*International Journal of Innovative Information Systems & Technology Research 14(3):196-205, July-Sept, 2026*

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DOI:10.5281/zenodo.21854445

# Digital Content Creation and Cloud Computing Tools for Secondary Education Delivery in Delta State, Nigeria

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**ABSTRACT**

The study examined the extent to which digital content creation technologies and cloud computing tools were integrated into the teaching and learning process for secondary education delivery in Delta State, Nigeria. The descriptive survey research design was adopted for the study. The population of the study consisted of 13,929 teachers in public senior secondary schools in Delta State. A sample size of 390 teachers was drawn using a multistage sampling procedure. A validated instrument titled "Integration of Emerging Technologies for Secondary Education Delivery Scale" (IETSEDS) was used to generate data for the study. The reliability coefficients obtained for the digital content creation technology and cloud computing subsections were 0.87 and 0.75 respectively. The research questions were analysed and answered using mean and standard deviation, whereas the hypotheses were tested using z-test statistics at the 0.05 alpha level. The findings of the study showed that digital content creation technologies and cloud computing tools were integrated into the teaching and learning process to a low extent. The study further revealed that significant differences existed between the mean ratings of teachers in urban and rural schools on the integration of digital content creation technologies and utilisation of cloud computing tools, with urban teachers recording higher mean ratings. The study concluded that digital content creation and cloud computing tools had not been sufficiently embedded in regular classroom instructional activities in public senior secondary schools in Delta State. Recommendations made among others included that the government, through the Ministry of Education, should provide digital content creation facilities, reliable internet services and cloud-based learning platforms and organise practical training that will enable teachers to design, store, retrieve and share digital instructional materials effectively.

**Keywords**: Digital content creation, cloud computing tools, teaching and learning, secondary education delivery, Delta State.

## INTRODUCTION

Education is widely recognised as an indispensable instrument for individual and societal development. It is the organised process through which knowledge, skills, values, attitudes and competencies are transmitted and developed. Through education, individuals acquire the intellectual, social and practical capacities required to participate productively in society. This explains why the Federal Republic of Nigeria (2014) described education as an instrument par excellence for national development. Education develops human capital, promotes social mobility, strengthens economic productivity and prepares individuals to respond constructively to changes within their environment. The Nigerian educational

system is organised into primary, secondary and tertiary levels, with each level performing specific but interconnected functions. Secondary education occupies the intermediary position between primary and tertiary education. It consolidates the knowledge and skills acquired at the primary level and prepares learners for tertiary education, vocational participation and useful living. The Federal Republic of Nigeria (2014) stated that secondary education is designed to provide learners with opportunities to acquire additional knowledge, skills and values beyond the primary level.

The importance of secondary education lies in its double-barrelled objective of preparing learners for further education and equipping those who may not proceed to tertiary institutions with competencies for productive living. Ukaigwe and Igbozuruike (2019) observed that, at this level, learners are expected to deepen their understanding of academic subjects, acquire vocational and technological skills and develop attitudes required for responsible citizenship. Consequently, the quality of secondary education learners received has considerable implications for the quality of entrants into tertiary institutions, the competence of the future workforce and the development of the nation. The realisation of the objectives of secondary education depends largely on the effectiveness of the teaching and learning process. Teaching is a deliberate and systematic activity through which a teacher organises learning experiences, presents curriculum content, guides learners and evaluates their progress (Igbozuruike et al., 2017) Learning involves the acquisition of knowledge, skills and attitudes arising from instruction and experiences. Effective teaching and learning therefore require competent teachers, appropriate instructional methods, relevant learning materials and a supportive educational environment that support innovation and use of technology to strengthen learner understanding.

Teachers are central to secondary education delivery. They interpret the curriculum, plan lessons, select instructional methods, prepare learning resources, assess students and provide feedback. However, teachers may not perform these responsibilities effectively when they depend exclusively on conventional instructional methods that offer learners limited opportunities for interaction, visualisation and flexible access to resources. The increasing application of digital technologies has consequently broadened teachers' responsibilities and created the need for enhancing their competencies in the use of emerging technologies and internet-based platforms in the performance of instructional duties.

Emerging technologies can be defined as recent or rapidly developing technological innovations with the potential to transform educational practices. They include artificial intelligence, cloud computing, digital content creation applications, augmented and virtual reality, technology-enhanced assessment systems and collaborative learning platforms. Almufarreh and Arshad (2023) observed that emerging technologies provide opportunities for personalised instruction, improved learner engagement and wider access to educational resources. Their educational value, however, depends on how teachers use them to address curriculum objectives and learners' needs. Among the emerging technologies relevant to secondary education delivery are digital content creation technologies, and cloud computing tools. Digital content creation technology refers to applications and devices used to produce instructional materials in electronic formats (Olaniran, 2020). Such materials include digital slides, instructional videos, audio recordings, animations, electronic illustrations, digital stories, infographics, online quizzes and interactive presentations. These technologies enable teachers to combine text, sound, images and motion when presenting lesson content, thereby making instruction clearer, more attractive and easier for learners to understand.

Digital content creation technologies can assist teachers in presenting complex or abstract concepts through diagrams, animations and audio-visual illustrations. Teachers can also design and modify materials to address differences in learners' abilities, interests and learning pace. Students may equally be involved in producing presentations, videos and other digital materials related to classroom topics. Such activities can strengthen creativity, communication, critical thinking and problem-solving skills. Hatlevik (2017) noted that digital competence involves the knowledge and skills required to use digital technologies meaningfully and responsibly. Süğümlü (2023) found that teachers exposed to structured training in digital content production created instructional materials in different formats, including presentations, online quizzes, puzzles, blogs and concept maps. Antón-Sancho et al. (2021) similarly

reported that digitally competent teachers attached considerable importance to applications such as Google Forms, Google Classroom and Kahoot. These findings suggest that teachers' capacity to create useful digital instructional content can be developed through appropriate preparation, practical training and institutional support. Nevertheless, access to digital applications does not automatically result in their effective classroom integration. Teachers require functional computers, smartphones, projectors, appropriate software, reliable electricity and internet connectivity. They ought to possess the technical and pedagogical competence required to select and apply digital tools appropriately. Tolorunleke and Olonikawu (2021) reported that inadequate technological resources and limited teacher competence contributed to the underutilisation of emerging technologies. Nyako, Ochoyi and Luka (2023) similarly identified inadequate computers, technical difficulties, unreliable electricity and negative attitudes as constraints to technology integration.

Cloud computing is another emerging technology with important implications for secondary education delivery. Cloud computing refers to the provision of storage facilities, applications, processing services and digital resources through the internet (Agrawal, 2021). It enables users to access files and applications from different locations and devices without depending entirely on physical storage systems. Common cloud computing tools used in education include Google Drive, Microsoft OneDrive, Dropbox, iCloud, Google Classroom and other cloud-based learning platforms. Cloud computing can support the storage, organisation, retrieval and distribution of instructional materials. Teachers can upload lesson notes, assignments, presentations, videos and other resources to cloud platforms for students to access when required. Cloud-based tools can also support remote learning, assignment management, communication and instructional continuity beyond the physical classroom. Agrawal (2021) observed that cloud computing became particularly valuable during the COVID-19 disruption because it enabled educational activities to continue through remote and flexible learning arrangements. The use of cloud computing can further reduce teachers' dependence on paper-based materials and physical storage devices. Instructional resources stored in the cloud can be updated, reused and shared with several learners without repeated printing. Olaniran (2020) maintained that cloud-based tools could promote resource sharing and improve access to instructional materials in secondary education. Cloud computing may therefore contribute to more economical, accessible and sustainable educational delivery when schools possess reliable connectivity and appropriate digital devices.

Despite these benefits, the utilisation of cloud computing tools in Nigerian educational institutions appears limited. Etim, Upula and Ekpo (2016) reported low awareness and utilisation of Google Docs, Dropbox, Google Sites and iCloud among educators. Ekong and Taylor (2022) similarly observed that teachers' awareness of the instructional benefits of cloud computing did not consistently translate into classroom practice. Simon et al. (2019) identified technical difficulties, cultural resistance, privacy concerns and inadequate infrastructure as barriers to cloud computing adoption in schools. Digital content creation and cloud computing tools perform complementary educational functions. Digital content creation applications enable teachers to produce instructional materials, while cloud computing provides platforms through which such materials can be stored, retrieved and shared. However, their integration may differ according to school location. Urban schools may have better electricity, internet connectivity, digital devices and technical support than rural schools. Such differences may create inequalities in teachers' use of emerging technologies and students' access to digitally supported instruction.

Although digital technologies are gaining attention in Nigerian secondary education, existing studies have not fully addressed the specific focus of this study. In Delta State, Ayidu (2024) found that teachers have limited ICT competence, while Urien (2024) examined general factors affecting technology use in teaching. However, these studies did not focus on teachers' use of digital tools for creating instructional content or on cloud computing for storing, retrieving, organising, and sharing resources. Outside Delta State, Udam and Mohammed (2024) studied cloud use among science teachers in Cross River State, and Abdulrahman et al. (2025) assessed teachers' awareness and readiness to use cloud computing in Lagos State. While these studies explored cloud technologies, they focused on specific groups or on awareness rather than actual classroom integration. As a result, there is still limited evidence on how teachers

combine digital content creation tools with cloud computing in secondary schools, especially in Delta State. This study therefore examines the extent to which teachers create digital instructional materials and use cloud platforms to manage and share them for teaching and learning.

**Statement of the Problem**

There is a consensus in literature that digital technologies have the capacity to improve instructional delivery, students' engagement and access to learning resources. This is perhaps why governments and educational agencies continue to encourage the integration of emerging technologies into secondary education. Preliminary observations, however, suggest that many teachers in public senior secondary schools in Delta State still depend largely on conventional instructional materials and methods. The extent to which teachers create digital instructional content and use cloud computing tools to store, retrieve and share learning resources appears unclear. This is discernible from the limited use of interactive presentations, audio-visual materials, cloud storage platforms and online resource-sharing systems in regular classroom activities. The situation seems more pronounced in rural schools where inadequate electricity, internet connectivity, digital facilities and technical support may restrict technology use. Continued underutilisation of these tools could limit flexible learning, reduce students' participation and widen the digital divide between urban and rural schools, thereby undermining the achievement of the goals of secondary education. The researchers were therefore constrained to investigate the extent to which digital content creation technologies and cloud computing tools were integrated into teaching and learning for secondary education delivery in Delta State, Nigeria.

**Aim and Objectives of the Study.**

The aim of the study was to investigate the integration of digital content creation technologies and cloud computing tools for secondary education delivery in Delta State, Nigeria. Specifically, the study had the following objectives:

1. To examine the extent to which digital content creation technology is integrated in the teaching and learning process for the delivery of secondary education in Delta State.
2. To determine the extent to which cloud computing tools are utilised in the teaching and learning process for the delivery of secondary education in Delta State.

**Research Questions**

The following research questions were answered in the study:

1. To what extent is digital content creation technology integrated in the teaching and learning process for the delivery of secondary education in Delta State?
2. To what extent are cloud computing tools utilised in the teaching and learning process for the delivery of secondary education in Delta State?

**Hypotheses**

The following hypotheses were tested at the 0.05 level of significance:

1. There is no significant difference between the mean ratings of teachers in urban and rural schools on the extent to which digital content creation technology is integrated in the teaching and learning process for secondary education delivery in Delta State.
2. There is no significant difference between the mean ratings of teachers in urban and rural schools on the extent to which cloud computing tools are utilised in the teaching and learning process for secondary education delivery in Delta State.

## METHODOLOGY

The study adopted the descriptive survey design. The population of the study consisted of 13,929 teachers in public senior secondary schools in Delta State, Nigeria. A sample size of 390 teachers was drawn using a multistage sampling procedure. Thirteen Local Government Areas were purposively selected across the three senatorial districts in the state. Five public senior secondary schools were randomly selected from each Local Government Area, giving a total of 65 schools, while six teachers were randomly selected from each school. A researcher-designed instrument titled "Integration of Emerging Technologies for Secondary Education Delivery Scale" (IETSEDS) was used to generate data. The two sections used for

the study contained 16 items structured to obtain responses on digital content creation technologies and cloud computing tools. The instrument was validated by two experts in Educational Management and one expert in Measurement and Evaluation from University of Port Harcourt. Its reliability was established using Cronbach alpha statistics, which yielded coefficients of 0.87 and 0.75 for the two sections respectively. The instrument was structured on a modified four-point rating scale of Very High Extent, High Extent, Low Extent and Very Low Extent, weighted 4, 3, 2 and 1 respectively. All 390 copies administered were retrieved and used in data analysis. The research questions were answered using mean and standard deviation. The criterion for acceptance was mean ≥ 2.50, whereas z-test statistics were used to test the hypotheses at the 0.05 alpha level.

## RESULTS

**Research Question One:** *To what extent is digital content creation technology integrated into the teaching and learning process for the delivery of secondary education in Delta State?*

**Table 1: Mean and standard deviation ratings of teachers on the integration of digital content creation technology in teaching and learning**

| S/N | Description of items | Urban Mean | SD | Rural Mean | SD | Mean-set | Rank | Remark |
|---|---|---|---|---|---|---|---|---|
| 1 | Teachers design customised digital materials to address varied students' learning needs. | 2.61 | 0.96 | 2.47 | 0.96 | 2.54 | 1st | High extent |
| 2 | Teachers create digital content to support students' self-paced learning. | 2.51 | 1.07 | 2.27 | 0.98 | 2.39 | 6th | Low extent |
| 3 | Teachers produce interactive videos to enhance students' engagement during lessons. | 2.55 | 0.88 | 2.32 | 0.81 | 2.44 | 4th | Low extent |
| 4 | Teachers use presentation software such as Canva and Microsoft Sway to create interactive lesson materials. | 2.40 | 1.03 | 2.07 | 0.92 | 2.24 | 8th | Low extent |
| 5 | Teachers design digital slide presentations to deliver lesson content. | 2.47 | 0.94 | 2.29 | 0.91 | 2.38 | 7th | Low extent |
| 6 | Teachers produce audio-visual materials to explain complex or abstract concepts. | 2.50 | 0.80 | 2.48 | 0.81 | 2.49 | 3rd | Low extent |
| 7 | Teachers create digital content to make lessons more engaging and participatory. | 2.64 | 1.01 | 2.41 | 0.96 | 2.53 | 2nd | High extent |
| 8 | Digital content creation technologies are integrated into regular classroom activities. | 2.53 | 1.00 | 2.29 | 0.87 | 2.41 | 5th | Low extent |
| | Aggregate | 2.53 | 0.96 | 2.33 | 0.90 | 2.43 | | Low extent |

Table 1 shows that the respondents rated items 1 and 7 to a high extent, with mean-sets of 2.54 and 2.53 respectively. This indicates that teachers designed customised digital materials to address varied learning needs and created digital content to make lessons more engaging and participatory. However, items 2, 3, 4, 5, 6 and 8 had mean-sets of 2.39, 2.44, 2.24, 2.38, 2.49 and 2.41 respectively and were rated to a low extent. The aggregate mean-set of 2.43 was below the criterion mean of 2.50. This shows that digital content creation technology was integrated into the teaching and learning process for secondary education delivery in Delta State to a low extent.

**Research Question Two:** *To what extent are cloud computing tools utilised in the teaching and learning process for the delivery of secondary education in Delta State?*

**Table 2: Mean and standard deviation ratings of teachers on the utilisation of cloud computing tools in teaching and learning.**

| S/N | Description of items | Urban Mean | SD | Rural Mean | SD | Mean-set | Rank | Remark |
|---|---|---|---|---|---|---|---|---|
| 9 | Teachers use cloud-based tools to store and organise educational materials. | 2.26 | 0.96 | 2.10 | 0.97 | 2.18 | 8th | Low extent |
| 10 | Teachers use Dropbox, iCloud, Google Drive and Microsoft OneDrive to share learning resources. | 2.26 | 0.83 | 2.10 | 0.89 | 2.18 | 8th | Low extent |
| 11 | Teachers use cloud platforms to make instructional materials readily accessible to students. | 2.61 | 0.86 | 2.34 | 0.84 | 2.48 | 2nd | Low extent |
| 12 | Teachers use video-conferencing platforms to support remote learning sessions. | 2.42 | 0.82 | 2.13 | 0.79 | 2.28 | 6th | Low extent |
| 13 | Teachers use cloud computing tools to manage and track students' assignments. | 2.46 | 0.85 | 2.32 | 0.84 | 2.39 | 4th | Low extent |
| 14 | Teachers use cloud technology to reduce dependence on paper-based instructional materials. | 2.60 | 1.05 | 2.31 | 0.95 | 2.46 | 3rd | Low extent |
| 15 | Teachers retrieve teaching resources from cloud platforms whenever needed. | 2.74 | 1.07 | 2.52 | 0.93 | 2.63 | 1st | High extent |
| 16 | Cloud computing tools are integrated into teachers' regular teaching and learning activities. | 2.44 | 0.90 | 2.02 | 0.79 | 2.23 | 7th | Low extent |
| | Aggregate | 2.47 | 0.92 | 2.23 | 0.87 | 2.35 | | Low extent |

Table 2 shows that item 15 had a mean-set of 2.63 and was rated to a high extent. This indicates that teachers retrieved teaching resources from cloud platforms whenever they were needed. However, items 9, 10, 11, 12, 13, 14 and 16 had mean-sets of 2.18, 2.18, 2.48, 2.28, 2.39, 2.46 and 2.23 respectively and were rated to a low extent. The aggregate mean-set of 2.35 was below the criterion mean of 2.50. The result therefore shows that cloud computing tools were utilised in the teaching and learning process for secondary education delivery in Delta State to a low extent.

**Test of Hypotheses**

**$Ho_1$**: There is no significant difference between the mean ratings of teachers in urban and rural schools on the extent to which digital content creation technology is integrated into teaching and learning in Delta State.

**Table 3: z-test analysis of the difference between urban and rural teachers' ratings on digital content creation technology**

| Respondents | N | Mean | SD | Df | z-cal. | z-crit. | Sig. level | Remark |
|---|---|---|---|---|---|---|---|---|
| Urban teachers | 149 | 2.53 | 0.81 | 388 | 2.50 | ±1.96 | 0.05 | Significant |
| Rural teachers | 241 | 2.33 | 0.75 | | | | | Ho rejected |

Table 3 shows that the calculated z-value of 2.50 was higher than the critical z-value of ±1.96 at 388 degrees of freedom and the 0.05 level of significance. The null hypothesis was therefore rejected. This indicates that a significant difference existed between the mean ratings of urban and rural teachers on the integration of digital content creation technology, with urban teachers recording the higher mean rating.

**$Ho_2$:** There is no significant difference between the mean ratings of teachers in urban and rural schools on the extent to which cloud computing tools are utilised in teaching and learning in Delta State.

**Table 4: z-test analysis of the difference between urban and rural teachers' ratings on cloud computing tools**

| Respondents | N | Mean | SD | Df | z-cal. | z-crit. | Sig. level | Remark |
|---|---|---|---|---|---|---|---|---|
| Urban teachers | 149 | 2.47 | 0.80 | 388 | 3.04 | ±1.96 | 0.05 | Significant |
| Rural teachers | 241 | 2.23 | 0.76 | | | | | Ho rejected |

Table 4 shows that the calculated z-value of 3.04 was higher than the critical z-value of ±1.96 at 388 degrees of freedom and the 0.05 level of significance. The null hypothesis was therefore rejected. This shows that a significant difference existed between the mean ratings of urban and rural teachers on the utilisation of cloud computing tools, with urban teachers recording the higher mean rating.

## DISCUSSION OF FINDINGS

The analysis of the data in Table 1 showed that digital content creation technology was integrated into the teaching and learning process for secondary education delivery in Delta State to a low extent. Although teachers designed customised digital materials to address varied student learning needs and created digital content to make lessons engaging and participatory, they made limited use of interactive videos, presentation software, digital slides and audio-visual materials. Digital content creation technologies were also not adequately integrated into regular classroom instructional activities. This finding agrees with Tolorunleke and Olonikawu (2021), who reported that emerging technology resources were inadequately utilised by teachers because of insufficient facilities and limited professional competence. The finding is also in line with Nyako et al. (2023), who observed that negative attitudes, inadequate computer facilities, technical difficulties and unreliable electricity restricted the adoption of emerging technologies in instructional processes. These factors may explain why teachers in public secondary schools in Delta State had not progressed sufficiently from conventional instructional methods to digitally supported content presentation.

The finding is, however, at variance with Süğümlü (2023), who reported that teachers exposed to structured digital training successfully produced instructional materials in different formats, including presentations, online quizzes, blogs, puzzles and concept maps. Antón-Sancho et al. (2021) similarly found that teachers with higher levels of digital competence made greater use of Google Forms, Google Classroom, Kahoot and other digital content creation applications. The difference between these findings and the result of the present study may be connected with differences in teacher preparation, access to digital facilities and institutional support. The test of the first hypothesis showed that a significant difference existed between the mean ratings of teachers in urban and rural schools on the integration of digital content creation technology. Urban teachers recorded a higher mean rating than rural teachers. This finding suggests that school location influenced teachers' opportunities to use digital tools. Urban schools may have better access to electricity, internet connectivity, digital devices, training programmes and technical support than rural schools. Nevertheless, the aggregate result remained below the criterion mean, indicating that even the relatively stronger integration recorded in urban schools was not sufficient.

The findings obtained from answering research question two showed that cloud computing tools were utilised in the teaching and learning process to a low extent. Teachers retrieved teaching resources from cloud platforms whenever they were needed, but made limited use of cloud tools for storing and organising educational materials, sharing learning resources, supporting remote learning, managing

assignments and reducing dependence on paper-based instructional materials. Cloud computing tools were also not adequately integrated into regular teaching and learning activities. These findings are in agreement with Etim, Upula and Ekpo (2016), who reported low awareness and utilisation of cloud computing tools such as Google Docs, Dropbox, Google Sites and iCloud among educators. The findings also support Ekong and Taylor (2022), who observed that teachers recognised some benefits of cloud computing but did not consistently translate such awareness into classroom practice. Apparently, knowledge of the usefulness of cloud technology does not automatically guarantee its utilisation. Teachers also require functional devices, affordable internet services, stable electricity, relevant digital competence and encouragement from school administrators.

The findings further agree with Simon et al. (2019), who identified accessibility, collaboration, cost reduction and software diversity as benefits of cloud computing in schools, while technical challenges, cultural resistance, privacy concerns and inadequate infrastructure constituted barriers to adoption. Similarly, Olaniran (2020) noted that cloud computing could support resource sharing and reduce dependence on physical storage in secondary schools. The low utilisation found in the present study therefore means that teachers and students were not obtaining the full instructional benefits of cloud-based technologies. The test of the second hypothesis revealed that a significant difference existed between the mean ratings of teachers in urban and rural schools on the utilisation of cloud computing tools. Urban teachers recorded a higher mean rating than rural teachers. This could be attributed to the stronger availability of internet services, electricity, digital devices and technical support in urban areas. Rural teachers may experience more severe connectivity and infrastructural problems, thereby limiting their ability to access and use cloud-based platforms regularly.

The findings have important implications for secondary education delivery. Digital content creation and cloud computing are complementary technologies. Teachers may create useful electronic instructional materials, but such materials cannot reach learners conveniently without suitable platforms for storage, retrieval and sharing. In the same way, cloud platforms have limited educational value when teachers lack the competence to produce and organise relevant digital content. The low integration of both technologies may therefore restrict flexible learning, reduce students' engagement and reinforce dependence on conventional instructional materials. Educational planners and administrators have to treat the provision of infrastructure, teacher training and institutional support as interconnected requirements for effective technology integration.

## CONCLUSION

Having established that digital content creation technologies and cloud computing tools were integrated into teaching and learning to a low extent, the need to strengthen their application in secondary schools has been substantiated. The study therefore concludes that these technologies have not been adequately embedded in regular classroom instructional activities in Delta State. The study further concludes that the stronger ratings recorded by urban teachers indicate inequalities in access, infrastructure and technical support. Effective integration will therefore require adequate facilities, reliable internet connectivity and continuous teacher competence development.

## RECOMMENDATIONS

Based on the findings of the study, the following recommendations were made:

1. The Delta State Ministry of Education should provide public secondary schools with functional computers, projectors, digital content creation applications and other relevant facilities. Teachers should also be trained regularly on how to create digital slides, interactive videos, audio-visual materials and customised instructional resources.
2. Government and educational administrators should provide reliable internet services and secure cloud-based learning platforms that will enable teachers to store, retrieve, organise and share instructional materials with students. Clear guidelines should equally be provided to ensure responsible access, data protection and effective utilisation.

3. Special attention should be given to public secondary schools in rural areas through the provision of electricity, internet connectivity, digital devices and technical support. This will help to reduce the disparity between urban and rural schools in the integration of digital content creation technologies and cloud computing tools.
4. School principals should regularly monitor and support teachers' use of these technologies during instructional supervision. School-based mentoring should also be organised to help teachers who require additional digital competence.

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