A Pre-service Art Teacher Digital Literacy Framework for Digital Literacy in Pre-Service Art Teacher Education in China

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Abstract: The Covid-19 pandemic transformed the importance of digital technologies in higher education to a level of necessity and made it possible for teaching and learning to continue during the peak of the pandemic lockdowns all around the world. In the post-pandemic higher education landscape, digital technologies have remained significant tools for teaching and learning. There are many commercial resources for digital technologies, but these resources have not been designed with the professional and pedagogical needs of art teachers in mind. This study addresses the pragmatic educational needs in digital literacy which goes beyond technical skills in digital technologies to encompass abilities in adopting effective digital operations in specific teaching environments, in the context of pre-service art teacher education in China. Intersection of the landscapes for digital technology, national policies in art education, were the identifiable problems addressed. In addition to low frequency and ineffective use of digital technologies in Chinese art education, there are currently no systematic and reliable points of reference for art teachers who are motivated to develop digital literacy in the specialized field of art. This article proposed a Pre-service Art Teacher Digital Literacy (PATDL) framework with a list of principles to guide the design of modules among pre-service art teachers in China. PATDL is informed by a European framework for the digital competence of educators, and applicable principles from computational thinking and media convergence. It is hoped that the framework can guide the design of modules which will enable pre-service art teachers to fully utilize digital technologies with a more informed and comprehensive understanding of their effective use.

Keywords: Digital technology, Pedagogy, Professional Development, SDG4, Training

1. Introduction

The integration of digital technology in art education in China is an ongoing process that is driving the digitalisation of art education (Ananga & Biney, 2021). The inclination towards transforming art education by adopting digital technology in China is aligned with numerous reports from around the world which highlight its influences in various aspects, including digital resources, infrastructure, user experience, and digital literacy (Alzahrani & Seth, 2021; Cavus, Mohammed & Yakubu, 2021; Raza et al., 2021; Al-Nuaimi et al., 2022). The COVID-19 pandemic experienced in China and beyond also highlighted the critical role of digital technology in higher education, as it enabled teaching and learning to continue despite the lockdowns (Ma, 2019). It also highlighted the convenience and efficiency of online education (Raza et al., 2021; Alejandro et al.,2023). As a result, digital technology continues to be a prominent feature in post-pandemic higher education.

This study addresses the pragmatic educational needs in digital literacy in the context of pre-service art teacher education in China by reviewing the relevant landscapes to illustrate the research background that includes the landscapes of digital technology, national policies and art education.

2. Landscape of Digital Technology and Related Terms

Digital technology can be understood as "Any product or service that can be used to create, view, distribute, modify, store, retrieve, transmit and receive information electronically in a digital form" (Redecker, 2017, p. 90). Related to this, digital technologies can be broken down to digital devices, digital resources (e.g. digital files, software, online services) and digital data (Redecker, 2017).

It is commonly assumed that the use of digital technology requires digital literacy although these two terms are far from synonymous. To the best of our knowledge, the term digital literacy first emerged around 1997, when Paul Gilster introduced it as: "the ability to properly use and evaluate digital resources, tools and services, and apply it to lifelong learning processes" (p. 220). For the purpose of this study, the conceptualisation of digital literacy is adopted from Admiraal et al. (2017) who framed digital literacy for teacher education as the competencies in adopting effective digital operations in specific teaching environments which go beyond technical skills in digital technologies.

Recent conceptualisations of digital literacy move the focus of understanding beyond the scope of technology or digital tools. Hague and Payton (2010) highlighted these components of digital literacy for teachers: creativity, critical thinking and evaluation, cultural and social understanding, collaboration, the ability to find and select information, effective communication, e-safety and functional skills. Falloon (2020) argues in favour of broader digital competency models that recognise the more diverse knowledge, capabilities and dispositions needed by future teachers to function ethically, safely and productively. Falloon (2020) proposed the teacher digital competency (TDC) framework that extends TPACK-aligned competencies to include personal-ethical competencies and personal-professional competencies. Apart from TDC, TPACK (Technological Pedagogical Content Knowledge), by Koehler, Mishra & Cain (2013) and Substitution, Augmentation, Modification, and Redefinition (SAMR) by Puentedura (2020) are two other frameworks which have been extensively explored in teacher education. The question of which framework to adapt or adopt remains a meaningful research focus due to the diverse requirements of various contexts.

3. Landscape of Policies in China Affecting Art Education

China is not excluded from the phenomenon of developing countries increasingly relying on digital technology to enhance their educational standards (Almaiah et al., 2020). Research publications and government policies indicate that the Chinese government and scholars recognise the importance of the use of digital technology in art education. Since 2010, educational informatisation has been given a crucial focus among the reforms spearheaded by the government (Zhao et al., 2018). The National Outline of the National Long-Term Education Reform and Development Plan focuses on the development of information infrastructure and high-quality educational resources (MOE, 2010). With the recent implementation of China's Education Modernisation 2035 nationwide, informatisation and developing lifelong learning systems remain two of the many tasks that require attention (Zhu, 2019). Within the context of pre-service art teacher education in China, it is crucial to better prepare pre-service art teachers to effectively use digital technology in their learning and future teaching careers, especially considering the facilitating effects of digital technology in developed and developing countries (Ma, 2019).

4. Landscape of Digital Technology and Art Education

In the field of art education, digital technology offers unique and specific educational benefits in the aspects of resources, teaching and learning methods, and supportive tools such as learning management systems. Art education relies heavily on digital media for lesson delivery compared to other educational specialisations (Zhao et al., 2018). Digital technology presents art educators with a wide range of teaching resources, including information, captivating images, and immersive audiovisual materials (Clark-Wilson et al., 2020). We believe that the potential of digital libraries that encompass not only Chinese but also international art resources can nurture creativity as a result of more extensive and diverse knowledge made available to art students, educators and art practitioners.

Digital media in art can save time, enhance aesthetic aspects, and transform traditional education methods (Marner, 2013), by creating an interactive and collaborative environment (Zheng, 2011). Digital tools

are known to provide multimedia and visual stimulation that can provide immersive and visually optimised learning experiences (Akula & Garibay, 2019; Liu et al., 2021). Rich digital repositories can shift a teacher-centric modus operandi to a more student-centred pedagogy, fostering active and autonomous learning (Bayoumi et al., 2022). Students can be assured of contents that they can review autonomously and consistently (Lin & Gao, 2020).

The emergence of the learning management system (LMS) optimises the online learning environment out of the classroom (Alqahtani & Rajkhan, 2020; Azmuddin et al.,2023). Through LMS, students can obtain learning resources provided by the teacher to carry out independent learning and explore their own interests (Geng et al., 2019). Teachers can monitor students' online learning frequency, learning duration, and interests through LMS in the form of statistical data (Turnbull et al., 2020). LMS provides teachers and students with a complete ICT mechanism which is embedded with video conferences, voice conferences, and textual information transmission functions, achieving high-level communication frequency, communication efficiency, and convenient communication (Rabiman et al., 2020). LMS helps teachers to identify individual student differences, which is conducive to formulating differentiated programs (Rabiman et al., 2020). When LMS is integrated with learning evaluation, students' learning progress and learning efficiency can gradually evolve into a form of quantitative and standardised evaluation (Oguguo et al., 2021).

All these benefits of digital technology for art education are highly enticing for a field that has been known to suffer from creativity due to being too influenced by the artistic styles and dependent on the knowledge troves of recognised and available Chinese art mentors (Pan, 2017). We are aware that attempting to integrate technology in art education may face resistance, especially in non-developed countries that do not have technological and human resource advantages, as demonstrated by University of Afghanistan's use of LMS for the first time during Covid-19 (Mohammadi et al., 2021). Fundamental issues such as hardware infrastructure and regulation policies are admittedly beyond the control of teacher educators. Thus, in the following section, we would position the researchers within the landscapes to clarify a specific problem that can be addressed.

5. Positioning the Researchers in the Landscapes

During the national lockdown of the COVID-19 period, many teacher training educators in China familiarised themselves with digital tools such as the institution's LMS system, mobile applications, Adobe Photoshop and Easy Paint Tool SAI. Later, when classes resume to the face-to-face mode of study, educators continued to align face-to-face lessons with online modes of learning through LMS, and gradually developed an interest to explore effective methods for blended modes of teaching and learning, whereby the blended mode is a combination of face-to-face, online and digital learning (Hrastinski, 2019). The blended mode has risen in popularity in many regional education departments in China, especially in higher education (Jiang & Kamel Syakir, 2022; Sulistyanto et al.,2023).

6. Issues of Digital Literacy in Art Education in China

The constant and fast developments in digital technology have increased the demand for digital literacy among teachers for academic purposes (Janssen et al., 2013). In order to effectively educate, professionals must possess the skills to utilise digital technologies in an informed manner, employing pedagogical approaches that enhance student learning and cultivate their digital competence (Lucas et al., 2021). The wide use of digital teaching equipment has intensified the requirements of digital literacy among teachers because digital literacy of teachers also affect student achievement of learning outcomes (Agustini & Sari, 2020). Visual art lecturers in pre-service education are not spared from this predicament. Chinese visual art lecturers face similar challenges as teachers in Europe where they would like to have more training in using digital technology (Bidarra & Rusman, 2017). One pressing challenge in art education in China is the inefficient use of digital technology among pre-service teachers instead of the lack of technology availability. The level of digital literacy among pre-service art teachers has been reported to be below educational standards (Zhao et al., 2018; Liu et al., 2020). The frequency and effectiveness of digital technology use in art education in China may be low because many pre-service teachers struggle to quickly master the various teaching and learning tools (Ma, 2019). At the same time, the intricate nature of the creation of art requires so much time and energy investment from the teacher that the provision of equal attention to every art student is a daunting challenge (Zhao et al., 2018).

Current modules for art teachers in pre-service education have not been designed with the aim of developing digital literacy. These modules are also not suitable for conducting blended modes of teaching and learning. Although commercial software exists for art education, there is a serious lack of applicability in education in general (Ottestad et al., 2014). The first author's extensive experience in art pre-service art teacher education in China indicates that existing teaching modules in China are usually written by software developers

and have not gone through revisions that align with the requirements of digital literacy. When the search for art education modules extends beyond the Chinese borders, two main foci emerge: modules that focus on culture or enhanced student performance. In Malaysia, Balakrishnan (2017) attempted the integration of artistic ideas among children from different cultural backgrounds to stimulate cross-ethnic collaborations in art. The Krasnoyarsk Territory art education modules of Kolesnik et al. (2018) tried to strengthen a national cultural identity. The Gradual Immersion Method (GIM) and the Art Movement Learning App (AMLA) show promising connections between the construction of surreal art forms and the activation of students' creativity (Sanabria & Arámburo-Lizárraga, 2017). In summary, what is available as points of references are art education modules, not art teacher education modules, and these modules mainly focus on culture or performance in art.

With these problems in mind, this article proposes a composite conceptual framework with a list of principles which can guide the design of modules targeted at developing digital literacy among pre-service art teachers in China through blended modes of learning. It is hoped that this framework can provide a systematic and reliable point of reference for art teachers who are motivated to develop digital literacy in the specialised field of art education. The rest of the article will describe the components of the framework and justify the selection of theories and principles.

7. PATDL: A Conceptual Framework for Digital Literacy in Pre-Service Art Teacher Education in China

In this research, a composite conceptual framework was proposed for developing digital literacy among pre-service art teachers in China (Refer to Figure 1 for illustration of PATDL). PATDL (Pre-service Art Teacher Digital Literacy) framework is informed by a European framework for the digital competence of educators (DigCompEdu), and applicable principles from computational thinking and media convergence. It is designed for blended modes of learning with DigCompEdu as the foundational framework. In face-to-face classes, computational thinking is integrated with DigCompEdu to guide teachers in involving digital technology in creative work. In online modes of learning, media convergence complements DigCompEdu by providing suggestions on developing digital competences in the era of media convergence.

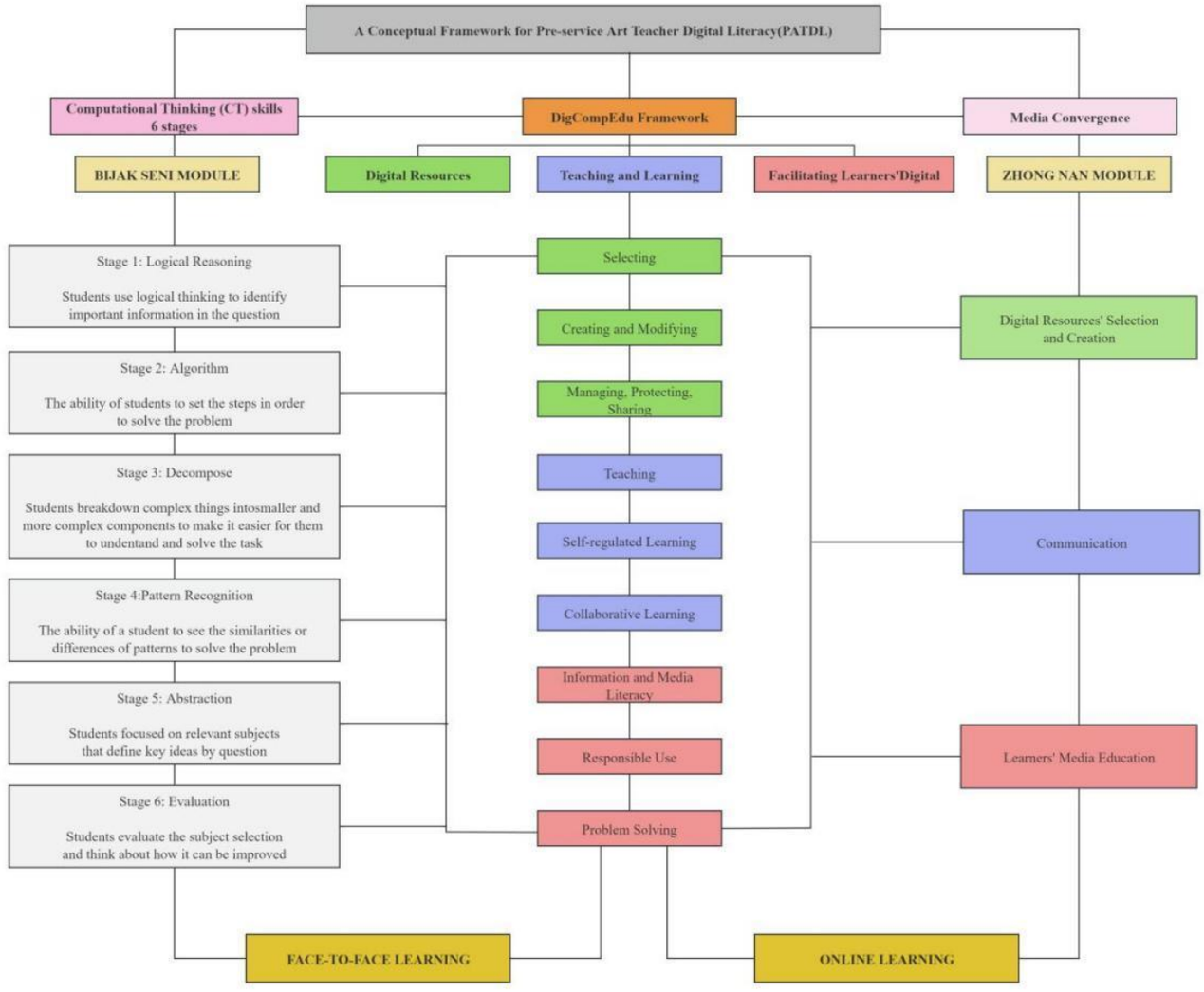

Fig.1 A Conceptual Framework for Pre-service Art Teacher Digital Literacy (PATDL)

DigCompEdu as Foundation of PATDL Framework

The European Framework for the Digital Competence of Educators (DigCompEdu) delineates 22 educator-specific digital competences under six distinct areas which can enable educators to identify and determine specific actions to enhance their competencies any given stage (Redecker, 2017; Ghomi & Redecker, 2019). The six areas of DigCompEdu are: 1) Professional Engagement, 2) Digital Resources, 3) Teaching and Learning, 4) Assessment, 5) Empowering and Learners, and 6) Facilitating Learners' Digital Competence (Redecker, 2017). DigCompEdu is a response to the growing awareness in Europe that educators need a set of specific digital competences to innovate education through digital technologies education (Ghomi & Redecker, 2019). The adaptability of DigCompEdu is indicated by the development of assessment instruments for teachers' digital competence (Ghomi & Redecker 2019; Cattaneo et al., 2022).

Although the background for DigCompEdu is the European context, the framework invites adaptation and modification to specific contexts and purposes (Redecker, 2017). We are attracted to the potential of DigCompEdu in supporting and guiding teachers' practice and continuous professional development in digital literacy (Caena & Redecker, 2019) in the context of pre-service art teacher education. Compared with TPACK, DigCompEdu provides more specific guidance for pedagogical dimensions and classroom activities instead of content-specific or technological dimensions (Caena & Redecker, 2019). Another validated teacher digital competency (TDC) framework by Falloon (2020) requires collaborative approach from various representations of an institution at faculty and program levels due to its comprehensiveness. We are more interested in referring to a framework which can be carried out by an individual teacher.

In terms of guiding the design of modules for art teacher education, DigCompEdu can provide appropriate guidelines for selecting learning activities since existing art teacher education modules that integrate

digital literacy seem to be non-existent to the best of our knowledge. Even when the literature search is extended to art education modules, these modules mostly focus on cultural exchanges and sustainability, or performance, as exemplified by Balakrishnan (2017) and Kolesnik et al. (2018).

To provide foundational guidelines for a conceptual framework which aims to address digital literacy among pre-service art teachers in China, we have decided to adapt three areas which are interconnected and integratable. The first area is Digital resources (Area 2 of DigCompEdu) which focuses on "the selection, creation, modification and management of digital educational resources" (Caena & Redecker, 2019: 363). This area relates to the assumption that teachers should learn to use technology to create new digital resources that respond to specific topics, content, teaching styles and learning objectives (Redecker, 2017). Our view is that digital resources can complement non-digital resources in face-to-face classrooms which are not flexible enough to address individual student needs. At the same time, teachers need to learn to responsibly use and manage digital content (Redecker, 2017).

The following are selected activities suggested by DigCompEdu under the area of Digital resources (Redecker, 2017: 44-48):

- ***Selecting*** (Redecker, 2017: 44)
  This activity aims to:
  - formulate appropriate search strategies to identify digital resources for teaching and learning.
  - select suitable digital resources for teaching and learning, considering the specific learning context and learning objective.
  - consider possible restrictions to the use or re-use of digital resources (e.g. copyright, file type, technical requirements, legal provisions, accessibility).
- ***Creating and modifying*** (Redecker, 2017: 46)
  These activities help teachers to:
  - modify and edit existing digital resources, where this is permitted. To combine and mix existing digital resources or parts thereof, where this is permitted.
  - create new digital educational resources.
  - consider the specific learning objective, context, pedagogical approach, and learner group, when adapting or creating digital learning resources.
- ***Managing, protecting, sharing*** (Redecker, 2017: 48)
  These activities enable teachers to:
  - share resources using links or as attachments, e.g. to e-mails.
  - share resources on online platforms or personal or organisational websites/blogs.
  - share one's own repositories of resources with others, managing their access and rights as appropriate.
  - respect possible copyright restrictions to using, re-using and modifying digital resources.
  - appropriately reference sources when sharing or publishing resources subject to copyright.

Regardless of the pedagogical approach chosen, an educator's specific digital competence lies in effectively orchestrating the use of digital technologies in the different phases and settings of the learning process. To guide the development of this competence, the second area of our conceptual framework includes Area 3 of DigCompEdu, Teaching and Learning, which relates to: "planning, designing and orchestrating the use of digital technologies in teaching practice. It focuses on the integration of digital resources and methods to promote collaborative and self-regulated learning processes and on the need to accompany these learner-led processes with effective guidance and support measures" (Caena & Redecker, 2019, p. 363).

The following is a list of activities that can develop this competence (Redecker, 2017: 52-58):

- ***Teaching*** (Redecker, 2017: 52)
  Teaching allows teachers to:
  - use classroom technologies to support instruction, e.g. electronic whiteboards, mobile devices.
  - structure the lesson so that different (teacher-led and learner-led) digital activities jointly re-inforce the learning objective.
  - set up learning sessions, activities and interactions in a digital environment.
  - structure and manage content, collaboration and interaction in a digital environment.
- ***Collaborative learning*** (Redecker, 2017: 56)
  Teachers need to:
  - implement collaborative learning activities in which digital devices, resources or digital information strategies are used.
  - implement collaborative learning activities in a digital environment, e.g. using blogs, wikis, learning management systems.

- employ digital technologies for collaborative knowledge exchange among learners.

- ***Self-regulated learning*** (Redecker, 2017: 58)
  Digital technologies are used as part of self-regulated learning to:
  - allow learners to collect evidence and record progress, e.g. audio or video recordings, photos.
  - allow learners to record and showcase their work (e.g. ePortfolios, learners' blogs).
  - enable learners to reflect on and self-assess their learning process.

Closely linked to Teaching and Learning is the final area which is Facilitating Learners' Digital Competence (Area 6 of DigCompEdu) in which digitally competent teachers should facilitate their students' digital competence, enabling them to manage risks and use digital technologies safely and responsibly. Teachers should be able to promote information and media literacy and integrate activities to enable digital problem solving, digital content creation and digital technology use for communication and cooperation (Caena & Redecker, 2019: 363).

DigCompEdu emphasises that the ability to facilitate learners' digital competence is an integral part of educators' digital competence (Redecker 2017: 23). Accordingly, learners' digital competence can be developed through the activities which are designed for them (Ghomi & Redecker, 2019).

The following is a list of activities that can be carried out to facilitate learners' digital competence (Redecker, 2017: 78-86):

- ***Information and media literacy*** (Redecker, 2017: 78)
  These activities aim to:
  - analyse, compare and critically evaluate the credibility and reliability of sources of data, information and digital content.
  - organise, store and retrieve data, information and content in digital environments.
- ***Responsible use*** (Redecker, 2017: 84)
  The aims are to:
  - protect devices and digital content, and to understand risks and threats in digital environments.
  - understand safety and security measures.
  - protect personal data and privacy in digital environments.
- ***Digital problem solving*** (Redecker, 2017: 86)
  This activity helps teachers to:
  - identify, evaluate, select and use digital technologies and possible technological responses to solve a given task or problem.
  - use digital technologies in innovative ways to create knowledge.
  - seek opportunities for self-development and to keep up-to-date with the digital evolution.

Integrating DigCompEdu and Computational Thinking for Face-to-face Mode

For face-to-face mode of learning, we intend to integrate DigCompEdu with computational thinking (Refer to Figure 1). The integration of computational thinking into art education is inspired by the interpretation of computational thinking for art education which is conveyed through a teaching and learning module named Bijak Seni (Smart Art) (Harrinni & Irma, 2019).

Computational thinking gained momentum in contemporary discourse through the impactful publication by Wing (2006). According to Wing (2006), computational thinking includes multiple aspects of problem identification and solution, prompting people to design and optimise systems according to rules. Similar to basic skills such as reading and writing, computational thinking has become one of the essential skills and tools in the new century to help educators improve performance (Wing, 2017). Computational thinking has garnered considerable recognition and is now considered a crucial skill for individuals coming of age in the digital age (Kong & Abelson, 2019). Computational thinking has been widely applied in the curriculum of various levels of education, for instance on information and communication technology learning using a programming language named Scratch (Harimurti et al., 2019).

Prior to performing a sequence of actions, the operation of computational thinking requires the practitioner to ensure that information related to that action is translated into clear, understandable, and complete links and steps (Taher et al., 2016). Computational thinking conveys people's thoughts with the help of computer carriers, has a solid, expressive ability, and is the product of the combination of human cognitive ability and computer ability (Barr & Stephenson, 2011). Moreover, the infusion of computational thinking has the potential to spark creativity among students in the art classroom (Mishra et al., 2013).

In practice, little is known about effectively incorporating computational thinking into education, especially in art education, but Harrinni and Irma (2019) has shown how the six elements of computational

thinking - Logical Reasoning, Algorithms, Decompose, Pattern Recognition, Abstraction and Evaluation - can enrich art education through their Bijak Seni module. Based on their application of computational thinking in the art classroom, students are inspired to explore their imagination to transcend conventional artistic paradigms and merge their artistic ability with the transformative potential of digital technology (Harrinni & Irma, 2019).

Harrinni and Irma (2019) demonstrated that integrating the six elements of computational thinking into art education requires a balance of teacher-centred and student-centred approaches. In the Bijak Seni module which targets drawing and painting skills, students are encouraged to explore the design of meaning and content of a drawing based on a theme that is open to individual interpretation. Students can consult relevant digital resources in the form of images, videos, audio and text to solve problems encountered in the creation of a painting. The teacher-centred approach guides the development of painting skills by supplementing relevant knowledge at strategic junctures of learning and identifying students' shortcomings in all stages of artistic creation.

Integrating DigCompEdu and Media Convergence for Online Mode

In the field of education, the concept of media convergence refers the fusion of technology, device integration, convergence of information dissemination forms, and societal integration with technology (Levyna & Guskova, 2017; Kačinová & Chalezquer, 2022; Yan & Zhao, 2023). Media convergence is not merely a technological shift of using diverse types of media in our lives (Jenkins, 2004) although most academic publications have focused on effects of media convergence on media consumption and regulation (Adnan et al., 2021). Media convergence has strong implications for education which have not been pedagogically addressed. For instance, observations made on technological applications in education (Blundell et al., 2022) indicated that both teachers and students actively engaged diverse types of digital tools to support teaching and learning. When we narrow the observation on signs of media convergence in a painting course, as a lecturer, the first author uses a digital blackboard to demonstrate a famous painting, shares visual and textual information through a digital projector to help students understand the history of a certain painter, uses the check-in function of the institution's LMS system to monitor student attendance and manage submissions of learning tasks. Teaching and learning thus is conducted through the combined support of multiple digital resources, digital tools, new media and traditional media.

However, it needs to be noted that although the young generation of students use digital devices, Internet applications and social media on a daily basis mostly for communication and entertainment, there is little knowledge of how to pedagogically involve these tools and media more meaningfully and effectively (Bidarra & Rusman, 2017). The decision to involve media convergence in a conceptual framework for digital literacy in pre-service art teacher education in China was inspired by the Zhongnan University of Economics and Law Convergence Media Art Education Module (Ma, 2021), which highlighted these four advantages of involving media convergence in art education:

- Incorporate traditional with new media for interaction, customisation, sharing, entertainment, data management and critical thinking.
- Broaden sources of content to move beyond the teacher's singular authority.
- Expand sources of information beyond text and pictures towards more multimodal and engaging sources.
- Coordinate contribution by everyone involved towards communication that leads to effective and meaningful collaboration.

For the aspired conceptual framework, specifically for the online learning mode, three aspects of media convergence are involved to complement the areas of digital competences which have been selected from DigCompEdu, specifically in digital resources selection and creation, teaching and learning, and learners' media education (Refer to Figure 1).

The three aspects of media convergence involved are as follows:

a. Digital resources selection and creation

Media convergence promotes the view that the diversification of digital tools and digital content has led to a phenomenon where it is no longer effective to rely solely on a particular type of digital technology no matter how popular or convenient it is (Ma et al., 2021). This is how Bidarra and Rusman (2017, p. 8) describes the multiple types of tools and media available to students in the current era like smart mobile phones (most students have one), networking software (freely available, e.g. Hangouts, WhatsApp, Skype), learning applications (widely available, e.g. Apple Store, Google Play) and open educational resources (in growing supply, e.g. MOOCs, iTunes U, Khan Academy). There are other tools available for learning organisations, such as collaborative tools (e.g. blogs, wikis, knowledge-building software), immersive environments (e.g. virtual worlds), media production and distribution tools, and many more. It is suggested that the following digital

resources can be used - interactive learning platforms (e.g. Kahoot, Mentimeter, iLearningApp, Quizlet), collaborative tools (e.g. Padlet and wikis), digital painting tools (Adobe Photoshop, Easy Paint Tool SAI, Clip Studio Paint, Corel Painter, ArtRage, and Krita).

Experts on media convergence offered some suggestions to prevent selection of digital resources being limited to dominant, mainstream or Western media. Adnan et al. (2021) found that despite developing countries possessing abundant local content, media presence is seriously lacking, hence education should intervene. Levyna and Guskova (2017) introduced the idea that youth culture under the influence of media convergence, in terms of the cultural values that they hold and communicative behaviour, should be considered for selection of digital resources. Selected digital content should include more humorous language expressions, visually appealing imagery, and more use of visual information instead of textual information. Additionally, course design should incorporate internet slang, songs, and stories as means to integrate digital culture into the curriculum and resonate with the younger generation.

b. Communication

Developments in media convergence are considered in the aspect of communication to support the digital competences in teaching, collaborative learning and self-regulated learning which have been selected from DigCompEdu. We posit that the digital tools made available in the era of media convergence support the sharing of knowledge and communication among students anytime and anywhere in the blended learning mode (Bidarra & Rusman, 2017).

Only by pedagogically utilising the widespread use of online media platforms made even more powerful by digital technology and 5G technology, and reflecting on them, can meaningful educational concepts be better formed in the new media environment (Yan & Zhao, 2023). In this regard, the communication among teachers and students should not be limited to specific information dissemination channels and be restricted to information exchange only.

One suggestion for applying media convergence in education points towards the cross-utilization of various forms of digital tools (e.g. WeChat, QQ, Weibo, blogs, TikTok, email, LMS) in various communication contexts, including student-student communication, student-teacher communication, and student-public interaction (Adnan et al., 2021; Yan & Zhao, 2023). Including and supporting student-public communication offers valuable feedback from the public which is not available in formal classrooms in the forms of criticism, appreciation and suggestions (Adnan et al., 2021). Therefore, in this conceptual framework, the manifestation of media convergence in pedagogical design is characterized by the cross-utilization of multiple communication tools and the interaction of students with other societal groups such as peers in the field of art.

Since the LMS operated by a learning institution has been underlined to support self-regulated learning, monitoring of learning and assessment, communication, and provide various choices digitally-embedded and integrated learning systems (Geng et al., 2019; Oguguo et al., 2021; Rabiman et al., 2020; Turnbull et al., 2020), we position it as the digital communication platform which anchors discussions among students and the provision of academic guidance from instructors.

c. Learners' Media Education

In this study, alongside digital literacy for teachers, media convergence focuses on the co-development of students' media literacy, digital literacy, and integrated information literacy within the context of pre-service art teacher education. Kačinová and Chalezquer (2022) define media convergence as the fusion and application of traditional and various new media, requiring users to possess strong abilities to navigate them effectively. This implies that students need to understand how to appropriately use software and resources in specific contexts and under various conditions to maximise their utility. Students must learn how to access various types of databases to retrieve resources, discern which resources are appropriate, understand the implications of using different software and digital resources, and master the ability to creatively manipulate digital resources. After all, education should intervene by supporting the development of skills required in the era of media convergence since the extent of convergence tends to be uneven in any given culture, “with those who are most affluent and most technologically literate becoming the early adapters and other segments of the population struggling to catch up” (Jenkins, 2004, p. 35).

A module in art education shared by Zhongnan University (Ma et al., 2021) offers valuable insights by establishing specific guidelines related to internet usage, including aspects such as online security, ICT (Information and Communication Technology), and data filtering. Students need to be educated in discerning types of data from the available resources. Data sources include faculty-created data, university database resources, and data sources obtained in collaboration with other institutions. Data from other agencies includes free and paid data, and some of the paid and free data must be used by the regulations of the relevant agencies.

High-quality resources may be justified in one of these criteria - expert recommendation, electronic word-of-mouth, best practice, popularity, and scarcity.

8. Conclusion

After reviewing the landscape of digital technology, particularly in the context of art education, this study observed that developments and research in pedagogy and teacher education which are responsive to contextual needs are necessary to cope with the changing circumstances of learning. Hence, Pre-service Art Teacher Digital Literacy (PATDL) is suggested in this research to guide the development of digital literacy among pre-service art teachers in China. PATDL is designed for the blended mode of learning, with DigCompEdu as the foundational framework which is complemented with applicable principles from computational thinking and media convergence. Consequently, it is imperative to collect evidence-based outcomes by designing modules which are guided by this framework and implementing them in classroom settings. We hope that PATDL can contribute towards efforts in enhancing pre-service art teachers' proficiency in utilising digital technology for art education and elevating their professionalism.

9. References

Ananga, P., & Biney, I. K. (2017). Comparing face-to-face and online teaching and learning in higher education. *MIER Journal of Educational Studies Trends and Practices*, 165-179. https://doi.org/10.52634/mier/2017/v7/i2/1415

Alzahrani, L., & Seth, K. P. (2021). Factors influencing students' satisfaction with continuous use of learning management systems during the Covid-19 pandemic: An empirical study. *Education and Information Technologies 26*(6), 1–19.

Al-Nuaimi, M. N., Al Sawafi, O. S., Malik, S. I., Al-Emran, M., & Selim, Y. F. (2022). Evaluating the actual use of learning management systems during the covid-19 pandemic: an integrated theoretical model. *Interactive Learning Environments,* 1-26. https://doi.org/10.1080/10494820.2022.2055577

Admiraal, W., van Vugt, F., Kranenburg, F., Koster, B., Smit, B., Weijers, S., & Lockhorst, D. (2017). Preparing pre-service teachers to integrate technology into K–12 instruction: evaluation of a technology-infused approach. *Technology, Pedagogy and Education, 26*(1), 105-120. https://doi.org/10.1080/1475939X.2016.1163283

Akula, R., & Garibay, I. (2019). Viztract: Visualization of complex social networks for easy user perception. *Big Data and Cognitive Computing, 3*(1), 17. https://doi.org/10.3390/bdcc3010017

Alqahtani, A. Y., & Rajkhan, A. A. (2020). E-learning critical success factors during the covid-19 pandemic: A comprehensive analysis of e-learning managerial perspectives. *Education sciences, 10*(9), 216. https://doi.org/10.3390/educsci10090216

Agustini, D., Lian, B., & Sari, A. P. (2020). School's strategy for teacher's professionalism through digital literacy in the industrial revolution 4.0. *International Journal of Educational Review, 2*(2), 160-173. https://doi.org/10.33369/ijer.v2i2.10967

Adnan, S., Pasha, Y. N., Mahesar, R. A., & Sheikh, S. (2021). Media revolutionary action capacity in the Era of converged networking. *International Journal of Management (IJM), 12*(4), 610-615.

Alejandro, B. A., Perez, N. B., & Rivera, F. M. (2023). Understanding the Lived Experience of ICT-trained Teachers in Online Classes. *Asian Journal of University Education*, 19(3), 563-572.

Azmuddin, R. A., Zamin, A. A. M., Zahari, H., Mokhtar, R., Radzi, F. A. M., & Idris, D. N. D. (2023). Analysing Tertiary Students' Reading Proficiency of CEFR Aligned Texts via Online Discussion Forum in a Learning Management System. *Asian Journal of University Education*, 19(1), 121-132.

Bayoumi, K., Ramli, N., Ebrahimi, M., Rosman, A. S., & Khan, A. (2022). The impact of building community and digital skills on students' online active learning experience during COVID-19 pandemic. *Journal of Positive School Psychology, 6*(3), 2133-2149.

Balakrishnan, B. (2017). A novel module for cultivate unity and harmony in multicultural society through arts education. *Journal for Multicultural Education, 11*(4), 306-322. https://doi.org/10.1108/JME-03-2015-0009

Barr, V., & Stephenson, C. (2011). Bringing computational thinking to K-12: What is involved and what is the role of the computer science education community?. *Acm Inroads, 2*(1), 48-54. https://doi.org/10.1145/1929887.1929905

Blundell, R., Costa Dias, M., Cribb, J., Joyce, R., Waters, T., Wernham, T., & Xu, X. (2022). Inequality and the COVID-19 Crisis in the United Kingdom. *Annual Review of Economics, 14*, 607-636. https://doi.org/10.1146/annurev-economics-051520-030252

Bidarra, J., & Rusman, E. (2017). Towards a pedagogical model for science education: bridging educational contexts through a blended learning approach. *Open Learning: the journal of open, distance and e-learning, 32*(1), 6-20. https://doi.org/10.1080/02680513.2016.1265442

Cavus, N., Mohammed, Y. B., & Yakubu, M. N. (2021). Determinants of learning management systems during COVID-19 pandemic for sustainable education. *Sustainability, 13*(9), 5189. https://doi.org/10.3390/su13095189

Clark-Wilson, A., Robutti, O., & Thomas, M. (2020). Teaching with digital technology. *ZDM Mathematics Education 52*, 1223–1242. https://doi.org/10.1007/s11858-020-01196-0

Caena, F., & Redecker, C. (2019). Aligning teacher competence frameworks to 21st century challenges: The case for the European Digital Competence Framework for Educators (Digcompedu). *European journal of education, 54*(3), 356-369. https://doi.org/10.1111/ejed.12345

Cattaneo, A. A., Antonietti, C., & Rauseo, M. (2022). How digitalised are vocational teachers? Assessing digital competence in vocational education and looking at its underlying factors. *Computers & Education, 176*, 104358. https://doi.org/10.1016/j.compedu.2021.104358

Falloon, G. (2020). From digital literacy to digital competence: the teacher digital competency (TDC) framework. *Educational Technology Research and Development, 68*, 2449-2472. https://doi.org/10.1007/s11423-020-09767-4

Gilster, P. (1997). *Digital Literacy*. New York: Wiley & Sons.

Geng, S., Law, K. M., & Niu, B. (2019). Investigating self-directed learning and technology readiness in blending learning environment. *International Journal of Educational Technology in Higher Education, 16*(1), 1-22. https://doi.org/10.1186/s41239-019-0147-0

Ghomi, M., & Redecker, C. (2019). Digital Competence of Educators (DigCompEdu): Development and evaluation of a self-assessment instrument for teachers' digital competence. *In Proceedings of the 11th International Conference on Computer Supported Education (CSEDU 2019)*, *1*, 541-548. SciTePress. DOI: 10.5220/0007679005410548

Hague, C., & Payton, S. (2010). *Digital Literacy Across the Curriculum*. Futurelab. https://www.nfer.ac.uk/publications/digital-literacy-across-the-curriculum/

Hrastinski, S. (2019). What do we mean by blended learning?. *TechTrends, 63*(5), 564-569. https://doi.org/10.1007/s11528-019-00375-5

Harimurti, R., & Asto, B. I. (2019). The concept of computational thinking toward information and communication technology learning. In *IOP Conference Series: Materials Science and Engineering 535*(1). IOP Publishing. https://iopscience.iop.org/article/10.1088/1757-899X/535/1/012004

Harrinni, M. N., & Irma R. I. (2019). The design and development of Bijak Seni, a teaching and learning module that incorporates computational thinking skills in visual art education for secondary school. *Journal of Advanced Research in Social Sciences and Humanities 4*(5), 184-19. https://dx.doi.org/10.26500/JARSSH-04-2019-0505

Jiang, L., & Kamel Shaker Al-Shaibani, G. (2022). Influencing factors of students' small private online course-based learning adaptability in a higher vocational college in China. *Interactive Learning Environments*, 1-22. https://doi.org/10.1080/10494820.2022.2105901

Janssen, J., Stoyanov, S., Ferrari, A., Punie, Y., Pannekeet, K., & Sloep, P. (2013). Experts' views on digital competence: Commonalities and differences. *Computers & Education, 68*, 473-481. https://doi.org/10.1016/j.compedu.2013.06.008

Jenkins, H. (2004). The cultural logic of media convergence. *International Journal of Cultural Studies, 7*(1), 33-43. https://doi.org/10.1177/1367877904040603

Kačinová, V., & Chalezquer, C. S. (2022). Conceptualization of media competence as an "augmented competence". *Revista Latina de Comunicación Social*, 80, 21-38. https://www.doi.org/10.4185/RLCS-2022-1514

Koehler, M., & Mishra, P. (2009). What is technological pedagogical content knowledge (TPACK)?. *Contemporary Issues in Technology and Teacher Education, 9*(1), 60-70. https://www.learntechlib.org/primary/p/29544/

Liu, Q., Chen, H., & Crabbe, M. (2021). Interactive study of multimedia and virtual technology in art education. *International Journal of Emerging Technologies in Learning (iJET), 16*(1), 80-93. https://www.learntechlib.org/p/218648/

Lin, X., & Gao, L. (2020). Students' sense of community and perspectives of taking synchronous and asynchronous online courses. *Asian Journal of Distance Education, 15*(1), 169-179.

Lucas, M., Bem-Haja, P., Siddiq, F., Moreira, A., & Redecker, C. (2021). The relation between in-service

teachers' digital competence and personal and contextual factors: What matters most?. *Computers & Education, 160,* 104052. https://doi.org/10.1016/j.compedu.2020.104052

Liu, Z. J., Tretyakova, N., Fedorov, V., & Kharakhordina, M. (2020). Digital literacy and digital didactics as the basis for new learning models development. *International Journal of Emerging Technologies in Learning (iJET), 15*(14), 4-18.

Levina, V. N., & Guskova, S. V. (2017). Mechanisma of cultural values and students' behavioral priorities forming under the influence of converged media materials. *Russian Language Studies, 15*(3), 317-332. https://doi.org/10.22363/2313-2264-2017-15-3-317-332

Ma, L. (2019).”互联网+” 时代高职教师信息素养的提升策略“Hulian wang+ Shidai Gaozhi Xinxi Suyang de Tisheng Celüe” [Strategies for improving the information literacy of higher vocational teachers in the era of “ Internet +”]. *现代职业教育[Modern vocational education] 32,* 24–25

Marner, A. (2013). Digital media embedded in Swedish art education–a case study. *Education Inquiry*, *4*(2), 355-373.

Mohammadi, M. K., Mohibbi, A. A., & Hedayati, M. H. (2021). Investigating the challenges and factors influencing the use of the learning management system during the Covid-19 pandemic in Afghanistan. *Education and Information Technologies*, *26*, 5165-5198. https://doi.org/10.1007/s10639-021-10517-z

Mishra, P., Yadav, A., & Deep-Play Research Group. (2013). Rethinking technology & creativity in the 21st century. *TechTrends*, *57*(3), 10-14.

Ma, Z., Guan, J., & Li, R. (2021). Research on innovative teaching mode of art education in the age of convergence of media. *International Journal of Emerging Technologies in Learning (iJET)*, *16*(2), 272-284.

Ministry of Education, China. (2010). 国家中长期教育改革和发展规划纲要”强调发展信息基础设施和优质教育资源 [The National Outline of the National Long-Term Education Reform and Development Plan focuses on the development of information infrastructure and high-quality educational resources]. http://www.moe.gov.cn/jyb_xwfb/s6052/moe_838/201008/t20100802_93704.html

Mikhailovna, L. N., & Anatol'Evna, S. E. (2018). Art education as a way of preserving the traditional ethnocultural identity of indigenous minority peoples from the North, Siberia and the Far East. *Science for Education Today*, *8*(4), 233-247.

Oguguo, B. C., Nannim, F. A., Agah, J. J., Ugwuanyi, C. S., Ene, C. U., & Nzeadibe, A. C. (2021). Effect of learning management system on student’s performance in educational measurement and evaluation. *Education and Information Technologies*, *26*, 1471-1483. https://doi.org/10.1007/s10639-020-10318-w

Ottestad, G., Kelentrić, M., & Guðmundsdóttir, G. B. (2014). Professional digital competence in teacher education. *Nordic Journal of Digital Literacy*, *9*(4), 243-249.

Pan, Y. (2017) 从高校艺术设计作品看中国艺术教育现状 “Cong Gaoxiao Yishu Zuopin Kan Zhongguo Yishu Jiaoyu Xianzhuang” [The Status quo of art education in China from Art design Works in colleges and Universities]. *学园 [Xueyuan] 3,* 112-113.

Puentedura, R.R. (2020, January 25). SAMR - A research perspective. http://hippasus.com/rrpweblog/archives/2020/01/SAMR_AResearchPerspective.pdf

Raza, S. A., Qazi, W., Khan, K. A., & Salam, J. (2021). Social isolation and acceptance of the learning management system (LMS) in the time of COVID-19 pandemic: an expansion of the UTAUT model. *Journal of Educational Computing Research*, *59*(2), 183-208. https://doi.org/10.1177/0735633120960421

Rabiman, R., Nurtanto, M., & Kholifah, N. (2020). Design and development e-learning system by learning management system (LMS) in vocational education. *Online Submission, 9*(1), 1059-1063.

Redecker, C. (2017). *European framework for the digital competence of educators: DigCompEdu* (JRC107466). Seville, Spain: Joint Research Centre. Retrieved from http://publications.jrc.ec.europa.eu/repository/handle/JRC107466

Sanabria, J. C., & Arámburo-Lizárraga, J. (2017). Enhancing 21st century skills with AR: Using the gradual immersion method to develop collaborative creativity. *Eurasia Journal of Mathematics, Science and Technology Education*, *13*(2), 487-501. https://doi.org/10.12973/eurasia.2017.00627a

Sulistyanto, H., Prayitno, H. J., Sutama, S., Narimo, S., & Sutopo, A. (2023). The Effectiveness of Hybrid Learning-Based Adaptive Media to Empower Student’s Critical Thinking Skills: Is It Really for VARK Learning Style?. *Asian Journal of University Education,* 19(1), 95-107.

Turnbull, D., Chugh, R. and Luck, J. (2020). Learning management systems: An overview. In Tatnall, A. (Eds.), *Encyclopedia of Education and Information Technologies* (pp. 1052-1058). Springer.

https://doi.org/10.1007/978-3-030-10576-1_248

Taher, M. A., Shrestha, P. N., Rahman, M. M., & Khalid, A. I. (2016). Curriculum Linked Video (CLV) as a tool for English Language Teaching (ELT) at secondary school classrooms in Bangladesh. *International Journal of Humanities, Arts and Social Sciences*, *2*(4), 126.

Van Deursen, A. J., & Helsper, E. J. (2015). The third-level digital divide: Who benefits most from being online?. In *Communication and information technologies annual* (pp. 29-52). Emerald Group Publishing Limited.

Wing, J. M. (2006). Computational thinking. *Communications of the ACM*, *49*(3), 33-35.

Wing, J. (2017). Computational thinking's influence on research and education for all. *Italian Journal of Educational Technology*, *25*(2), 7-14.

Yan, L., & Zhao, R. (2023). Interactive voice system for political education innovation based on the era of 5G converged media. *Soft Computing*, 1-11.

Zhao, P., Kynäshlahti, H., & Sintonen, S. (2018). A qualitative analysis of the digital literacy of arts education teachers in Chinese junior high and high schools. *Journal of Librarianship and Information Science*, *50*(1), 77-87. https://doi.org/10.1177/0961000616658341

Zheng, H. (2010) 美术教学信息化的“三部曲”——浅谈信息化技术在中学美术教学中的有效运用 “Meishu Jiaoxue Xinxi Huade Sanbu qu Qiantan Xinxi Jishu Zai Zhongxue Meishu Jiaoxue Zhongde Youxiao Yunyong” [The "Trilogy" of Information technology in Art teaching -- On the effective application of information technology in middle school art teaching]. *学园[Xueyuan]*, *22*, 66-67.

Zhu, Y. (2019). New national initiatives of modernizing education in China. *ECNU Review of Education*, *2*(3), 353-362. https://doi.org/10.1177/2096531119868069