditions in other national systems. Follow-up data collection relied on student perceptions rather than direct teacher observation.

Technical infrastructure assumptions may not hold in resource-constrained environments. The study period coincided with initial pandemic responses when motivation for change peaked. Subsequent "pandemic fatigue" might yield different engagement patterns.

7. Conclusions

This study demonstrates the feasibility of rapid digital competency development under crisis conditions. The intervention successfully prepared 816 educators for emergency remote teaching within a compressed five-day timeline. Key success factors included relevant content, practical focus, and immediate application opportunities.

Critical design considerations for emergency professional development include:

- Realistic scope definition acknowledging time and cognitive constraints.
- Pre-assessment protocols identifying baseline competencies.
- Structured collaboration with clear role definitions.

- Technical support scaling proportional to participant numbers.
- Post-training support sustaining initial gains.

The research contributes empirical evidence on emergency professional development effectiveness, informing future crisis response strategies. As educational systems develop resilience frameworks, rapid competency development mechanisms become essential infrastructure components.

Future research should examine optimal cohort sizes, investigate cultural factors affecting technology adoption, and develop automated support systems reducing instructor burden. Longitudinal studies tracking skill retention and evolution would inform sustained professional development approaches.

The COVID-19 pandemic accelerated educational digitalization by several years. While crisis-driven transformation creates challenges, it also reveals latent capacity for rapid adaptation. This study's findings suggest that carefully designed interventions can catalyze lasting positive change even under adverse conditions.

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Declaration on Generative AI

The authors used Claude Opus 4 to translate the article from Ukrainian into English.

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