Digital Access Gaps and Participation Barriers in Hybrid Arts Education Programs

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Abstract: This study investigates how the digital divide shapes student participation barriers in hybrid arts education programs. The study is designed to collect data from approximately 720 students enrolled in 30 hybrid arts-related programs across urban, suburban, and community learning centers. Data sources include student questionnaires, platform login records, online attendance data, assignment submission logs, teacher feedback records, and interview transcripts. The study measures device availability, internet stability, home learning space, digital literacy, platform familiarity, online attendance rate, login frequency, assignment completion rate, feedback reception frequency, peer interaction frequency, learning satisfaction, and dropout intention. Quantitative analysis applies logistic regression, multiple regression, mediation analysis, latent class analysis, and group comparison to identify different types of participation barriers and learner profiles. The study further examines whether digital literacy and teacher support mediate the relationship between technological access and learning continuity. Based on latent class analysis, students can be classified into groups such as high-access active learners, digitally constrained persistent learners, low-support inactive learners and high-risk disengaged learners. Interview data from approximately 50 students are used to explain why some learners remain formally enrolled but become inactive in online learning tasks. The innovation of this study lies in moving beyond a simple access-based view of the digital divide and building a multidimensional model that connects technology access, platform behavior, teacher support, and sustained participation in hybrid arts education.

Keywords: Digital Divide, Hybrid Arts Education, Participation Barriers, Digital Inclusion, Learning Analytics, Latent Class Analysis, Learning Continuity.

Introduction

Hybrid arts education has become increasingly common as educational institutions combine face-to-face instruction with online platforms and digital learning tools. Students may now participate in classroom teaching while simultaneously using digital systems for attendance, assignment submission, portfolio development, teacher feedback, peer discussion, and independent practice. This blended structure can extend learning beyond the physical classroom and provide greater flexibility in when and where students engage with artistic activities. At the same time, participation in hybrid learning increasingly depends on students' ability to access and use digital resources effectively. Recent research has shown that the digital divide cannot be understood solely in terms of computer ownership or internet connectivity. It also involves differences in digital literacy, platform familiarity, learning environments at home, teacher support, and students' capacity to participate consistently in technology-mediated learning activities [1,2]. Research on public arts education has further emphasized that the organization of teaching resources and collaborative instructional models can influence the efficiency and accessibility of arts learning systems [3]. These issues are particularly relevant to arts education because many learning activities depend on visual demonstration, repeated practice, portfolio documentation, timely feedback, and interaction with teachers and peers. The development of hybrid learning has therefore changed both the opportunities and the barriers associated with arts participation. Digital platforms can provide students with access to recorded demonstrations, multimedia learning materials, online critique, digital portfolios, and

asynchronous communication [4,5]. Such functions may be particularly useful for learners who cannot participate continuously in conventional classroom settings [6,7]. However, the same technologies can create new forms of exclusion when students have limited devices, unstable internet connections, restricted home learning spaces, inadequate technical support, or insufficient confidence in using digital platforms. Studies of online and hybrid education have consistently shown that device availability, internet quality, family socioeconomic conditions, and institutional support are associated with attendance, engagement, and academic performance [8]. These findings suggest that technological access remains an important condition for participation, but they also indicate that access alone does not fully explain why some students remain active while others gradually disengage.

Digital literacy provides an additional dimension of this problem. Effective participation in hybrid learning requires students to navigate learning platforms, upload assignments, manage digital files, communicate online, respond to feedback, and regulate their own learning schedules. Research has demonstrated that students' digital competencies, self-management skills, and confidence in technology use are closely related to their ability to benefit from online learning environments [9,10]. Students who technically possess a device and an internet connection may nevertheless experience substantial participation difficulties if they are unfamiliar with platform functions or lack confidence in completing digital learning tasks. This distinction is especially important in arts-related programs, where students may need to record performances, submit visual work, edit digital materials, upload large media files, or participate in online critique sessions [11,12]. The digital divide in hybrid arts education should therefore be understood as a multidimensional participation problem rather than as a simple difference between students who have access to technology and those who do not. Learning analytics has provided new opportunities to examine these differences through observable behavioral data. Recent studies have used login frequency, online attendance, assignment submission, discussion activity, learning duration, and feedback records to identify patterns of engagement and predict students who may be at risk of disengagement or dropout [13,14]. Such indicators can reveal forms of participation that may not be captured by questionnaires alone. A student, for example, may remain formally enrolled in a course while showing declining login activity, delayed assignment submission, limited interaction with teachers, or repeated absence from online learning tasks [15,16]. These behavioral patterns are particularly relevant to hybrid education because formal enrollment does not necessarily indicate sustained participation across both online and offline components. Combining learning analytics with students' reported experiences may therefore provide a more comprehensive understanding of how digital barriers develop and how they influence learning continuity. Research specifically addressing online and hybrid arts education has also identified both educational opportunities and instructional challenges [17,18]. Digital learning environments can broaden access to artistic resources, encourage digital creation, and provide new channels for presenting and sharing creative work [19,20]. However, previous studies have also reported difficulties related to reduced studio interaction, limited access to materials and equipment, weaker embodied learning experiences, and reduced opportunities for immediate peer collaboration [21,22]. These challenges distinguish arts education from many general online courses because artistic learning often depends on physical demonstration, sensory experience, material experimentation, and continuous interaction between learners and instructors. Consequently, students who encounter technological or environmental barriers may experience disadvantages that affect not only their access to course content but also the quality of their artistic practice, feedback, and social participation. Despite growing research on digital inequality and hybrid learning, several important questions remain insufficiently examined. Much of the existing literature still emphasizes technological access, even though access alone cannot explain differences in login frequency, assignment completion, online attendance, or intentions to continue learning [23,24]. Studies of digital engagement frequently focus on general academic courses or large-scale online education, while hybrid arts programs have received comparatively limited empirical attention. Research in arts education, meanwhile, often relies on small samples, individual programs, or qualitative case studies, making it difficult to determine how technology access, digital literacy, teacher support, and online participation jointly influence learning continuity across heterogeneous student groups. There is also limited evidence explaining why some students remain officially enrolled while gradually becoming inactive in digital learning activities. This distinction between enrollment and active participation is important because unnoticed disengagement may precede withdrawal, poor performance, or long-term exclusion from arts learning opportunities.

The present study addresses these issues by examining approximately 720 students enrolled in 30 hybrid arts-related programs across urban, suburban, and community learning centers. It integrates questionnaire data with platform-based behavioral records, including login frequency, online attendance, assignment submission, teacher feedback, and other indicators of digital participation. Logistic regression and multiple regression are

used to examine factors associated with participation barriers and learning continuity, while mediation analysis evaluates whether digital literacy, teacher support, or platform engagement help explain the relationship between technology access and sustained participation. Latent class analysis is employed to identify distinct patterns of digital engagement, and group comparisons are used to examine whether participation barriers vary across socioeconomic, geographic, and learning-background groups. Approximately 50 semi-structured interviews further explore why some learners remain enrolled but become increasingly inactive in online tasks and how device conditions, home learning environments, platform difficulties, teacher communication, and feedback experiences shape their continued participation. By combining self-reported experiences, behavioral learning data, and qualitative evidence, this study seeks to move beyond an access-based understanding of the digital divide and develop a more comprehensive explanation of participation inequality in hybrid arts education. The findings are expected to contribute to research on digital inclusion by clarifying how technological conditions, digital competence, instructional support, and observable learning behavior interact, while also providing practical evidence for improving platform design, teacher support, resource allocation, early identification of disengagement, and retention strategies in hybrid arts programs.

Materials and Methods

Sample and Study Setting

The study was carried out in 30 hybrid arts-related programs in urban, suburban, and community learning centers. About 720 students were included. The programs covered visual arts, music, design, drama, dance, and mixed arts courses. All programs used both face-to-face classes and online platforms. The students differed in age, family income, device access, internet quality, home learning space, and previous digital learning experience. Data were collected during one teaching term under normal teaching conditions. Students were included if they were formally enrolled, attended at least two face-to-face classes, and had valid platform records. Students with incomplete questionnaire data or unmatched online records were removed.

Experimental Design and Control Setting

A quasi-experimental design was used to compare students under different hybrid learning conditions. The experimental group included programs with digital inclusion measures. These measures included device sharing, platform training, regular teacher feedback, online peer discussion, and flexible assignment submission. The control group included programs using standard hybrid teaching without extra digital support. Both groups had similar course goals, class length, assignment types, and assessment periods. This design was used because random assignment was difficult in school-based and community arts programs. The comparison was used to test whether digital inclusion measures were related to online attendance, platform use, assignment completion, learning satisfaction, and dropout intention.

Measurement Methods and Quality Control

Data were collected from questionnaires, platform login records, online attendance data, assignment logs, teacher feedback records, and student interviews. The questionnaire measured device availability, internet stability, home learning space, digital literacy, platform familiarity, learning satisfaction, and dropout intention. Platform records were used to measure login frequency, online attendance rate, assignment completion rate, feedback reception frequency, and peer interaction frequency. Teacher feedback records were used to count the number and timing of feedback events. About 50 students were interviewed to explain why some learners remained enrolled but became inactive in online tasks. Before formal data collection, two arts education researchers and two hybrid teaching instructors reviewed the questionnaire. A pilot test with 60 students was used to check item clarity. Log data and questionnaire data were matched by anonymous student IDs. Abnormal login records, duplicate submissions, and incomplete attendance entries were removed before analysis.

Data Processing and Model Formulas

All variables were coded and checked before analysis. Continuous variables, including login frequency, online attendance rate, assignment completion rate, feedback reception frequency, and peer interaction frequency, were standardized to reduce scale differences. Categorical variables, such as device availability and internet stability, were recoded into ordered levels. Missing values were checked by variable type. Cases with large missing sections were removed. A small number of missing scale values were replaced by the mean score of the same dimension. The Participation Barrier Index was calculated as follows (1):

$$PBI_i=w_1DA_i+w_2IS_i+w_3HLS_i+w_4DL_i+w_5PF_i \quad (1)$$

where PBI_i is the participation barrier index of student i, DA_i is device availability, IS_i is internet stability, HLS_i is home learning space, DL_i is digital literacy, PF_i is platform familiarity, and w_1 to w_5 are dimension weights. Logistic regression was used to estimate dropout intention (2):

$$\log\left(\frac{p_i}{1-p_i}\right)=\beta_0+\beta_1 DA_i+\beta_2 IS_i+\beta_3 DL_i+\beta_4 TS_i+\beta_5 LF_i+\beta_6 AC_i+\varepsilon_i \quad (2)$$

where p_i is the probability of dropout intention, TS_i is teacher support, LF_i is login frequency, AC_i is assignment completion rate, and ε_i is the error term.

Statistical Analysis and Model Testing

Descriptive statistics were used to examine digital access, platform behavior, and learning outcomes. Group comparison was used to test differences among students from urban, suburban, and community learning centers. Multiple regression was used to examine the effects of digital access, digital literacy, teacher support, and platform behavior on learning satisfaction and assignment completion. Mediation analysis was used to test whether digital literacy and teacher support explained the link between technology access and learning continuity. Latent class analysis was used to divide students into different participation groups, including high-access active learners, digitally constrained persistent learners, low-support inactive learners, and high-risk disengaged learners. Interview data were analyzed by thematic coding and used to explain the quantitative results. Statistical significance was set at $p<0.05$.

Results and Discussion

Digital Access and Participation Barriers

Students' online participation varied across digital access conditions. Students with personal devices, stable internet, and a suitable home learning space had higher online attendance, more frequent logins, and better assignment completion. Students with shared devices or unstable internet were more likely to miss online sessions and submit tasks late. This result indicates that the digital divide in hybrid arts education was not only related to device ownership. Access quality, internet cost, home conditions, and platform familiarity also affected participation. This finding is consistent with previous studies reporting that students may have basic access but still face problems caused by weak network quality, high data cost, or limited control over devices [25,26]. In arts programs, these problems may be more serious because students often need to upload images, watch demonstrations, revise portfolios, and receive visual feedback. As shown in Figure 1, participation barriers were linked to device access, internet stability, home learning space, digital skills, and platform use.

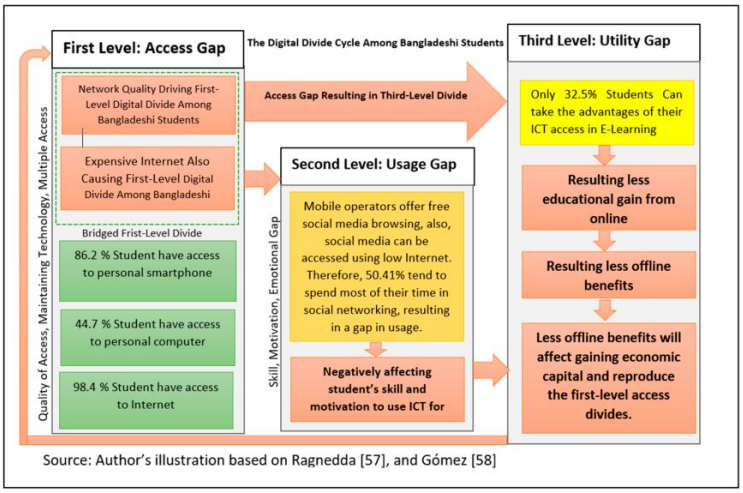

Figure 1. Digital Access Barriers to Participation in Hybrid Arts Education

Digital Literacy, Teacher Support, and Learning Continuity

Digital literacy and teacher support were closely related to learning satisfaction and assignment completion. Students with stronger digital literacy logged in more often, used platform tools more easily, and completed online portfolio tasks on time. Teacher support also played an important role. Students who received regular feedback, clear platform guidance, and flexible submission options had lower dropout intention. Mediation analysis indicated that digital literacy and teacher support partly explained the link between access conditions and learning continuity. This means that limited access did not always lead to disengagement when students received enough guidance. This finding is in line with recent studies showing that online dropout is related not only to technology problems, but also to course design, teacher presence, learning confidence, and support services [27, 28]. In hybrid arts education, teacher support is especially important because students need advice on process, materials, visual presentation, and revision.

Learner Profiles Based on Barrier Types

Latent class analysis identified four learner groups. The first group was high-access active learners. These students had stable access, high login frequency, strong assignment completion, and low dropout intention. The second group was digitally constrained persistent learners. These students had shared devices or unstable internet, but they still maintained participation through motivation and teacher support. The third group was low-support inactive learners. These students had acceptable access, but they had low feedback reception, weak peer interaction, and poor online attendance. The fourth group was high-risk disengaged learners. These students had poor access, weak digital skills, low satisfaction, and high dropout intention. These findings indicate that students with similar access may have different learning outcomes. Platform familiarity, teacher feedback, and peer interaction also mattered. As shown in Figure 2, dropout risk related to the digital divide was affected by access, digital skills, institutional support, and training. This result extends earlier learning analytics studies that mainly used login records or assignment submission to identify at-risk students [29]. In hybrid arts courses, platform records should be examined together with access conditions and support records.

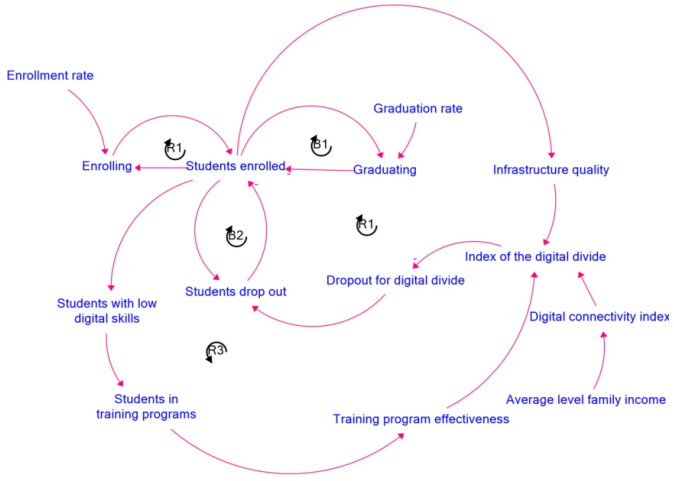

Figure 2. Links between Digital Access, Skills, Support, and Dropout Risk

Comparison With Previous Studies and Teaching Implications

Compared with previous studies, this study gives a clearer account of participation barriers in hybrid arts education. Earlier studies often focused on general online courses, higher education platforms, or emergency remote teaching. Many studies measured the digital divide through device access, internet access, or demographic differences [30]. Other studies examined dropout in online education, but hybrid arts programs were less often studied. This study used questionnaires, login records, online attendance, assignment logs, teacher feedback records, and interviews from 720 students in 30 hybrid arts programs. This design helped explain why some students stayed enrolled but became inactive in online tasks. Interview results indicated that hidden inactivity was often related to unstable internet, shared devices, unclear platform rules, weak feedback, and low confidence in digital tasks. In practice, hybrid arts programs should include device sharing, platform training, regular teacher feedback, flexible deadlines, and peer interaction. These measures may reduce hidden participation barriers and improve learning continuity.

Conclusion

This study examined how the digital divide affects student participation in hybrid arts education. The results showed that device access, internet stability, home learning space, digital literacy, platform familiarity, and teacher support were related to online attendance, login frequency, assignment completion, learning satisfaction, and dropout intention. Students with stable access and stronger digital skills had better participation. Students with shared devices, weak internet, limited support, or low confidence in platform use were more likely to become inactive. Digital literacy and teacher support also reduced the negative effect of poor access on learning continuity. The main contribution of this study is that it examines the digital divide as more than an access issue. It links access, platform behavior, teacher feedback, and continued participation in hybrid arts education. In practice, hybrid arts programs can improve participation through device sharing, platform training, regular feedback, flexible deadlines, and peer interaction. This study also has limitations. The data were collected from 30 programs during one teaching term, so the results may not apply to all arts education settings. Future studies should include more regions, longer follow-up data, and different types of arts programs to test the stability of the findings.

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