# Bridging the Literacy Gap for Adults: Streaming and Engaging in Adult Literacy Education through Livestreaming

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## ABSTRACT

Literacy—the ability to read, write, and comprehend text—is an important topic addressed by UNESCO. Despite global efforts to promote adult literacy education, rural areas with limited resources still lag behind. As livestreaming has gained popularity in China, many streamers leveraged its accessibility and affordability to reach low-literate adults. To gain a better understanding of the practices and challenges faced by adult literacy education through livestreaming, we conducted a mixed-methods study involving a 7-day observation of livestreaming sessions and an interview study with twelve streamers and ten viewers. We discovered streamers' altruistic motives and unique interactive approaches. Viewers perceived livestreaming as a more engaging, community-supportive method than traditional approaches. We also identified both shared and unique challenges for streamers and viewers that limit its efficacy as a learning tool. Finally, we recognized opportunities to enhance educational equity, emphasizing design implications for advancing adult literacy education and promoting diversity in livestreaming.

## CCS CONCEPTS

• **Human-centered computing → Empirical studies in HCI**.

## KEYWORDS

livestreaming, adult literacy, education

**ACM Reference Format:**
Shihan Fu, Jianhao Chen, Emily Kuang, and Mingming Fan. 2024. Bridging the Literacy Gap for Adults: Streaming and Engaging in Adult Literacy Education through Livestreaming. In *Proceedings of the CHI Conference on Human Factors in Computing Systems (CHI '24), May 11–16, 2024, Honolulu, HI, USA.* ACM, New York, NY, USA, 15 pages. https://doi.org/10.1145/3613904.3642423

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*CHI '24, May 11–16, 2024, Honolulu, HI, USA*
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ACM ISBN 979-8-4007-0330-0/24/05
https://doi.org/10.1145/3613904.3642423

## 1 INTRODUCTION

Despite the global literacy rate reaching 86.3% in 2020, over 750 million individuals over the age of 15 worldwide remain illiterate [73, 80]. Literacy, defined as the ability to read, write, and comprehend text, is crucial for communication, education, and problem-solving [38]. Illiteracy persists as a significant issue, affecting not only developing nations but also more economically advanced countries [56]. The United Nations Educational, Scientific, and Cultural Organization (UNESCO) has emphasized the importance of adult literacy education, considering it a fundamental human right [71, 72]. Literacy serves as a means to helping people achieve various goals, including improving self-esteem, expanding social networks, and lifting themselves and their families out of poverty [19, 79]. It also empowers them to have a voice in broader society and influence future generations [62]. Although substantial literacy improvement efforts occurred during the 20th century, progress has been uneven, particularly in resource-deprived rural areas [65].

Recognizing the critical role of literacy skills for personal well-being and community development [3, 12], countries around the world have implemented massive literacy movements at a different pace since the last century [5]. Traditional adult literacy campaigns, often government-operated, have primarily depended on regional

facilities to deliver training through classes led by local facilitators [9]. Despite these global efforts, a significant number of people still struggle with low literacy skills. Literacy programs face numerous challenges. A primary issue is time constraints, as these programs often offer only basic levels of instruction within a limited duration, which is insufficient for learners to achieve sustainable proficiency [34]. This problem is compounded by the inconsistent participation of adult learners, marked by low enrollment, high dropout rates, and rapid loss of acquired skills [1, 2, 58, 59]. An additional concern is the declining availability of traditional adult literacy programs. This decline is due to a shift in government focus and resources towards other educational and developmental goals, which worsens access issues for underserved populations [15, 74].

The emergence of livestreaming platforms has expanded accessibility to knowledge [48], which removes geographical and time barriers, making literacy education more accessible. Furthermore, due to their ability to deliver video content in real-time and offer various social interaction functions, livestreaming platforms are prevalent in many countries [83]. For instance, in China, with a user base of 617 million in 2020 [55], popular platforms like Douyin and Kuaishou have reached both urban and rural audiences, offering diverse content, encompassing educational resources [43]. Livestreaming has been explored for various educational purposes, including programming skill development [17, 25, 29], second language acquisition [4], and the cultural heritage preservation [45].

Recent reports have highlighted an emerging phenomenon in China: livestreamers are voluntarily using these platforms to teach adult literacy, establishing an innovative educational approach that extends beyond the scope of traditional literacy programs [69, 78]. These streamers have established unique pedagogical frameworks within livestreaming sessions, starting with basic phonetics principles and progressing to instruction in Chinese characters [66]. This approach offers an accessible educational alternative for underserved populations. One of the key strengths of livestreaming is its support for multimedia content, including audio and video. This feature is particularly beneficial for low-literate users, as it provides access to information in ways that traditional text-based media cannot [37]. While audiences for livestreams in areas such as video gaming [42], intangible cultural heritage [45], and e-commerce livestreams [68] are typically literate, the audience for adult literacy livestreams consists mainly of low-literate individuals. This demographic requires streamers to adopt different strategies to effectively engage with their viewers, addressing the potential challenges imposed by both the audience's needs and the platform's limitations. As it gains popularity, livestreaming shows its potential to expand the reach of adult literacy education to a wider audience and play a crucial role in reinforcing basic educational practices. However, the use of livestreaming as a tool for adult literacy education remains underexplored in systematic research.

To better understand the practices, opportunities, and challenges of using livestreaming platforms for the education of adult literacy, we address the following research questions (RQs):

**RQ1**: What are the motivations for teaching and watching adult literacy livestreams in China?

**RQ2**: How do streamers teach and interact with viewers? Specifically, what practices do they employ to promote adult literacy education?

**RQ3**: What challenges do streamers and viewers face in adult literacy education livestreaming, and how do they address these challenges?

To explore our research questions, we observed 20 adult literacy livestreamers over 7 days and conducted interviews with 12 streamers and 10 viewers. We discovered three primary motivations for streamers, including a desire to share knowledge and a sense of responsibility towards marginalized individuals, beyond economic benefits. Viewers are motivated to watch livestreaming not just to improve their literacy. The easy access to these platforms, along with the affordability and flexibility of online learning, also encouraged them to participate in livestreaming learning. Streamers also creatively used interactive features like live calls and comments, originally intended for entertainment, to enhance educational delivery. Furthermore, they built supportive communities and used various media (e.g., tiered fan groups) for personalized teaching, fostering social interaction, which kept viewers engaged in learning. We identified three key challenges in using livestreaming for adult literacy education from both streamers' and viewers' perspectives, along with the strategies they used to overcome them. These challenges are divided into those common to both sides and those unique to each. Lastly, our results indicate that adult literacy livestreaming significantly contributes to equal access to education for marginalized individuals.

Our research addresses a crucial gap in the HCI field by exploring the unique online education ecosystem of adult literacy livestreams, which differ from other educational streams. We specifically focus on the needs of illiterate viewers and streamers, a group not thoroughly examined in previous studies. Additionally, we emphasize the potential for optimizing platform design in collaboration with traditional adult literacy programs, aiming to promote lifelong learning among adults from diverse backgrounds and varying digital literacy levels. Finally, we underscore the significant role of educational livestreaming diversification in providing marginalized individuals access to education and fostering educational equality.

## 2 BACKGROUND AND RELATED WORK

### 2.1 Challenges in Adult Literacy Education

Illiteracy remains a persistent global challenge, affecting millions of adults worldwide. According to UNESCO, around 773 million adults lack basic literacy skills [80], including reading, writing, and using numbers from written sources. Basic literacy is a fundamental part of the right to education, as recognized in the Universal Declaration of Human Rights [6]. To tackle this issue, literacy campaigns are conducted at local, national, and international levels, which typically involve providing literacy courses. However, these efforts face several challenges, such as limited educational resources, insufficient education duration, and difficulty covering all illiterate groups [65]. Many adult literacy programs and campaigns in various countries rely on large-scale tactics to reach a significant number of people in a limited period, as seen in Bolivia, Nicaragua, Venezuela, Nepal, and Pakistan [32]. However, most individuals require more time and educational resources to enhance their literacy abilities to a level competent for daily living. Though literacy programs exist, they tend to be limited to the lowest levels and are

insufficient in duration to enable learners to achieve sustainable levels of proficiency [34].

In China, a similar situation exists. Various literacy policies and movements were implemented over the past few decades [7, 61], which have been motivated by the national policy to "eliminate illiteracy" (known as "saomang" in Chinese). In response, the government established adult education institutions and night schools to provide literacy education for adults. With the rapid development over the past few decades and the general improvement in education levels, government, and social organizations have shifted their focus and resources to other educational and developmental projects, leading to a gradual decrease in literacy programs. However, the country still has an illiterate population of 37.75 million people in 2021 [57], with illiteracy being particularly severe in rural areas [82]. Geographic isolation, technological barriers, and economic constraints have intensified the difficulties for low-literate groups, such as the elderly and rural residents, due to the limited access to literacy education available for the adult illiterate population [66]. As a result, addressing challenges in adult literacy education remains a pressing issue in China and globally.

## 2.2 Promoting Adult Literacy via ICTs

Increasing amounts of information online challenge particularly those with poor foundational literacy skills. They are at risk of being excluded from new and emerging uses of Information and Communication Technologies (ICTs) and other media [33, 35, 52]. Thus previous work has explored the use of ICTs to address the challenges related to low literacy in two main aspects.

On the one hand, researchers have explored different designs to make ICT systems more accessible to people with low literacy skills. These include providing inclusive graphical user interfaces [70], multi-modal interactions with systems [21, 27], and assistive technologies [64, 76]. For example, Taoufik et al. [70] created a usable graphical user interface for an E-government portal website, enabling illiterate individuals to interact with static content and access online services, thus benefiting from the Fez e-government portal. A mobile system called VideoKheti used speech, graphics, and touch interactions to help low-literate farmers in rural India find and watch agricultural extension videos in their language and dialect, making video content more accessible to low-literate users [21]. Watanabe et al. [76] presented Facilita, an assistive technology that generates accessible content from web pages automatically, using simplification techniques to help lower-literacy users understand the text content of web applications.While effective, implementing them requires significant financial support. As a result, their reach is limited to a smaller proportion of illiterate individuals.

Another area of research explores using ICTs to support literacy education for low-literate populations. Various techniques have been developed to improve literacy, both for adult individuals [22, 36, 75] and for intergenerational learning [49, 50]. Hill et al. [36] presented CAPITAL Words, an educational Android application that helps low-literate adults in a local literacy center improve phonemic awareness through auto-generated reading and spelling exercises. An assistive alternative interface developed by Drew et al. [22] enables illiterate users in the US to acquire reading skills by composing and playing Short Message Service (SMS) and other content using voice composition and playback. A voice-based literacy curriculum was developed by Madaio et al. for low-cost mobile devices, which was deployed with families in rural communities in Côte d'Ivoire, allowing them to engage with the curriculum through recorded messages accessible via feature phones [50]. However, these studies often use participatory design approaches, involving deep engagement with small communities and distinct cultural settings, thus implementation is often limited, lacking scalability for broader adoption in internet environments.

Given this limitation, there has been increasing research into emerging technologies aimed at improving access to online learning platforms. Common forms of online education access include massive open online courses (MOOCs), video tutorials, and online discussion groups [39]. However, a learner's ability to engage effectively in these forms of online learning depends on their reading and writing skills. They need to use various communication tools, such as email and chat, to interact effectively throughout the online learning process[63]. These approaches assume a certain level of literacy skills of learners to navigate and participate in online learning activities. Consequently, there is a lack of emphasis on developing tailored accessible online teaching resources specifically designed to support adults without basic literacy skills, who face significant barriers in accessing and benefiting from online resources due to their inability to read or write. There is a significant need to explore a widely accessible online education resource dedicated to teaching basic literacy skills, which encompass fundamental reading and writing abilities, to a broader audience.

## 2.3 Livestreaming and its Practices in China

In recent years, livestreaming has gained significant popularity in China, making it increasingly accessible to people in underdeveloped areas. Platforms like Douyin and Kuaishou have emerged as the most popular livestreaming platforms, boasting daily active user counts of 400 million and 300 million in 2020 [24, 40]. Unlike popular livestreaming platforms in the United States or Europe, these livestreaming platforms in China initially emerged as short video-sharing platforms, which attracted a large user base. Another advantage of livestreaming platforms is their support for multimedia content, such as audio and video. This capability enables illiterate users to access information in ways that traditional text-based media cannot [37]. Additionally, these platforms require low technological literacy, enhancing accessibility for people with limited literacy skills [14]. As a result, these platforms have created a specific online education environment that is particularly beneficial for adult literacy education.

There has been a growing interest in the study of livestreaming within the HCI community. Prior research has primarily focused on entertainment-centered livestreaming in various domains, including video gaming [42, 67], outdoor activities [46], intangible cultural heritage [45], and e-commerce [68, 81]. These studies have shown that livestreaming can cultivate engaging and interactive entertainment experiences within the livestreaming community [30, 41]. Previous studies have also examined livestreaming in the context of knowledge sharing and education, such as skill-sharing for programming [17, 25, 29] and second language acquisition [4, 13].

These studies demonstrated the potential of livestreaming on public platforms for popularising education. Several other studies on education livestreaming have focused on the transformation of higher education practices from a traditional co-located paradigm to a remote online paradigm during the COVID-19 global pandemic and resulting lockdown policies [16, 18].

However, these studies do not necessarily reflect adult literacy livestreaming in China. Literacy-focused livestreaming, aimed at illiterate adults, faces unique challenges compared to streams for audiences with basic literacy [4, 17, 25]. Understanding how low-literate individuals engage with these platforms reveals fundamental differences in interaction and learning. In addition, unlike traditional higher education systems that employ private platforms (e.g., Zoom) [18], these streamers have opted to utilize entertainment-focused livestreaming platforms to deliver their content. This platform choice can broaden reach, but it may also encounter disruptive behaviors from certain viewers and misunderstanding from those who are not the intended audience. Furthermore, though previous studies have reflected low-literate users utilizing online platforms, such as creating and sharing short videos [14], as well as receiving virtual cultural literacy training [53], these studies have not delved into the current state of literacy education itself. The HCI community has not yet extensively explored the specific practices and challenges faced by adult literacy education, There is a lack of a comprehensive examination of the experience from both the perspectives of educators and learners. Therefore, this work provides new insights into adult literacy livestreaming education, filling a crucial gap in current research.

## 3 METHOD

To gain a deeper understanding of adult literacy livestreaming, we employed both observation and interview methods. In the first stage, we observed 20 adult literacy streamers on Douyin and Kuaishou to gain a general comprehension of the content, noting some unique behaviors and interactions between streamers and viewers related to livestreaming. In the second stage, we interviewed 12 adult literacy streamers (Table 1) and 10 viewers (Table 2) of these streamers to understand their practices. Our observations of livestreams helped us collect more contextual information about livestreaming practices before the interviews, enabling us to ask more focused and in-depth questions that stimulated enriching discussions with participants. After the interviews, we utilized the content of the livestreams and other available data within the platform (e.g., short videos) to supplement the findings from our interviews.

### 3.1 Observing the Livestreams of Adult Literacy Streamers

We initially observed adult literacy livestreams to gain preliminary insights for our study. To enhance the diversity and effectiveness of the observation phase, we intentionally selected adult literacy livestreams covering a range of teaching content. The selected livestreams were generally popular, with an average of 100-400 concurrent viewers each. During this process, two researchers divided the work of watching livestreams from 20 different streamers over 7 days. We tracked the schedules of each streamer to identify sessions with no overlap in time. When sessions from multiple streamers occurred simultaneously, the researchers viewed recordings of the missed sessions later. Each researcher watched 1 to 2 live sessions daily respectively, spending 40 to 50 minutes on each session. This approach resulted in approximately 15 hours of livestreamed content being observed in total. To identify potential streamers, we first searched major livestreaming platforms in China (e.g., Douyin, Kuaishou, Bilibili, etc.), using keywords related to adult literacy education (e.g., adult literacy teaching, Chinese character teaching, and Chinese phonetic guide). We found that streamers were mainly active on Kuaishou and Douyin, as they are the most popular livestreaming platforms in China, boasting daily active user counts of 400 million and 300 million in 2020 respectively [24, 40].

Additionally, we captured screenshots of representative moments during the livestreams to aid our analysis, taking detailed notes on livestreaming content, interaction approaches, and community dynamics. Since many livestreamers also deliver their teaching content via short videos, we reviewed their account pages which displayed both these videos and livestreaming recordings. We refrained from interacting with the livestreamers to maintain objectivity and avoid influencing the observation results or affecting the streamer's or viewers' behaviors.

### 3.2 Interviews with Livestreamers and their Viewers

We recruited 12 adult literacy livestreamers (Table 1) and 10 viewers (Table 2) of these streamers through direct messages on livestreaming platforms and snowball sampling. We sent private messages to active adult literacy livestreamers' personal accounts on Douyin or Kuaishou to invite them for an interview. Viewers were recruited by reaching out to them in the streamers' group chat, with the streamers' consent. All interviews were conducted remotely via video or audio calls. Each participant received 120 CNY (approximately 17 US dollars) as compensation after the interview.

Each semi-structured interview lasted approximately 40 to 50 minutes. Interviews with streamers focused on their motivations for teaching adult literacy via livestreaming, content, viewer engagement methods, and their experiences and challenges in this teaching medium. Viewer interviews explored their reasons for choosing livestreaming for literacy learning, their duration of study in this format, comparisons with traditional learning methods, and their interaction with both streamers and fellow viewers. These interviews were audio-recorded and transcribed by the first author, a native Mandarin speaker, after obtaining participant consent.

### 3.3 Data Analysis

Our data included the interview transcripts and notes from the observers during the livestreams. Two researchers first read through the transcripts to gain an overall understanding, then independently coded them using an open coding approach [20]. We utilized a combination of deductive and inductive coding techniques. Initially, three main themes — motivation, practice, and challenges — were established to guide our semi-structured interviews. For each main theme, we inductively constructed sub-themes by assigning codes to participants' responses. Codes that were repeated or similar were then grouped into higher-level themes. For example, when streamers described their motivations for streaming, we

**Table 1: Demographics of the interview streamers. (Platforms: K–Kuaishou, D–Douyin)**

| ID | Age | Platforms | Years of Streaming | Number of Followers | Prior Teaching Experience |
|---|---|---|---|---|---|
| S1 | 50+ | K & D | 0.5+ | 259k | Middle school |
| S2 | 46 | K | 3+ | 219k | Elementary school |
| S3 | 57 | K | 0.5+ | 8k | Kindergarten |
| S4 | 40 | K & D | 2 | 138k | Elementary school |
| S5 | 59 | K | 1+ | 14k | Elementary school |
| S6 | 73 | K | 2+ | 386k | Elementary school |
| S7 | 50+ | K | 2+ | 57k | Elementary school |
| S8 | 30 | K | 3 | 49k | Elementary school |
| S9 | 40+ | K & D | 2 | 203k | Kindergarten |
| S10 | 52 | K | 5+ | 87k | Kindergarten |
| S11 | 41 | D | 3+ | 162k | Kindergarten |
| S12 | 40+ | K | 2+ | 76k | Elementary school |

**Table 2: Demographics of the interview viewers. (Platforms: K–Kuaishou, D–Douyin)**

| ID | Age | Platforms | Years of Watching Streaming | Streamer Watched |
|---|---|---|---|---|
| V1 | 18 | K & D | 0.5+ | S5 |
| V2 | 54 | K | 2+ | S4 |
| V3 | 69 | K & D | 1 | S8 |
| V4 | 18 | K | 1+ | S3 |
| V5 | 21 | K | 0.5+ | S3, S11 |
| V6 | 44 | K | 1+ | S4 |
| V7 | 68 | K | 1+ | S2 |
| V8 | 52 | K | 1+ | S2 |
| V9 | 72 | K & D | 1+ | S10 |
| V10 | 50 | K | 1 | S2 |

categorized these responses under the main theme 'motivation'. Within this, we identified a sub-theme "Economic Benefits" for the repeated codes: "virtual gifts", "income", and "sell". The data was further supplemented by looking at screenshots of representative moments during the observed livestreams. The notes for the screenshots mostly described the teaching content of the livestream, (e.g., "Pinyin", "Chinese characters" ). To ensure consistency, researchers compared their codes and achieved consensus through discussions. Any remaining disagreements were resolved through further discussions among the entire research team.

## 4 FINDINGS

In this section, we present our findings on the motivations of streamers and viewers (RQ1), practices of adult literacy livestreamers (RQ2), and challenges and strategies (RQ3).

### 4.1 Motivations of Streamers and Viewers (RQ1)

In this section, we describe the motivations behind streamers and viewers engaging in adult literacy through livestreaming platforms.

*4.1.1 Motivations of Streamers.* We found that adult literacy streamers livestreamed for reasons both similar to and different from other streamers. Like many streamers [11, 45], they sought to **build self-worth through knowledge sharing**, and **gain economic benefits**. However, one frequently mentioned distinct motivation was a strong desire to **help care for the low-literate population**.

***(1) Caring for the low-literate population.*** The majority of streamers (N=11) expressed that their motivation to start livestreaming stemmed from their concern for the low-literate population, due to the limited educational resources available for adults with low literacy levels. S4 emphasized the urgency of teaching literacy skills to adults, stating, *"Adults often lack access to formal education and are left without anyone to teach them, while children have access to schools and teachers"*.

Six streamers mentioned that their fans had recounted their unfortunate experiences due to low literacy, further motivating them to continue livestreaming. S5 demonstrated her care by providing free literacy instructions to fans who are experiencing challenging circumstances beyond livestreaming. Touched by their experiences, she wanted to help in any way she could, stating, *"One of my fans told me that he injured his hand when he was young and couldn't afford treatment, preventing him from learning to read and write. Now, by watching my livestreams, he has regained the opportunity to learn literacy. After hearing about his situation, I began providing him with personal guidance and teaching him myself"*.

***(2) Building Self-worth through Knowledge Sharing.*** All interviewed streamers had prior teaching experience in various educational roles, including primary schools, middle schools, and kindergartens. This background equipped them with expertise in foundational education, particularly literacy skills such as reading and writing characters. Most (N=10) were unemployed or retired, prompting them to view livestreaming as an ideal platform to share their existing knowledge and showcase their teaching skills.

Interestingly, it appeared that those who engaged in knowledge sharing had a deeper motivation, namely, the desire to enhance their self-worth. For example, S6, a retired primary school teacher, initially felt idle after retirement but found renewed purpose in her livestreaming career. She expressed, *"I am a retiree with nothing to do at home. I decided to start livestreaming because I enjoy teaching and communicating with people, which gives me a lot of energy"*. This sentiment was echoed by S7, who emphasized, *"Knowledge is only valuable when shared. Despite my age, I can livestream from home and share my knowledge with people from across the country, which is a way for me to contribute"*.

***(3) Gaining Economic Benefits.*** Streamers often cited economic gain as a primary motivator for teaching via livestreaming. However, their approach to generating income differed from typical streamers. While most livestreaming platforms enable viewers to send virtual gifts to their favorite streamers, which can be converted into money and stored in their e-wallets [11], adult literacy streamers refrained from encouraging their viewers to send virtual gifts during their livestreams. Recognizing the technological challenges faced by their audience, particularly illiterate adults and elderly individuals over fifty, who may struggle to navigate smartphone interfaces, they refrained from requesting virtual gifts. *"I don't expect or ask for virtual gifts from them"*, as S9 said.

Most streamers (N=10) supplemented their income by selling literacy-related books or online courses as a one-time purchase,

differing from traditional e-commerce streamers who rely on recurrent product purchases. They emphasized that this income served as a supplementary source rather than their primary livelihood. Additionally, some streamers (N=6) mentioned receiving donations from supportive viewers. It is important to note that purchasing these products or making donations is voluntary, and viewers can still access streamers' rooms whether they make a purchase or not.

*4.1.2 Motivations of Viewers.* For viewers, the motivation to watch livestreaming goes beyond their desire to **improve literacy**. It also includes **the ease of access to livestreaming platforms**, as well as **the affordability and flexibility of online learning**.

***(1) Improve Literacy.*** All viewers showed a desire to improve their literacy skills, coupled with a self-motivated approach. The majority of the viewers (N=9) had no formal education nor attended school. This lack of educational background led them to view literacy as a fundamental first step in their learning journey. V4 explained, *"Before I could read, it was hard to shop alone because I couldn't understand the labels. This made me upset. I thought if I learned to read, it would help me with shopping"*.

Some viewers also expressed that they faced many difficulties and even discrimination in their daily lives, further inspiring them to learn. For example, V7, a farmer, encountered discrimination while trying to take public transportation due to her inability to read. She shared, *"When buying a bus ticket, I couldn't read the signs and had to ask the ticket seller for help. She wasn't very kind. After experiencing such things many times, I made up my mind to learn"*.

***(2) Ease of Access to Livestreaming Platforms.*** When asked why viewers chose livestreaming platforms as a learning approach, all of them mentioned that these platforms were the most accessible educational resources available to them. They all discovered adult literacy livestreaming by chance while browsing other types of short videos or livestreams. Specifically, motivating factors included the absence of traditional offline educational resources, the simplicity of using live streaming platforms, and the real-time interactions of livestreaming. For example, V10 expressed, *"Night schools aren't available like they used to be. Around 20 years ago, I went to a community night school that offered basic education, including literacy. These days, I don't hear about such offline educational resources anymore"*. The video-focused format of the livestreaming platform simplifies use for those with limited literacy skills. V7 emphasized, *"On my phone, I only use short video apps because they're simple - just open and start watching. Other apps with complicated operations or a lot of text are too difficult for me to handle"*.

Viewers also expressed significant benefits from the real-time interaction of livestreaming. V5 shared, *"I tried to learn by myself before with a first-grade textbook, but it was challenging to learn literacy alone. In the livestreams, streamers show us how to write Chinese characters, stroke by stroke, which is much clearer than trying to learn from a book by myself"*.

***(3) Flexibility and Affordability of Online Learning.*** Many viewers (N=7) mentioned that the reason they choose to watch livestreams is because it is a flexible and affordable educational resource. V4 said, *"I have to work during the daytime, while steamers usually start livestream at night, I can always catch up with the livestreaming time after finishing work at 8 pm"*. Some viewers noted that even if they miss a live session, they can still access other resources on the platform for supplementary learning, like recorded livestreams and short videos. For example, *"When I couldn't spare time for long livestream sessions, I kept up with my learning by watching the streamer's short videos"* (V3). With the variety of resources available on the platform, she can maintain her learning journey.

Beyond the platform's flexibility, viewers also appreciate that livestreaming is a free educational resource. V1 said, *"Due to my disability, it's difficult for me to attend school, and my family isn't financially strong. Watching livestreams doesn't cost anything. Moreover, after the streamer[S5] learned about my situation, she offered me private tutoring at no charge, helping me improve my literacy skills quickly"*.

## 4.2 Practices of Adult Literacy Livestreamers (RQ2)

Through observations and interviews, we obtained detailed information about the content that streamers taught and how they interacted with the audience to enhance engagement. Additionally, we uncovered valuable information about adult literacy practices extending beyond the livestreaming platform.

*4.2.1* ***Livestreaming Content.*** We discovered that instead of covering all aspects of literacy skills such as listening, reading, and writing, the streamers specifically focused on teaching Chinese phonetics principles (letter pronunciation of Pinyin), improving writing skills, enhancing the ability to recognize Chinese characters, as well as teaching digital literacy skills.

***(1) Pinyin.*** Pinyin, the official romanization system for Mandarin Chinese based on phonetic principles (Fig 1 (a)), utilizes the Latin alphabet [44]. Seven out of the 20 observed streamers focused on teaching Pinyin, which includes the pronunciation of each letter and the corresponding spelling rules. Pinyin, fundamental in learning Chinese, is primarily taught to young children from kindergarten to first grade. For illiterate adults just starting to learn to read and write, the streamers offered pinyin instructions. Once learners acquired proficiency in Pinyin, they could begin utilizing keyboards for typing, highlighting the significance of Pinyin instruction in enabling learners to engage in written communication.

***(2) Chinese Characters.*** Thirteen of the 20 observed streamers focused on teaching Chinese characters (Fig 1(b)). They targeted illiterate adults who understood grammar and could communicate in Chinese but struggled with recognizing and writing characters. Therefore, their content focused mainly on recognizing, writing, and building words. Viewers could learn pronunciation, structure, stroke order, and combining characters into words. Due to the large number of unique characters, learning Chinese characters was typically more difficult than learning Pinyin. The lessons usually focused on teaching commonly used characters, with content difficulty levels ranging from second grade to middle school.

***(3) Digital Literacy Skills.*** Digital literacy, which refers to the ability to effectively use and navigate digital technologies in the digital age [51], was a unique content that was observed in adult literacy livestreaming. In these livestreams, some streamers focused on teaching digital literacy skills specifically related to the use of

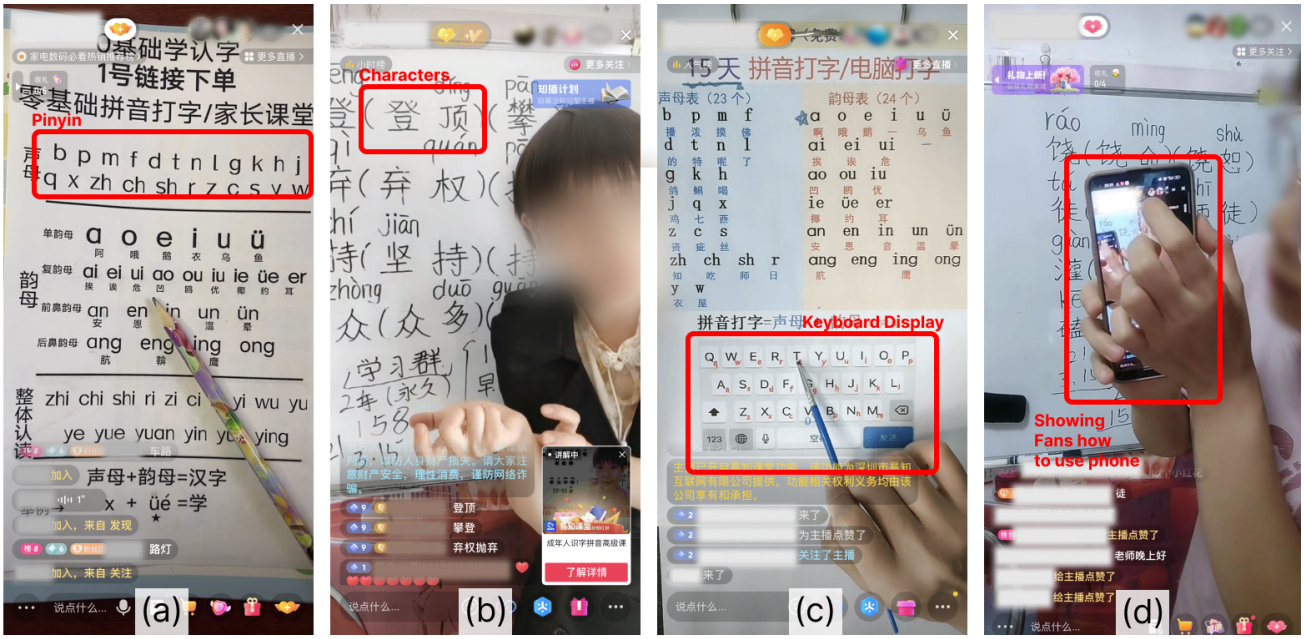



**Figure 1: Teaching content of streamers including (a) teaching basic Chinese phonetic principles, Pinyin, (b)teaching Chinese characters, (c)teaching how to use the keyboard on the smartphone to type, and(d) teaching digital literacy, such as how to subscribe to the streamer on the phone.**

smartphones. Five out of 20 streamers also focused on teaching their audience how to type on the smartphone keyboard (Fig 1(c)). They taught basic keyboarding skills, such as common smartphone keyboard layouts and text input methods.

In addition, six out of 12 interviewed streamers indicated they taught viewers digital skills, such as how to effectively search for information using search engines, and how to post comments during the livestreams (see Figure 1(d)). For example, P6 used two smartphones, one for livestreaming and the other for demonstrating operations in front of the camera, stating, *"low-literate audience may not know how to post a comment during a livestream, so I show them step by step by placing the screen in front of the camera"*. This helped learners to actively participate during the livestream. Moreover, S11 stressed the importance of teaching the viewers how to use search engines as dictionaries on their mobile phones, mentioning, *"I tell them how to use a search engine to look up words. If they come across words they don't know how to read, they can copy the words into the search box and find out how to pronounce them"*.

*4.2.2* ***Interaction Between Streamers and Audience.*** A notable finding was the streamers' strategic use of interactive platform features. To interact with viewers, streamers mainly used two key features: live calls and real-time comments. These interactive tools served not only to engage viewers within the livestream but also to assess their progress in real-time. Despite these features' initial design for entertainment rather than educational purposes, they have inadvertently contributed to promoting adult literacy teaching.

***(1) Live calls.*** The live call feature allows viewers to engage in real-time audio interaction with streamers. Streamers typically displayed text, Chinese characters, or pinyin in front of the camera, prompting streamers in the live call to read aloud, effectively facilitating a Q&A session. Based on our observations, live calls consumed a significant portion of the livestreaming time, as adult learners derived substantial benefits from this interactive approach, particularly in evaluating their learning achievements and pronunciation. Streamers were committed to accommodating every streamer who wanted to engage in live calls. Generally, most streamers engaged in live calls with one viewer at a time (Figure 2(a)). S6 explained her approach, *"During the calls, I'll point to the words on the blackboard and have them read them out loud. This helps me assess their progress and see if they mastered the lesson"*.

S4 adopted a slightly different approach, allowing up to three streamers to engage in live calls simultaneously but ensuring they took turns reading aloud to prevent chaos. Despite the potential for confusion when multiple streamers spoke simultaneously via live calls, some streamers supported this learning approach, emphasizing its facilitation of real-time communication among learners (Figure 2(b)), providing mutual guidance, and creating a supportive environment. For example, S3 permitted up to five viewers to join live calls simultaneously, *"I have multiple fans joining live calls together. This means that my fans can talk and interact with each other during live calls, providing guidance and support. It's like a group learning session where everyone can join and help one another"*.

Viewers also found live calls highly beneficial. V1 explained, *" During live calls, the streamer can directly correct my pronunciation, enabling me to make faster improvements. This immediate feedback is something I can't get from other learning methods"*. Such real-time interaction is crucial for literacy education, allowing instant




**Figure 2: Adult literacy streamers interacting with their viewers for teaching purposes. (a) a streamer showcasing pinyin to the camera, providing guidance for viewers to practice reading, and engaging in a live call with one viewer, (b) a streamer on a live call with multiple viewers, (c) a viewer sending a voice comment, and (d) a viewer sending a text comment.**

corrections to enhance understanding. Moreover, several viewers highlighted the benefits of learning from others' participation, fostering a sense of community. For example, V5 remarked, *"When others join the live call, I check for similar mistakes in my own learning. Actively learning from the teacher's real-time corrections to others is more effective than merely listening to lessons. Plus, hearing the voices of fellow learners creates a feeling of studying together"*.

***(2) Real-time Comments.*** Two types of real-time comments could be sent in livestream rooms: text and voice comments. Typically, Viewers sent text comments related to the streamer's instructional content (Figure 2(d)), enabling streamers to offer immediate feedback and interaction. For instance, they asked questions or had viewers practice typing pinyin and Chinese characters. S5 shared her approach, stating, *"I encourage viewers to practice typing in the comments, and I respond to all the comments they send. If there are any mistakes, I can correct them immediately"*. Viewers also appreciated this interactive approach, as it provided them with an opportunity to practice and enhance their typing skills. For instance, *"I started learning to type in the adult literacy livestream. This has not only improved my ability to communicate in text form but also allowed me to engage in typed conversations with others more fluently"*(V7).

In addition to text comments, viewers had the option to send voice comments (Figure 2(c)), providing a more inclusive form of interaction that eliminated the need for typing and allowed streamers to assess pronunciation. Streamers found voice comments convenient and accessible, easing pronunciation accuracy evaluation and feedback. S1 elaborated on this, *"Once I click on the voice comments, I can listen and tell viewer if he's reading correctly. It's convenient and more accessible than live calls, which are limited to interactions with only one or two individuals"*. Additionally, voice comments provided an interactive alternative for users who were not adept at typing, serving as an additional way to boost their engagement. V2 explained, *"When I'm unable to join the live call and struggle with typing, I read the characters and post voice comments"*.

*4.2.3* ***Teaching Practices Beyond Livestreams.*** Due to the limited interactive features on livestreaming platforms, almost all streamers use supplementary tools to enhance their adult literacy teaching further for more personalized instruction.

***(1) Tiered Fan Groups.*** Most streamers displayed their WeChat IDs while livestreaming, which is a messaging and social media app that supports individual and group chats. They chose this platform because though illiterate adults have limited or no access to digital platforms, they used WeChat due to its widespread popularity in China, and the availability of assistive features such as voice message and image transmission. Once the fans became "friends" with the streamers on WeChat, streamers could invite them into a fan group chat. Instead of inviting all fans to the same group chat, streamers established tiered group chats, where fans with similar literacy skills are grouped together.

In the group chat, streamers created and sent extra instructional short videos as learning materials for fans of different literacy levels needing diverse content. In this way, streamers ensured that the instructional videos (see figure 3 (b)) shared within the group were accessible and understandable. S5 emphasized the importance of curating teaching content for different skill levels, *"I will invite them to different group chats"*, S5 stated, *"Beginner learners will join in a group chat where the most fundamental literacy content is taught, and as they progress, the difficulty level will gradually increase"*.

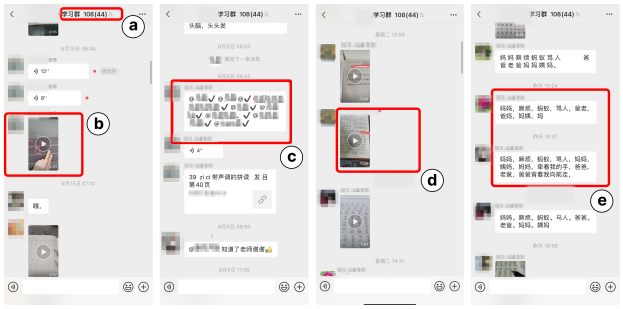



**Figure 3: S7 showcased interactions with fans in a WeChat group. Streamer posted daily instructional videos (b) in a tiered fan group (a), Streamer checked fans' assignments (c), and tagged specific members to provide feedback, Fans posted their assignments in video format (d), and Fans posted their assignments in text format(e).**

***(2) Supportive Community in Group Chat.*** Group chats also served as a means to build a supportive learning community. Streamers regularly posted daily learning tasks, which focused on practicing essential literacy skills in writing, typing, and speaking. Fans were encouraged to participate by submitting assignments and showcasing their learning outcomes. They could submit their assignments in different formats, including videos(see figure 3(d)), voice messages, or written text(see figure 3(e)). Streamers also reviewed the assignments, checked the learning outcomes, and provided feedback in the group chat(see figure 3(c)).

Furthermore, streamers also encouraged interaction and support among fans, since the nature of fan groups fostered a sense of peer support. S7 highlighted this collaborative learning environment, saying, *"I'm delighted to see my fans engaging in mutual communication in the fan group, as it encourages them to persist in learning"*. Viewers also found community support and friendship through their engagement with other fans in the group chat. V1 elaborated, *"I've met people around my age in the fan group, we encourage each other, and I even share my daily life with them"*. Similar to knowledge-sharing livestreams, some viewers voluntarily took on a teaching assistant role within the group, correcting peers' mistakes and aiding others in their learning. V10 mentioned, *"Sometimes, I notice errors in others assignments and point them out. as it makes me happy to use my knowledge to benefit others in their learning"*. The fan community thus provided social and emotional support that complemented the educational content, keeping viewers engaged and motivated in their literacy development.

## 4.3 Challenges and Coping Strategies (RQ3)

We identified three types of challenges in utilizing livestreaming for adult literacy education from the perspectives of both streamers and viewers, along with the strategies they employed to address these challenges. Challenges are categorized into shared and unique challenges. **Shared challenges** are those that affected both streamers and viewers similarly, impacting their experiences and practices with livestreaming. **Unique challenges**, on the other hand, referred to specific problems faced by either streamers or viewers.

*4.3.1 Shared Challenges.* In this section, we focus on the challenges shared by both streamers and viewers. These challenges include **lack of qualification validation**, **the constraints of learning and teaching via livestreaming**, and issues of **misunderstandings and intentional trolling**.

***(1) Lack of Qualification Validation.*** Although all our interviewed streamers mentioned their previous experience as professional teachers, both streamers and viewers reported encountering unprofessionalism in livestream teaching, witnessing some streamers providing inadequate literacy skills, such as incorrect pronunciation or writing guidance. Streamers were concerned that unprofessional individuals teaching adult literacy could mislead viewers, potentially harming their ability to acquire accurate literacy knowledge and skills, e.g., *"I've observed streamers who teach Chinese characters with incorrect strokes, it can lead to incorrect writing habits and hinder their learning ability"* (S5).

This amateurism led to decreased learner trust, underscoring the need for validating teaching content. Viewers also reported losing trust in unprofessional and irresponsible teachers. V9 recalled, *"Once during a livestream, I encountered a streamer who didn't correct a viewer's mistake. Although all of us viewers noticed the error, the teacher seemed oblivious"*. Trust was a crucial factor in viewers' willingness to follow and learn from a streamer because they relied on the teacher's expertise and commitment to quality education. When this trust was compromised, it significantly affected their motivation and engagement in the learning process.

***(2) Constraints of Learning and Teaching via Livestreaming.*** Viewers may miss portions of the session due to time constraints, making it challenging to participate in real time. To accommodate this, some streamers posted short videos. These curated short videos typically ranged from a few seconds to a minute in length, and due to their format, they could be widely shared on social media. The content of these curated videos was often highly condensed with literacy knowledge and focused on Chinese characters used in daily life. As V5 stated, *"As an adult with many responsibilities, I can't always catch livestreams. These short videos are a great way for me to keep up with the lessons I miss"*. This approach allowed viewers to learn at their own pace and on their own schedule.

Moreover, streamers faced attentional resource constraints when teaching through livestreaming. They must frequently interact with learners to ensure their engagement during the livestream. However, this could interrupt lesson flow, as streamers must simultaneously teach while reading real-time comments on the screen. S4 shared, *"I try not to miss any comments, as I need to correct any mistakes made by learners. However, excessive comments can slow the lesson and require me to extend the livestreaming duration"*.

***(3) Misunderstandings and Intentional Trolling.*** While literacy education content is generally well-received on public livestreaming platforms, some streamers and viewers encountered negative experiences due to misunderstandings, discouraging streamers and affecting viewers' learning experience. As the teaching content was tailored for illiterate users, it often progressed slowly, leading some literate viewers to question its validity. S11 shared, *"Once, a viewer commented during a livestreaming, saying, 'You're too verbose, teaching basic phonetics for so long is not real teaching'"*. Frequent

interactions, such as live calls, with strangers in the livestreaming also increased the risk of malicious behavior, making it difficult to control. V9 recalled, *"For a while, there were always people who joined the live call to curse. Even after being blocked by the steamer, they kept coming back, severely disrupting the class"*.

*4.3.2 Unique Challenges for Streamers.* In addition to the shared challenges, streamers and viewers individually face many unique challenges. For streamers, unique challenges include navigating the distinct approaches required for **teaching adults and children**, **determining the difficulty of instructional content**, **fragmented technology eco-system**, and **internet traffic-limiting**.

***(1) Teaching Adults vs. Children.*** Many streamers developed teaching strategies for adult learners, recognizing the importance of understanding the differences between adult and child pedagogy. For example, adults did not necessarily need to have a comprehensive understanding of certain Chinese characters, such as complex or rare characters found in classical literature. Instead, their immediate priority was to quickly learn to recognize and type commonly used characters, such as those found on street signs, in hospitals, or in everyday conversation, to meet their practical needs. For example, S9 encouraged her students to use abbreviations when typing and sending comments in the livestream, *"I don't teach them as strictly as I would children. Adults learn Chinese characters not for passing exams, but for daily life. They may not be able to write characters exactly yet, but being able to type is a great way to communicate with others"*. Some streamers also designed their own unique instructional content that was more relevant to adult learners' life experiences. For example, S1 prepared specific teaching content close to adult life, such as bus stop signs and vocabulary words that appear in hospitals. This approach made the learning experience more engaging and relevant for adult learners. As S1 said, *"This allows them to learn and apply the knowledge in real-life situations"*.

***(2) Determining Difficulty of Instructional Content.*** Streamers face the challenge of striking a balance between repetitive and progressive teaching methods to cater to the diverse skill levels of their audience. One common strategy is teaching repetitively, for example, pinyin was taught in a specific sequence and then revisited from the beginning. As explained by P3, *"For the most basic pinyin knowledge, I repeat it several times so the audience can grasp it. This approach allows both familiar members of the audience to review the material and new audience to learn and participate"*.

Other streamers, such as S6, adopted a different approach to progressive teaching by arranging their livestreaming schedule to accommodate different levels of difficulty. She explained, *"My livestream is divided into morning and afternoon sessions. In the morning session, I primarily focus on teaching the fundamentals of pinyin. In the afternoon session, I guided them through practicing advanced spelling and writing Chinese characters. Audiences can choose to participate in different sessions of my livestream sessions based on their learning level"*.

***(3) Fragmented Technology Eco-System.*** To meet the diverse and personalized needs of adult learners, these streamers utilized various media and platforms, such as creating short videos, using WeChat, and live streaming platforms, to provide effective instructions. The technological landscape related to livestreaming adult literacy activities was diverse and intricate, managing multiple technological tools and platforms could be time-consuming for adult literacy teachers. For example, they needed to put extra effort into creating and publishing content through short videos to engage fans and archive knowledge for fan review. Utilizing technologies like WeChat for communication and documenting the learning process could enhance learning efficiency, but it also placed additional demands on the teacher's physical and cognitive abilities.

Furthermore, adult literacy education practices often involve catering to different learners' needs through personalized instruction within the fan group. Adult literacy streamers regularly reviewed and provided tailored feedback on assignments submitted by their fans. As S12 explained, *"I know many teachers used to teach adult literacy via livestreaming, but they eventually quit due to the overwhelming workload of grading assignments"*.

***(4) Internet Traffic-limiting.*** Some streamers mentioned a decline in their audience and struggled to attract new followers for a long time. Streamers believe that platforms promote active streams that generate high revenue through virtual gifts and product sales, from which they could earn a commission or gain more popularity. However, adult literacy livestreams differed from highly entertaining and interactive livestreams that are currently popular on platforms, streamers were less likely to engage in such behaviors, as they believed it would interfere with the teaching progress, and adult literacy content is not as entertaining as other types of livestreaming. As a result, their livestreams may appear less active in terms of commercial value compared to other types of livestreams. S6 elaborated, *"If the platform does not recognize your livestreaming room as a 'promising' one, the platform will not promote new fans to you"*.

Limiting internet traffic may discourage illiterate individuals from accessing adult literacy livestreams. Streamers expressed their desire for attention, recognition, and support from platforms, organizations, and governments to encourage more illiterate people to participate in their livestreams. By promoting these livestreams with platform exposure, not only would the illiterate individuals learn about these resources but also their family and friends, potentially encouraging others to start learning literacy skills as well.

*4.3.3 Unique Challenges for Viewers.* The biggest challenges for viewers in online learning were **balancing self-exposure**, **complex interactions**, and **the learning curve for seniors**.

***(1) Self-exposure of Learning Online.*** Many viewers struggled with feelings of embarrassment or shame over their literacy challenges, which was worsened by the pressure of real-time interactions in livestreams. For some, the psychological burden led to hesitancy in actively participating. V5 shared, *At first, I was too afraid to join the live call. I already stuttered when reading alone, let alone speaking with the streamer in front of so many viewers. I was terrified of making a mistake"*. However, as viewers became more familiar and comfortable with the material through repeated exposure, and some streamers worked hard to cultivate a supportive, non-judgmental environment, viewers' confidence started to grow.

For instance, despite fans occasionally stuttering or making errors during live calls, lengthening the session, streamers addressed concerns with patience and encouragement. S2 explained, *"While*

*it impacts the efficiency of the livestreaming, I never blame viewers. Some may misread or stumble due to nerves or skill level, but I consistently encouraged them"*. V6 appreciated how streamer fostered participation, saying, *"They always urged us to join the calls, noting he wouldn't know where we struggled unless we tried. Over time I felt more comfortable voluntarily joining live calls to practice"*.

***(2) Complicated Interaction Features.*** Most livestreaming platforms were designed for audiences with a certain level of literacy. Even though the use of livestreaming platform was relatively simple compared to other text-based platforms, viewers still faced some challenges. Challenges encountered when posting audio and text comments, joining the live call, or following streamers on the platform, could only be solved through self-exploration and hints from streamers. V10 mentioned, *At first, I didn't know how to do anything during the livestreams, I could only watch them. Later, the streamer slowly taught us step-by-step how to leave comments and join live calls"*. V5 further added, *"It took me a long time just to get comfortable leaving a simple text comment"*.

In addition to basic interactive functions, some livestreaming platforms also featured more advanced tools that allowed viewers to engage through live polling, sending virtual gifts, and participating in interactive quizzes with the streamer. However, these supplementary features posed even greater difficulties for viewers with low literacy levels. V7 shared her experience, *"At first all the icons and buttons on the screen were very confusing. I didn't understand what 'liking' a comment meant or how to send gifts. It was frustrating not being able to fully interact"*. Gradually gaining familiarity with the interface through practice and the streamer's guidance was important. With continued support, viewers progressively expanded their technical skills along with their literacy development.

***(3) Senior Viewers' Learning Curves.*** The majority of viewers we interviewed were older adults who missed out on formal schooling during their younger years mainly due to financial hardships. Now in their senior stage of life with more free time after retiring from work, they have begun learning literacy. However, these senior viewers commonly faced steep learning curves. It took a considerable length of time for them to reach a basic level of familiarity with foundational concepts, such as the phonetic principles. V9 shared, *"When I first began using livestreams to learn, it was very difficult. I remember one early session focused on simple characters, but it took me two hours just to review and write them out"*.

To enhance learning outcomes, viewers repeatedly practiced and watched relevant content. For example, *"I kept replaying those short videos over and over. Sometimes my grandchildren would help me practice too. Eventually, I was able to understand the material"* (P10).

# 5 DISCUSSION

In this paper, we explored the motivations, practices, and challenges of adult literacy livestreaming. Additionally, we delved into broader educational activities beyond livestreaming, providing valuable insights into the distinctive pedagogical models of adult literacy education. We offer design implications to enhance the inclusivity of livestreaming platforms for education and promote more effective pedagogical interactions.

## 5.1 Design Implications for Facilitate Adult Literacy Education

*5.1.1 Design to Facilitate Adult Literacy Streamers' Communication with Viewers.* Streamers' strategic employment of interactive features on platforms had inadvertently aided in promoting adult literacy education. However, these interactive functions on live streaming platforms were primarily designed for gamers or entertainment enthusiasts and did not fully meet the needs of educational content creators [17]. Streamers needed to strike a balance between interacting with the audience (for example, responding to comments) and teaching. Some streamers noted that although they actively monitored and responded to live comments to ensure audience understanding, it became impractical when faced with a large volume of comments. Frequent interactions disrupted the class and negatively impacted the learning experience during the live stream. Previous research explored different methods to enhance online learning through collaborative annotations by students [23, 28, 31], yet limited attention has been given to real-time livestreaming, especially regarding the specific needs of individuals from diverse educational backgrounds, especially low-literate users.

In the context of livestreaming, we propose a feature that visualizes viewer commenting behavior, building on prior work [47]. This feature empowers streamers by providing them with keyword visualization, comment volume visualization, and the ability to view the most voted comments in real time. Keywords can be visually emphasized based on their frequency, with the most common words displayed in larger font sizes or different colors. Comment volume visualization will update dynamically as new comments are posted, forming a word cloud that gives streamers an immediate sense of which topics are engaging or confusing the audience. Through this approach, streamers can gain a rapid understanding of viewers' reactions during the stream, facilitating reflection on the effectiveness of their teaching strategies.

*5.1.2 Design for Personalized Interactive Features for Low-literate Viewers.* In our findings, livestreaming platforms(e.g., Douyin) have already lowered the technical literacy barrier compared to text-based platforms for low-literate users. However, they still posed certain challenges to user interaction. Complex interaction features on these platforms sometimes increased viewers' distraction and learning costs. Currently, these viewers primarily learned how to use these platforms through guidance from the streamers. This finding echoes previous observations that users with low literacy could easily record and edit videos on Douyin, thereby generating and sharing short video content [14]. Similarly, Chen et al. [14] found that adults with low literacy were able to navigate basic functions on Douyin independently. In this study, we also observed that people with lower technical literacy are actively using the same platforms, but they generally avoid overly complex features, preferring basic interactions like watching live videos. This suggests livestreaming platforms have great potential to lower technical barriers to literacy education if interface complexities can be reduced. In this study, we also observed that people with lower technical literacy are actively using the same platforms, but they generally avoid overly complex features.

Livestreaming platforms should develop accessibility features that allow viewers with different literacy skills to customize their

livestreaming interface, even allowing streamers to help them customize an interface that is easier to learn, retaining only certain essential functions. Currently, the interface of livestreaming platforms only supports two modes: clear screen (eliminating all function buttons on the page, leaving only the video) and full functionality, which lacks flexibility.

*5.1.3 Career Support for Adult Literacy Livestreamers.* Our findings show that streamers created curated supplementary teaching resources in the form of short videos, providing their fans with consistently updated content. However, current platforms' assistive tools tend to record entire livestreaming sessions, making it challenging for streamers to effectively utilize hours of video content. Prior work has proposed effective tools with automation techniques to provide easy access to online learning resources [54, 60, 77], primarily for use with pre-recorded videos. Future work could explore more techniques to help streamers optimize supplementary resource creation and reduce the need for re-recording. In line with prior work on creative livestream archive segmentation [26], we propose the development of an auto-generation tool that captures key knowledge points during live teaching sessions and generates condensed videos, addressing this challenge more efficiently.

Furthermore, unlike profit-driven streamers who prioritize virtual gifts or promote products for sale, adult literacy streamers focus primarily on knowledge sharing and interactive teaching. This aligns with the research of Zhang et al. [84], which highlights how commercialized streamers focused primarily on the monetization potential, overlooking liverstreaming's potential to foster community and reciprocal relationships. While most platforms tended to promote livestreaming rooms with high-income value and audience traffic [45], adult literacy livestreaming generated lower sales revenue, resulting in limited visibility [11]. To support these streamers and promote accessible education to a broader audience, platforms should consider metrics for engagement that include social impact and public welfare.

*5.1.4 Creating a Safe Teaching and Learning Environment.* Our research found that conducting literacy education on public platforms was susceptible to inadequate teaching qualifications and trolling. Platforms aiming to advance literacy should prioritize creating a supportive, non-judgmental environment for both streamers and learners. Additional moderation and verification measures could help address these issues. For example, streaming room entrances could prominently display customized tags indicating the introductory and educational nature of the content to prevent unintentional misunderstandings and online harassment. Furthermore, streamers could also go through an application and review process to verify their teaching credentials and curriculum relevance before being approved to broadcast literacy content. Clear community guidelines should warn viewers about respecting the learning space, in which violators may face temporary bans.

## 5.2 Using Livestreaming Platforms for Adult literacy Education: Why and How

*5.2.1 Improving Educational Livestreaming Diversity and Accessibility.* Within the framework of adult lifelong learning, literacy is widely recognized as a fundamental skill necessary for full engagement in society [34]. However, significant disparities persist in the field of adult lifelong learning, particularly concerning the accessibility of diversity education content [8]. Our research findings indicate that livestreaming can serve as a valuable tool in adult literacy education, addressing the limitations of traditional educational approaches. Therefore, it is crucial to acknowledge the barriers underrepresented educational practitioners face in the livestreaming community and strive to enhance diversity and inclusivity.

Within this unique online learning ecosystem of livestreaming, the roles of *teachers* and *students* take precedence over the roles of *streamers* and *fans*. As viewers continued to engage with the livestreams, join fan groups, and interact with the live streamer and other low-literate adults, a sense of community reduced dropout rates among adult learners. As livestreaming's global popularity continues to grow, we envision a future in which educational practitioners from various disciplines can share their knowledge through livestreaming, enabling lifelong learning for adults and extending to marginalized individuals. Establishing inclusive learning environments within the livestreaming community has the potential to substantially advance global education equality.

*5.2.2 Promoting Adult Literacy Education Access through Multifaceted Approaches.* Our findings revealed the distinct characteristics of adult literacy teaching. First, the streamers dedicated to teaching adult literacy tailored their approach to the age and learning requirements of the target audience. These approaches are focused on the rapid acquisition of practical literacy skills, such as typing, and enhance social experiences by teaching commonly used Chinese characters. Second, given the real-time nature of livestreaming, these streamers chose to teach repetitively, ensuring accessibility and knowledge dissemination to viewers of all proficiency levels. Even when gradually increasing the difficulty of their lessons, streamers prioritize ensuring that learners had a strong and comprehensive understanding.

Despite these efforts, achieving consistent learning outcomes for all learners remained a challenge in distance education [10]. Consequently, governments and non-profit organizations should increase support and incentives for adult literacy practitioners. Recognizing literacy livestreams as an essential solution to overcome the limitations of traditional adult literacy education, such as limited resources and motivational barriers [34], is essential. While extending assistance to these streamers, it is important to foster a collaborative ecosystem that involves local communities and governments.

## 5.3 Limitations and Future Work

While our study offers valuable insights, it is important to acknowledge its limitations. The observations were conducted over a relatively short span of seven days, potentially limiting our ability to fully understand the diverse behaviors and practices of streamers over longer periods. Additionally, the scope of streaming platforms in our study was confined to Douyin and Kuaishou. This limitation meant that some of our findings and design recommendations may not be fully applicable to users of other livestreaming platforms, which could have distinct norms or technical features.

Nevertheless, our analysis reached a point of saturation, providing comprehensive and representative results that reflect the

experiences and perspectives of the streamers and viewers we interviewed and observed. To build upon this research, future studies should strive for larger and more varied interview samples for various cultural backgrounds. By acknowledging these limitations and building on our research methodology, future studies can further enhance the understanding and improvement of adult basic education practices in livestreaming contexts.

## 6 CONCLUSION

Our comprehensive exploration of adult literacy education via livestreaming provides key insights into the motivations, practices, and challenges faced by both streamers and viewers. Challenges that emerged in this context are platform-related obstacles and the diverse demographics of viewers seeking literacy education. However, our findings underscore the ingenuity of adult literacy streamers, who employed resourceful strategies within these constraints to effectively promote literacy education, thus benefiting underserved populations. Furthermore, the online educational ecosystem crafted by these streamers served as an inspirational model for promoting literacy education and fostering lifelong learning among adults in diverse regions and countries. As we continue to harness the capabilities of technology and innovative educational methods, we can work collectively towards a future where literacy and lifelong learning become accessible to all.

## ACKNOWLEDGMENTS

We thank our reviewers for their constructive feedback and all our participants for their involvement and dedication. This work is partially supported by 1) 2024 Guangzhou Science and Technology Program City-University Joint Funding Project (PI: Mingming Fan); 2) 2023 Guangzhou Science and Technology Program City-University Joint Funding Project (Project No. 2023A03J0001) ; 3) Guangdong Provincial Key Lab of Integrated Communication, Sensing and Computation for Ubiquitous Internet of Things (No.2023B1212010007).

## REFERENCES

[1] Helen Abadzi. 1994. *What we know about acquisition of adult literacy: is there hope?* Vol. 245. World Bank Publications.

[2] Helen Abadzi. 2003. *Teaching adults to read better and faster: Results from an experiment in Burkina Faso.* Vol. 3057. World Bank Publications.

[3] Pamela Abbott, Roger Mugisha, Peter Mtika, and Wenceslas Nzabalirwa. 2020. Failing adult learners: Why Rwanda's adult literacy education is not delivering. *International Journal of Educational Development* 79 (2020), 102288. https://doi.org/10.1016/j.ijedudev.2020.102288

[4] Nurain Adila Abdul Samat, Harwati Hashim, and Melor Md Yunus. 2019. Live streaming: a new platform for ESL learning. *Creative Education* 10, 12 (2019), 2899–2906. https://doi.org/10.4236/ce.2019.1012215

[5] Robert F Arnove and Harvey J Graff. 1987. *National literacy campaigns: Historical and comparative perspectives.* Springer Science & Business Media.

[6] UN General Assembly et al. 1948. Universal declaration of human rights. *UN General Assembly* 302, 2 (1948), 14–25.

[7] Harbans S Bhola. 1984. *Campaigning for Literacy: Eight National Experiences of the Twentieth Century, with a Memorandum to Decision-Makers.* ERIC.

[8] Ellen Boeren. 2017. Understanding adult lifelong learning participation as a layered problem. *Studies in Continuing Education* 39, 2 (2017), 161–175. https://doi.org/10.1080/0158037X.2017.1310096 arXiv:https://doi.org/10.1080/0158037X.2017.1310096

[9] Bob Boughton. 2016. *Popular Education and Mass Literacy Campaigns.* SensePublishers, Rotterdam, 149–164. https://doi.org/10.1007/978-94-6300-444-2_10

[10] Rovy Branon and Christopher Essex. 2001. Synchronous and Asynchronous Communication Tools in Distance Education. *TechTrends: Linking Research and Practice to Improve Learning* 45, 1 (2001). https://www.learntechlib.org/p/90312

[11] Beiyan Cao, Changyang He, Muzhi Zhou, and Mingming Fan. 2023. Sparkling Silence: Practices and Challenges of Livestreaming Among Deaf or Hard of Hearing Streamers. In *Proceedings of the 2023 CHI Conference on Human Factors in Computing Systems* (Hamburg, Germany) *(CHI '23)*. Association for Computing Machinery, New York, NY, USA, Article 58, 15 pages. https://doi.org/10.1145/3544548.3581053

[12] Ian Cheffy, Juliet McCaffery, and Brian Street. 2016. Promoting Literacy from the UK: The Contribution of the British Association for Literacy in Development (BALID). *Prospects* 46 (2016), 507–512. Issue 4. https://doi.org/10.1007/s11125-017-9402-0

[13] Di (Laura) Chen, Dustin Freeman, and Ravin Balakrishnan. 2019. Integrating Multimedia Tools to Enrich Interactions in Live Streaming for Language Learning. In *Proceedings of the 2019 CHI Conference on Human Factors in Computing Systems* (Glasgow, Scotland Uk) *(CHI '19)*. Association for Computing Machinery, New York, NY, USA, 1–14. https://doi.org/10.1145/3290605.3300668

[14] Si Chen, Xinyue Chen, Zhicong Lu, and Yun Huang. 2023. "My Culture, My People, My Hometown": Chinese Ethnic Minorities Seeking Cultural Sustainability by Video Blogging. *Proc. ACM Hum.-Comput. Interact.* 7, CSCW1, Article 76 (apr 2023), 30 pages. https://doi.org/10.1145/3579509

[15] Xueer Chen. 2023. Adult literacy policy and practice in post-1949 China: A historical perspective. *Studies in the Education of Adults* 55, 1 (2023), 120–137. https://doi.org/10.1080/02660830.2022.2076312 arXiv:https://doi.org/10.1080/02660830.2022.2076312

[16] Xinyue Chen, Si Chen, Xu Wang, and Yun Huang. 2021. "I Was Afraid, but Now I Enjoy Being a Streamer!": Understanding the Challenges and Prospects of Using Live Streaming for Online Education. *Proc. ACM Hum.-Comput. Interact.* 4, CSCW3, Article 237 (jan 2021), 32 pages. https://doi.org/10.1145/3432936

[17] Yan Chen, Walter S. Lasecki, and Tao Dong. 2021. Towards Supporting Programming Education at Scale via Live Streaming. *Proc. ACM Hum.-Comput. Interact.* 4, CSCW3, Article 259 (jan 2021), 19 pages. https://doi.org/10.1145/3434168

[18] Zhilong Chen, Hancheng Cao, Yuting Deng, Xuan Gao, Jinghua Piao, Fengli Xu, Yu Zhang, and Yong Li. 2021. Learning from Home: A Mixed-Methods Analysis of Live Streaming Based Remote Education Experience in Chinese Colleges during the COVID-19 Pandemic. In *Proceedings of the 2021 CHI Conference on Human Factors in Computing Systems* (Yokohama, Japan) *(CHI '21)*. Association for Computing Machinery, New York, NY, USA, Article 348, 16 pages. https://doi.org/10.1145/3411764.3445428

[19] Christopher Colclough, Sarah Packer, and Anna Motivans. 2005. *Education for All: The Quality Imperative.* UNESCO Publishing, Paris.

[20] Juliet Corbin and Anselm Strauss. 2014. *Basics of Qualitative Research: Techniques and Procedures for Developing Grounded Theory.* Sage publications.

[21] Sebastien Cuendet, Indrani Medhi, Kalika Bali, and Edward Cutrell. 2013. VideoKheti: Making Video Content Accessible to Low-Literate and Novice Users. In *Proceedings of the SIGCHI Conference on Human Factors in Computing Systems* (Paris, France) *(CHI '13)*. Association for Computing Machinery, New York, NY, USA, 2833–2842. https://doi.org/10.1145/2470654.2481392

[22] Kristin Dew, Muna Haddadin, Carin Fishel, and Apurva Dawale. 2013. Karaoke: An Assistive Alternative Interface for Illiterate Users. In *CHI '13 Extended Abstracts on Human Factors in Computing Systems* (Paris, France) *(CHI EA '13)*. Association for Computing Machinery, New York, NY, USA, 25–30. https://doi.org/10.1145/2468356.2468362

[23] Brian Dorn, Larissa B. Schroeder, and Adam Stankiewicz. 2015. Piloting TrACE: Exploring Spatiotemporal Anchored Collaboration in Asynchronous Learning. In *Proceedings of the 18th ACM Conference on Computer Supported Cooperative Work & Social Computing* (Vancouver, BC, Canada) *(CSCW '15)*. Association for Computing Machinery, New York, NY, USA, 393–403. https://doi.org/10.1145/2675133.2675178

[24] Douyin. 2020. 2019 Douyin Data Report. https://lmtw.com/mzw/content/detail/id/180878. Accessed January 6, 2020.

[25] Travis Faas, Lynn Dombrowski, Alyson Young, and Andrew D. Miller. 2018. Watch Me Code: Programming Mentorship Communities on Twitch.Tv. *Proc. ACM Hum.-Comput. Interact.* 2, CSCW, Article 50 (nov 2018), 18 pages. https://doi.org/10.1145/3274319

[26] C. Ailie Fraser, Joy O. Kim, Hijung Valentina Shin, Joel Brandt, and Mira Dontcheva. 2020. Temporal Segmentation of Creative Live Streams. In *Proceedings of the 2020 CHI Conference on Human Factors in Computing Systems* (Honolulu, HI, USA) *(CHI '20)*. Association for Computing Machinery, New York, NY, USA, 1–12. https://doi.org/10.1145/3313831.3376437

[27] Elsa Friscira, Hendrik Knoche, and Jeffrey Huang. 2012. Getting in Touch with Text: Designing a Mobile Phone Application for Illiterate Users to Harness SMS. In *Proceedings of the 2nd ACM Symposium on Computing for Development* (Atlanta, Georgia) *(ACM DEV '12)*. Association for Computing Machinery, New York, NY, USA, Article 5, 10 pages. https://doi.org/10.1145/2160601.2160608

[28] Elena L. Glassman, Juho Kim, Andrés Monroy-Hernández, and Meredith Ringel Morris. 2015. Mudslide: A Spatially Anchored Census of Student Confusion for Online Lecture Videos. In *Proceedings of the 33rd Annual ACM Conference on Human Factors in Computing Systems* (Seoul, Republic of Korea) *(CHI '15)*. Association for Computing Machinery, New York, NY, USA, 1555–1564. https://doi.org/10.1145/2702123.2702304

[29] Lassi Haaranen. 2017. Programming as a Performance: Live-Streaming and Its Implications for Computer Science Education. In *Proceedings of the 2017 ACM Conference on Innovation and Technology in Computer Science Education* (Bologna, Italy) *(ITiCSE '17)*. Association for Computing Machinery, New York, NY, USA, 353–358. https://doi.org/10.1145/3059009.3059035

[30] William A. Hamilton, Oliver Garretson, and Andruid Kerne. 2014. Streaming on Twitch: Fostering Participatory Communities of Play within Live Mixed Media. In *Proceedings of the SIGCHI Conference on Human Factors in Computing Systems* (Toronto, Ontario, Canada) *(CHI '14)*. Association for Computing Machinery, New York, NY, USA, 1315–1324. https://doi.org/10.1145/2556288.2557048

[31] William A. Hamilton, Nic Lupfer, Nicolas Botello, Tyler Tesch, Alex Stacy, Jeremy Merrill, Blake Williford, Frank R. Bentley, and Andruid Kerne. 2018. Collaborative Live Media Curation: Shared Context for Participation in Online Learning. In *Proceedings of the 2018 CHI Conference on Human Factors in Computing Systems* (Montreal QC, Canada) *(CHI '18)*. Association for Computing Machinery, New York, NY, USA, 1–14. https://doi.org/10.1145/3173574.3174129

[32] Ulrike Hanemann. 2014. *Evolution of literacy campaigns and programmes and their impact since 2000.* Background paper for the EFA Global Monitoring Report 2015. UNESCO, Paris. http://unesdoc.unesco.org/images/0023/002323/232398e.pdf

[33] U. Hanemann (Ed.). 2014. *Harnessing the potential of ICTs for literacy teaching and learning: Effective literacy and numeracy programmes using radio, TV, mobile phones, tablets and computers.* UIL, Hamburg. http://unesdoc.unesco.org/images/0022/002295/229517E.pdf

[34] Ulrike Hanemann. 2015. Lifelong literacy: Some trends and issues in conceptualising and operationalising literacy from a lifelong learning perspective. *International Review of Education* 61, 3 (2015), 295–326. https://doi.org/10.1007/s11159-015-9490-0

[35] R. Hartley and J. Horne. 2005. Social and economic benefits of improved adult literacy: Towards a better understanding.

[36] Jennifer Hill and Rahul Simha. 2016. Designing a Literacy-Based Mobile Application for Adult Learners. In *Proceedings of the 2016 CHI Conference Extended Abstracts on Human Factors in Computing Systems* (San Jose, California, USA) *(CHI EA '16)*. Association for Computing Machinery, New York, NY, USA, 3076–3083. https://doi.org/10.1145/2851581.2892397

[37] Matthew Paul Huenerfauth. 2002. Design approaches for developing user-interfaces accessible to illiterate users. *University College Dublin, Ireland* (2002), 23–32.

[38] Elizabeth B. Keefe and Susan R. Copeland. 2011. What is Literacy? The Power of a Definition. *Research and Practice for Persons with Severe Disabilities* 36, 3-4 (2011), 92–99. https://doi.org/10.2511/027494811800824507 arXiv:https://doi.org/10.2511/027494811800824507

[39] Sean Kross, Eszter Hargittai, and Elissa M. Redmiles. 2021. Characterizing the Online Learning Landscape: What and How People Learn Online. *Proc. ACM Hum.-Comput. Interact.* 5, CSCW1, Article 146 (apr 2021), 19 pages. https://doi.org/10.1145/3449220

[40] Kuaishou. 2019. 2019 Kuaishou Content Report. https://www.sohu.com/a/341556976_298418. Accessed September 17, 2019.

[41] Jie Li, Xinning Gui, Yubo Kou, and Yukun Li. 2019. Live Streaming as Co-Performance: Dynamics between Center and Periphery in Theatrical Engagement. *Proc. ACM Hum.-Comput. Interact.* 3, CSCW, Article 64 (nov 2019), 22 pages. https://doi.org/10.1145/3359166

[42] Yi Li, Chongli Wang, and Jing Liu. 2020. A Systematic Review of Literature on User Behavior in Video Game Live Streaming. *International Journal of Environmental Research and Public Health* 17, 9 (2020). https://doi.org/10.3390/ijerph17093328

[43] Quan Long and Alec C. Tefertiller. 2020. China's New Mania for Live Streaming: Gender Differences in Motives and Uses of Social Live Streaming Services. *International Journal of Human–Computer Interaction* 36, 14 (2020), 1314–1324. https://doi.org/10.1080/10447318.2020.1746060 arXiv:https://doi.org/10.1080/10447318.2020.1746060

[44] Suping Lu. 1996. A Study on the Chinese Romanization Standard in Libraries. *Cataloging & Classification Quarterly* 21, 1 (1996), 81–96. https://doi.org/10.1300/J104v21n01_06

[45] Zhicong Lu, Michelle Annett, Mingming Fan, and Daniel Wigdor. 2019. "I Feel It is My Responsibility to Stream": Streaming and Engaging with Intangible Cultural Heritage through Livestreaming. In *Proceedings of the 2019 CHI Conference on Human Factors in Computing Systems* (Glasgow, Scotland Uk) *(CHI '19)*. Association for Computing Machinery, New York, NY, USA, 1–14. https://doi.org/10.1145/3290605.3300459

[46] Zhicong Lu, Michelle Annett, and Daniel Wigdor. 2019. Vicariously Experiencing It All Without Going Outside: A Study of Outdoor Livestreaming in China. *Proc. ACM Hum.-Comput. Interact.* 3, CSCW, Article 25 (nov 2019), 28 pages. https://doi.org/10.1145/3359127

[47] Zhicong Lu, Seongkook Heo, and Daniel J. Wigdor. 2018. StreamWiki: Enabling Viewers of Knowledge Sharing Live Streams to Collaboratively Generate Archival Documentation for Effective In-Stream and Post Hoc Learning. *Proc. ACM Hum.-Comput. Interact.* 2, CSCW, Article 112 (nov 2018), 26 pages. https://doi.org/10.1145/3274381

[48] Zhicong Lu, Haijun Xia, Seongkook Heo, and Daniel Wigdor. 2018. You Watch, You Give, and You Engage: A Study of Live Streaming Practices in China. In *Proceedings of the 2018 CHI Conference on Human Factors in Computing Systems* (Montreal QC, Canada) *(CHI '18)*. Association for Computing Machinery, New York, NY, USA, 1–13. https://doi.org/10.1145/3173574.3174040

[49] Michael A. Madaio, Fabrice Tanoh, Axel Blahoua Seri, Kaja Jasinska, and Amy Ogan. 2019. "Everyone Brings Their Grain of Salt": Designing for Low-Literate Parental Engagement with a Mobile Literacy Technology in CôTe d'Ivoire. In *Proceedings of the 2019 CHI Conference on Human Factors in Computing Systems* (Glasgow, Scotland Uk) *(CHI '19)*. Association for Computing Machinery, New York, NY, USA, 1–15. https://doi.org/10.1145/3290605.3300695

[50] Michael A. Madaio, Evelyn Yarzebinski, Vikram Kamath, Benjamin D. Zinszer, Joelle Hannon-Cropp, Fabrice Tanoh, Yapo Hermann Akpe, Axel Blahoua Seri, Kaja K. Jasińska, and Amy Ogan. 2020. Collective Support and Independent Learning with a Voice-Based Literacy Technology in Rural Communities. In *Proceedings of the 2020 CHI Conference on Human Factors in Computing Systems* (Honolulu, HI, USA) *(CHI '20)*. Association for Computing Machinery, New York, NY, USA, 1–14. https://doi.org/10.1145/3313831.3376276

[51] Allan Martin and Jan Grudziecki. 2006. DigEuLit: Concepts and Tools for Digital Literacy Development. *Innovation in Teaching and Learning in Information and Computer Sciences* 5, 4 (2006), 249–267. https://doi.org/10.11120/ital.2006.05040249 arXiv:https://doi.org/10.11120/ital.2006.05040249

[52] R. Martínez and P. Fernández. 2010. The social and economic impact of illiteracy: Analytical model and pilot study. (2010). http://unesdoc.unesco.org/ark:/48223/pf0000190571_eng

[53] Devi Melisa, Pawito Pawito, and Yulius Slamet. 2020. The Use of YouTube Social Media to Educate Society through Virtual Literacy during COVID-19 Pandemic. https://api.semanticscholar.org/CorpusID:229497231

[54] Toni-Jan Keith Palma Monserrat, Shengdong Zhao, Kevin McGee, and Anshul Vikram Pandey. 2013. NoteVideo: Facilitating Navigation of Blackboard-Style Lecture Videos. In *Proceedings of the SIGCHI Conference on Human Factors in Computing Systems* (Paris, France) *(CHI '13)*. Association for Computing Machinery, New York, NY, USA, 1139–1148. https://doi.org/10.1145/2470654.2466147

[55] National Copyright Administration Network Copyright Industry Research Base. n. d.. China Internet Copyright Industry Development Report 2020.

[56] Prema Nedungadi, Kathryn Devenport, Rita Sutcliffe, and Raghu Raman. 2023. Towards a digital learning ecology to address the grand challenge in adult literacy. *Interactive Learning Environments* 31, 1 (2023), 383–396. https://doi.org/10.1080/10494820.2020.1789668 arXiv:https://doi.org/10.1080/10494820.2020.1789668

[57] National Bureau of Statistics of China. 2021. *China Statistical Yearbook - 2022 - Illiterate population aged 15 years and over, by sex, by subregion (2021).* Retrieved May 27, 2023 from http://www.stats.gov.cn/sj/ndsj/2022/indexch.htm

[58] Daniel Ortega and Francisco Rodríguez. 2008. Freed from Illiteracy? A Closer Look at Venezuela's Misión Robinson Literacy Campaign. *Economic Development and Cultural Change* 57, 1 (2008), 1–30. https://doi.org/10.1086/590461 arXiv:https://doi.org/10.1086/590461

[59] John Oxenham. 2002. Skills and Literacy Training for Better Livelihoods: A Review of Approaches and Experiences. http://hdl.handle.net/10986/9767

[60] Amy Pavel, Colorado Reed, Björn Hartmann, and Maneesh Agrawala. 2014. Video Digests: A Browsable, Skimmable Format for Informational Lecture Videos. In *Proceedings of the 27th Annual ACM Symposium on User Interface Software and Technology* (Honolulu, Hawaii, USA) *(UIST '14)*. Association for Computing Machinery, New York, NY, USA, 573–582. https://doi.org/10.1145/2642918.2647400

[61] Glen Peterson. 1997. *The Power of Words: literacy and revolution in South China, 1949-95.* Vol. 1. UBC Press.

[62] Esther Prins. 2008. Adult literacy education, gender equity and empowerment: Insights from a Freirean-inspired literacy programme. *Studies in the Education of Adults* 40, 1 (2008), 24–39. https://doi.org/10.1080/02660830.2008.11661554 arXiv:https://doi.org/10.1080/02660830.2008.11661554

[63] Anabel Quan-Haase. 2005. Trends in Online Learning Communities. *SIGGROUP Bull.* 25, 1 (jan 2005), 2–6. https://doi.org/10.1145/1067699.1067700

[64] Bruno Brochado Ribeiro, Debora Maurmo Modesto, and Simone Bacellar Leal Ferreira. 2015. Using Mediation Dialogs to Improve Navigation of Low Literate Users on the Web. In *Proceedings of the 14th Brazilian Symposium on Human Factors in Computing Systems* (Salvador, Brazil) *(IHC '15)*. Association for Computing Machinery, New York, NY, USA, Article 7, 10 pages. https://doi.org/10.1145/3148456.3148463

[65] Mark Richmond, Clinton Robinson, Margarete Sachs-Israel, and Education Sector. 2008. *The Global Literacy Challenge.* UNESCO, Paris. Retrieved August 23, 2008, 2011.

[66] RUCnews. 2022. *Can live-streaming literacy really save illiteracy?* Retrieved May 27, 2023 from https://www.huxiu.com/article/1291046.html

[67] Thomas Smith, Marianna Obrist, and Peter Wright. 2013. Live-Streaming Changes the (Video) Game. In *Proceedings of the 11th European Conference on Interactive TV and Video* (Como, Italy) *(EuroITV '13)*. Association for Computing Machinery, New York, NY, USA, 131–138. https://doi.org/10.1145/2465958.2465971

[68] Ningjing Tang, Lei Tao, Bo Wen, and Zhicong Lu. 2022. Dare to Dream, Dare to Livestream: How E-Commerce Livestreaming Empowers Chinese Rural Women.

In *Proceedings of the 2022 CHI Conference on Human Factors in Computing Systems* (New Orleans, LA, USA) *(CHI '22)*. Association for Computing Machinery, New York, NY, USA, Article 297, 13 pages. https://doi.org/10.1145/3491102.3517634

[69] Winnie Tang. 2022. *A 73-year-old grandmother who teaches adults to read and write is "hiding" the secrets of tens of thousands of adults in her live studio.* ChinaNews (China News Service). http://www.chinanews.com.cn/sh/2022/11-07/9888742.shtml

[70] Imane Taoufik, Hind Kabaili, and Driss Kettani. 2007. Designing an E-Government Portal Accessible to Illiterate Citizens. In *Proceedings of the 1st International Conference on Theory and Practice of Electronic Governance* (Macao, China) *(ICEGOV '07)*. Association for Computing Machinery, New York, NY, USA, 327–336. https://doi.org/10.1145/1328057.1328125

[71] UNESCO. 1975. Declaration of Persepolis. In *International Symposium for Literacy*. UNESCO, Persepolis.

[72] UNESCO. 2005. *EFA Global Monitoring Report 2006. Literacy for Life.* Technical Report. UNESCO.

[73] UNESCO. 2020. EXPLORE THEMES - EDUCATION & LITERACY - Literacy. http://uis.unesco.org/en/topic/literacy

[74] Daniel A. Wagner. 2011. What happened to literacy? Historical and conceptual perspectives on literacy in UNESCO. *International Journal of Educational Development* 31, 3 (2011), 319–323. https://doi.org/10.1016/j.ijedudev.2010.11.015

[75] Xindi Wang, Kesava Karthik Kota, Kolli Reddy, Denise Baran, and Nalin Bhatia. 2018. Litebox: Design for Adult Literacy. In *Extended Abstracts of the 2018 CHI Conference on Human Factors in Computing Systems* (Montreal QC, Canada) *(CHI EA '18)*. Association for Computing Machinery, New York, NY, USA, 1–6. https://doi.org/10.1145/3170427.3180654

[76] Willian Massami Watanabe, Arnaldo Candido Junior, Vinícius Rodriguez Uzêda, Renata Pontin de Mattos Fortes, Thiago Alexandre Salgueiro Pardo, and Sandra Maria Aluísio. 2009. Facilita: Reading Assistance for Low-Literacy Readers. In *Proceedings of the 27th ACM International Conference on Design of Communication* (Bloomington, Indiana, USA) *(SIGDOC '09)*. Association for Computing Machinery, New York, NY, USA, 29–36. https://doi.org/10.1145/1621995.1622002

[77] Sarah Weir, Juho Kim, Krzysztof Z. Gajos, and Robert C. Miller. 2015. Learnersourcing Subgoal Labels for How-to Videos. In *Proceedings of the 18th ACM Conference on Computer Supported Cooperative Work & Social Computing* (Vancouver, BC, Canada) *(CSCW '15)*. Association for Computing Machinery, New York, NY, USA, 405–416. https://doi.org/10.1145/2675133.2675219

[78] Weina Wen. 2022. *73-year-old teaches adults to read and write live, CYC: illiterate group shouldn't be ignored.* Beijing Youth Daily. https://m.thepaper.cn/baijiahao_20656273

[79] Charl C. Wolhuter and Nicola Barbieri. 2017. Is the Ideal of Universal Adult Literacy in the World by the Year 2030 Statistically Attainable? *Rivista internazionale di scienze sociali* 1 (2017), 87–102. https://doi.org/10.1400/250416

[80] World Population Review. 2020. Literacy Rate by Country 2020. Online. https://worldpopulationreview.com/country-rankings/literacy-rate-by-country

[81] Qunfang Wu, Yisi Sang, Dakuo Wang, and Zhicong Lu. 2023. Malicious Selling Strategies in Livestream E-Commerce: A Case Study of Alibaba's Taobao and ByteDance's TikTok. *ACM Trans. Comput.-Hum. Interact.* 30, 3, Article 35 (jun 2023), 29 pages. https://doi.org/10.1145/3577199

[82] H. Xia. 2005. Thoughts on speeding up literacy education for women in China. *Theory and Reform* 2 (2005), 123–125. In Chinese.

[83] Yi Xu and Yixin Ye. 2020. Who Watches Live Streaming in China? Examining Viewers' Behaviors, Personality Traits, and Motivations. *Frontiers in Psychology* 11 (2020). https://doi.org/10.3389/fpsyg.2020.01607

[84] Xiaoxing Zhang, Yu Xiang, and Lei Hao. 2019. Virtual gifting on China's live streaming platforms: hijacking the online gift economy. *Chinese Journal of Communication* 12, 3 (2019), 340–355. https://doi.org/10.1080/17544750.2019.1583260 arXiv:https://doi.org/10.1080/17544750.2019.1583260