A Literature Review of Video-Sharing Platform Research in HCI

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ABSTRACT

Video-sharing platforms (VSPs) such as YouTube, TikTok, and Twitch have grown rapidly in recent years and attracted millions of users. Research topics such as online communities, video interactions, and recommendation algorithms have drawn increasing attention. Group and community dynamics were also examined with live streaming and short-form videos. However, HCI literature lacks a holistic picture of video-sharing research themes, methods, and findings that summarizes the diverse topics on interaction modalities and communities. Prior reviews on VSPs were about a particular platform or reviewed as a part of social media. This paper contributes a scoping review of 106 articles on video-sharing published in HCI literature from 2012 to June 2022. We identified six research themes through grounded theory analysis and encoded five HCI research methods in VSP studies. We concluded a framework with five components to structure findings in video-sharing research, with which we reflect on future directions on this topic.

CCS CONCEPTS

• **Human-centered computing → HCI theory, concepts and models**; **Social media**.

KEYWORDS

literature review, video, video-sharing, YouTube, TikTok, Twitch

ACM Reference Format:
Ava Bartolome and Shuo Niu. 2023. A Literature Review of Video-Sharing Platform Research in HCI. In *Proceedings of the 2023 CHI Conference on Human Factors in Computing Systems (CHI '23), April 23–28, 2023, Hamburg, Germany.* ACM, New York, NY, USA, 20 pages. https://doi.org/10.1145/3544548.3581107

1 INTRODUCTION

The number of social media users was estimated to be 4.59 billion in 2022 [47]. Video-based social media sites – otherwise known as video-sharing platforms (VSPs) – have reached new heights in popularity. YouTube, TikTok, and Twitch have millions of users and billions of watch hours. Video traffic will be 82% of all internet traffic by 2022, up from 73% in 2017 [8]. YouTube is the second-biggest social media platform worldwide, following Facebook [46]. In the US, YouTube rose above Facebook in 2018 as the platform with the largest user base [145]. As VSPs have grown in popularity among social media users, they have also drawn the attention of researchers from various disciplines. There is also an increasing concentration on video-sharing interaction and community phenomena in Human-Computer Interaction (HCI) and Computer-Supported Cooperative Work and Social Computing (CSCW).

While there are many literature reviews on research about social media [78, 165, 173], VSPs are a distinct form of social media. VSPs contrast with other blogging, networking, and forum social media in that VSPs are "content communities," where contributing new videos and establishing communities are central to platform culture [25, 77, 189]. Despite the emergence of HCI literature studying platforms like YouTube, TikTok, and Twitch, there does not yet exist a comprehensive overview of the core research topics, analysis methods, and VSP components in video-sharing studies. We aim to fill this gap by conducting a scoping review of video-sharing in HCI literature. Prior studies referred to YouTube, TikTok, and Twitch as "video-sharing platforms" or "live-streaming platforms." In this review, based on the four properties of social media [136], we summarize VSP papers in HCI and define *"video-sharing platforms (VSPs)"* by their four common characteristics:

- From the *content* perspective, VSPs enable users to broadcast user-generated videos as the primary media type to the public through video uploading or live streaming.
- From the *user* perspective, video creators and streamers share personally meaningful videos to engage other users, with some becoming micro-celebrities through professionalization, who may obtain monetary income through revenue-sharing, affiliate marketing, or gifting.
- From the *social* perspective, VSPs offer various creator-viewer interaction features around videos, such as liking, favoriting, sharing, subscribing, commenting, chatting, and making donations, which lead to the formation of virtual communities.
- From the *service* perspective, besides displaying and streaming videos, VSPs employ video ranking, recommendation, and personalization algorithms to improve video delivery services and experiences.

Van Dijck noted that the early structure of YouTube contrasted other social media, as it cultivated a virtual space for amateur user-generated videos [189]. The novelty of VSPs lies in that they introduce streamed content and user-uploaded videos while allowing social networking [189]. VSP users generate stickiness because of the ability to create videos and contribute values [40]. Social activities on VSPs contrast networking platforms in that social interaction such as commenting, liking, and favoriting revolve around videos rather than offline relationships [19, 67]. Compared to Facebook and Twitter, user profiling and peer-to-peer connections are less central to VSPs [25, 77, 189]. VSPs support self-branding and celebrification, encouraging users to professionalize their content,

CHI '23, April 23–28, 2023, Hamburg, Germany

ACM ISBN 978-1-4503-9421-5/23/04…$15.00
https://doi.org/10.1145/3544548.3581107

form virtual communities, and become micro-celebrities on the platform [81, 119]. Another difference between VSPs and blogging, networking, and forum sites is that VSPs reward video creators by sharing revenue, enabling them to leverage video creation and brand endorsements to gain income [58, 68, 120]. From the service perspective, like Facebook and Twitter [43], video experiences are greatly influenced by the ranking, filtering, and recommendation algorithms [2, 35, 205]. But the algorithm-augmented video feeds differentiate VSPs from video-conferencing platforms such as Zoom and Microsoft Teams. By our definition of VSPs, we focus on reviewing papers on YouTube, Tiktok, and Twitch. We also include articles studying video sharing on other platforms such as Facebook, Instagram, Periscope, Bilibili, etc.

Based on the four VSP characteristics, we reviewed 106 papers studying video-sharing across the top HCI conferences and journals. We used twenty more papers from the other five venues to validate our findings. Our scoping review applies a rigorously grounded theory method [203] and provides an initial indication of the extant literature. In addition to summarizing the major themes and findings, we encoded research methods and illustrated their applications across different research topics. Last, we synthesized the papers' findings and framed our summary around the core components of VSPs. In sum, this review addresses three research questions:

(1) RQ1: What are the common research themes in video-sharing HCI literature?
(2) RQ2: What methods are used to research video-sharing techniques and platforms?
(3) RQ3: What is the extent and nature of findings in video-sharing HCI literature?

We identified six core video-sharing research themes: (1) Online Communities and Internet Sub-cultures; (2) Social Participation and Relationships; (3) New Video Interaction Systems and Techniques; (4) Interaction with VSPs; (5) Videos as a Design Material; and (6) Videos as a Machine Learning Dataset. The most commonly used methods were qualitative observation, interview, survey, big data analysis, and user study and evaluation. Last, to illustrate the main findings in video-sharing HCI literature, we constructed a framework that positions the research around five major components: creator, viewer, video, community, and platform. Based on the VSP components, we summarize the future work suggested by HCI researchers and discuss future research directions.

2 BACKGROUND

2.1 Social Media Research and Literature Reviews

Social media such as Facebook, YouTube, WhatsApp, Instagram, TikTok, and Twitter are online platforms that facilitate connection, creation, and information sharing. The definition of "social media" has evolved over time with the emergence of new platforms [77]. Obar and Wildman synthesized definitions of social media from literature and conceptualized the *service*, *content*, *user*, and *social* features of social media[136]: (1) Social media services are internet-based applications; (2) User-generated content is the lifeblood; (3) Individuals and groups create user-specific profiles for a site or app; (4) Social media services facilitate the development of social networks online by connecting a profile with those of other individuals or groups. Although these features describe aspects of video-sharing platforms, researchers have considered VSPs to be categorically different from "social networking sites", instead calling them "content communities" [77].

Past reviews have summarized social media research's topics, methods, and components. Kapoor et al., for example, found that most social media studies focused on behavioral aspects of social media and its integration for marketing and organizational purposes [78]. Snelson et al. and Shibuya et al. found that most social media studies employed interviews, surveys, focus groups, and content analysis [165, 173]. Shibuya also extracted prominent research topics, including users' behavioral patterns, privacy and health concerns, and designing human-centered online spheres [165]. Prior reviews mostly focused on the networking nature [20, 130, 165, 198], the data analysis methods [4, 79, 88, 124], and the organizational uses of text- or networking-based social media [76, 78]. Research on Facebook commonly recognizes the platform as a micro-blogging, networking-based social media that facilitates communication through text, multimedia posts, and user-created profiles [20, 130, 198]. Reddit features user-created forums called "subreddits" or "communities" that organize posts by subjects [124, 149]. Twitter is a micro-blogging and networking-based social media where users communicate through "tweets" [4, 76, 79, 88]. However, VSPs contrast other social media from the perspectives of content, users, social connections, and services [77, 189].

Research has referred to platforms such as YouTube [72, 112, 118, 134, 161], TikTok [80, 167], and Twitch [36, 112] as "video-sharing platforms" or "live-streaming platforms." A review of YouTube research between 2006 and 2009 noted that most papers focused on online videos' educational and healthcare benefits [170]. Another review suggested six priorities of YouTube research, including users, groups, and communities; teaching/learning; social/political impact; video creation/production; legal/ethical; media management; and commercial interests [172]. Madathil et al. reviewed papers about the spread of health information and misinformation on YouTube [116]. VSPs offer unique platform activities such as uploading, watching, quoting, favoriting, commenting on, responding to, and archiving videos [189]. Contrary to sites centered around social networking, VSP social interactions are rooted in content creation [19, 77]. Videos and live streaming simulate face-to-face interpersonal communication [19] and can be catalysts for "parasocial relationships" [29, 150]. Previous VSP reviews have focused on YouTube and its usage in a specific domain. With the emerging video interactions and community activities on different platforms, it is necessary to frame this topic in HCI.

2.2 An Introduction of Video-Sharing Platforms

YouTube was first launched in 2005 and acquired by Google in 2008 [26]. According to Statista, in 2022, YouTube has 2.6 billion active monthly users worldwide, ranking it as the largest VSP and the second most popular social media platform [46]. YouTube has more than 51 million active channels in over 80 languages, attracting users to watch over a billion hours of videos every day [15]. Most YouTube users are in the age group of 15-35, and 70% of YouTube

watch time comes from mobile devices [15]. At its core, YouTube allows users to publish, watch, and interact with long- or short-form videos. HCI research on YouTube videos has covered video creation, communities, and platform algorithms [18, 59, 70, 111, 133, 134, 161, 205].

First launched in 2011, Twitch is a growing VSP for live streaming. In 2022, Twitch had 140 million monthly active users [199]. Twitch streams combine live video/audio media and text-based chat channels [64]. Twitch content primarily consists of streamers playing video games [64]. HCI studies on Twitch have focused on live streaming techniques and community interactions (e.g., [36, 52, 117, 144, 159, 163]).

TikTok (Douyin) is a fast-growing short-form VSP launched in 2016. TikTok reported 1 billion monthly active users worldwide in 2021, a 45% growth since 2020 [175]. TikTok is the second-most popular VSP worldwide, following YouTube [46]. Besides short videos, the recommendation mechanism of TikTok is the "For You" page, where users can scroll through a feed of curated content for passive viewing [80]. The algorithmic recommendation and the entertainment nature have been a recent focus of TikTok research in HCI. Studies have examined how users perceive, are impacted by, and interact with TikTok videos [9, 50, 80, 167].

Periscope, Facebook Watch, Instagram Reels, and Bilibili are VSPs or services with considerable popularity. Bilibili is a popular VSP based in China, with 293.6 million active users in the first quarter of 2022 [174]. Facebook Watch is a dedicated video service of Facebook introduced in 2015. Periscope was launched in 2015 and discontinued in 2021, and earlier HCI research has examined video-sharing and live streaming on this platform [63, 180].

This review frames the scope of "video-sharing platforms" based on the perspectives of content, user, social, and service [136]. The primary media type of VSP content is user-generated videos that are shared or live-streamed to the public at large. Jhaver et al. noted that YouTube, TikTok, and Twitch are examples of creator logic platforms that share videos or live streams in a one-to-many fashion [74]. Lee et al. described YouTube and Twitch as video-sharing platforms where people share footage of everyday life [93]. Karizat et al. identified TikTok as a mobile and short-form video-sharing platform [80]. Research has described that the core user group on VSPs are creators who share personally meaningful content such as vlogs [70], how-to videos [23], and games [31]. Through professionalizing their video content, video creators can not only potentially become micro-celebrities [45, 74, 134, 192], but also receive monetary benefits via the platform, viewers, and sponsors [120, 120, 205]. The video interactions of VSPs support social activities between creators and viewers. Common social interactions with videos include a combination of quantitative feedback (number of views, ratings, and subscriptions) [39, 80, 209], qualitative content (comments, chatting, and Danmaku) [118, 209], and donating or gifting creators [192]. Video creators, viewers, and moderators form virtual communities around shared interests [59, 200, 209]. To bolster video delivery experiences, VSPs use various algorithmic approaches. In recent years, researchers have studied VSP algorithms for understanding video searching [72], recommendation [14, 143], and viewership [35, 117].

2.3 Video-Sharing Platform Research

Researchers outside of HCI have also taken an interest in VSPs. For example, psychology and sociology research has examined the cognitive, affective, and social factors in viewing VSP content and socializing with other users. Studies have examined cognitive-behavioral factors in YouTube surrounding addiction [42], watching Twitch streams [168, 208], and video-blogging [128]. Common research methods include quantitative data analysis [42], user surveys [168, 208], and content analysis [128]. In research areas related to health and wellness, studies examined the health-themed videos related to obesity [53, 213], HIV [139], H1N1 influenza [142], e-cigarettes [141], and vaccines [11, 181]. These studies collected health-related videos and performed content analysis to understand their roles in public health.

Researchers in communication, journalism, information science, and media studies also investigated the motivation of VSP users. Studies have examined the motivations for using YouTube [82], TikTok [126, 138, 190], and Twitch [60]. Studies also investigated the representation and experiences of marginalized groups such as racial and ethnic minorities [62], people with disabilities or mental health issues [75], and female-identifying creators [204]. Parasocial relationships with YouTubers [89] and information overload [131] were also research topics. These studies mostly used the research method of surveying a large number of VSP users [60, 75, 82, 126, 138] or performing video content analyses [62, 190].

VSP research is also an emergent topic in marketing, business, and management. Research in this domain focused on branding [49, 101] and product promotion [156] through creators' parasocial interactions with the viewers. Other studies also examined how nonprofit organizations used VSPs [194]. Surveys [49, 101], quantitative analysis [156], and content analysis [194] were also used in video-sharing research in this field.

In contrast to other fields, HCI studies have focused on the interaction and collaborative aspects of VSPs as they relate to users, communities, and networks. Considering no review exists on the VSP research in HCI, this work is motivated by providing a holistic picture of the themes, methods, and components of HCI video-sharing research. Although CHI and CSCW studies have examined individual VSPs or user groups, there needs to be a holistic picture of VSP research in HCI. For content, VSPs offer rich audio-visual information, as well as quantitative and qualitative data [152, 162]. We seek to present a collection of research tools utilized by HCI researchers to examine VSPs. VSP creators face unique challenges and develop strategies for managing their identity, performance, and relationships in their virtual communities [36, 56, 144, 192]. A summary of existing work on content creation in VSP communities can guide user and field studies to frame research questions and generate new findings. From the social perspective, studies have examined unique social phenomena on VSPs, such as the micro-celebrity effect [94, 119, 151] and live streaming interactions [32, 209]. Social media and social computing researchers could benefit from a breadth of the unique social interactions and affordances of VSPs. VSPs feature algorithm-enhanced experiences [35, 80]. Our review seeks to inform human-AI interaction researchers with VSP algorithmic functions and services examined in the literature.

3 PAPER SEARCH AND SELECTION

To establish a comprehensive corpus of papers on video-sharing in HCI, we first defined the scope and inclusion criteria for our search [203]. We concentrated our search on major HCI publication venues, based on the top 20 publications of Human-Computer Interaction on Google Scholar. Google Scholar's list comprises major HCI venues across a breadth of research interests and ranks the top 20 publications by their five-year h-index and h-median metrics[1]. We removed ACM Human-Robot Interaction and IEEE Human-Machine Systems because they do not usually contain social media and video-sharing research. The final list included 18 conference proceedings and journals (see Table 1). In contrast to other paper search methods such as database searching and backward snowballing [73], publication-venue-based searching allowed us to identify high-quality publications and ensure that papers are in the HCI scope. Recognizing that there are other HCI venues, we conducted a post-hoc analysis of 20 video-sharing papers in five other venues to examine whether the research theme, methods, and components can be applied to other studies (see Section 7).

Next, we formulated a list of search terms that were reflective of our research scope of video-sharing [203]. The chosen words and phrases include common video-sharing terms such as "video sharing," "video-sharing," "online video," "online-video." "live streaming," "live stream," "livestream," and "live-stream." We include a few platform names including "YouTube," "TikTok," "Twitch," "Vimeo," and "Facebook Watch." We restrict our search to papers published between 2012 and 2022. We used SerpAPI[2] to crawl Google Scholar and retrieve candidate papers for review. We formatted our searches as "<keyword> source: <venue name>" to apply our inclusion criteria of search terms and venues. A program iterated all combinations of keywords and venue names (Table 1) and retrieved the papers. Adding search terms was incremental by assessing keywords' effectiveness in returning VSP papers. We noticed general words like "online video" (matched 2088 papers), "video sharing" (matched 1810 papers), and the largest VSP "YouTube" (matched 1381 papers) retrieved the most papers. The addition of search words stopped when a considerable number of papers were collected. We excluded "video" as a search key because it retrieved many papers on video games. We didn't include Instagram and Snapchat as search words since they are often studied as photo and video sharing/messaging platforms for social networking [37, 91, 178]. This review focuses on video-sharing and live-streaming platforms. With this approach, papers about other regional VSPs (e.g., Bilibili and Douyu) could be retrieved with our search. SerpAPI extracted the title, authorship, publication year, and webpage of the papers. We conducted additional crawls for the abstract of each paper.

The first round of searching returned 4,578 papers by SerpAPI, and most papers were not about video-sharing. To refine the dataset, we used programmatic filtering to exclude papers that lacked any keyword in the abstract or were not published between 2012 and 2022. This resulted in a subset of 648 publications for manual filtering. Then the two authors manually reviewed the papers according to the definition of VSPs. A paper was included if it studied or collected data on the content, users, social activities, or services of VSPs, or if the paper presented designs specifically for video-sharing. Papers that involve other information (e.g., Reddit data or user study data) besides VSP data were also included. Papers were removed if they were short papers (posters, demos, workshop papers, and extended abstracts), were not focused on video-sharing (e.g., only mentioned "YouTube" as an example of social media), or were focused on non-VSP videos (e.g., videos for video-conferencing, course sharing, or CCTV).

Conference	Acronym	Publisher
ACM CHI Conference on Human Factors in Computing Systems	CHI	ACM
ACM Conference on Computer-Supported Cooperative Work & Social Computing	CSCW	ACM
IEEE Transactions on Affective Computing	TAC	IEEE
ACM Conference on Pervasive and Ubiquitous Computing	UbiComp	ACM
International Journal of Human-Computer Studies	IJHCS	ELSEVIER
Proceedings of the ACM on Interactive, Mobile, Wearable and Ubiquitous Technologies	IMWUT	ACM
Proceedings of the ACM on Human-Computer Interaction	PACMCHI	ACM
ACM Symposium on User Interface Software and Technology	UIST	ACM
Conference on Designing Interactive Systems	DIS	ACM
International Conference on Intelligent User Interfaces	IUI	ACM
Behaviour and Information Technology	BIT	Taylor&Francis
International Journal of Human-Computer Interaction	IJHCI	Taylor&Francis
ACM Transactions on Computer-Human Interaction	TOCHI	ACM
Universal Access in the Information Society	UAIS	Springer
International Conference on Multimodal Interfaces	ICMI	ACM
Virtual Reality	-	Springer
IEEE Virtual Reality Conference	IEEEVR	IEEE
HCI International	HCII	Springer

Table 1: The proceedings and journals for paper searching. The list was retrieved from Google Scholar in Nov. 2021.

The first round of searches was completed on November 20th, 2021. After filtering, 95 papers were selected to form our review pool. The second round was made on June 20th, 2022, to include newly available articles after the first round (including CSCW'21 and CHI'22). The second search round was the same as the first, except that the search date was between November 20th, 2021, and June 20th, 2022. This search resulted in another 11 papers. Taken together, we were left with a review pool of 106 articles.

4 LITERATURE REVIEW METHODS

We aim to conduct a systematic, theory-driven scoping review of video-sharing research to provide an initial indication of how HCI researchers define emergent topics, apply research methods, and frame findings [146]. For RQ1 and RQ3, we followed Wolfswinkel's grounded theory literature review method [203]. Wolfswinkel et al. outlined a three-step analysis. First, *Open Coding* is the process of generating high-level abstractions that emerge from the review pool. *Axial Coding* further develops categories and relates paper information to possible sub-categories. In the last step, *Selective Coding*, categories and sub-categories are reviewed, integrated, and refined to form a newly developed theory. Wolfswinkel's method has been widely used for reviews [135, 160, 210].

4.1 Research Themes (RQ1)

The purpose of identifying common research themes in RQ1 is to identify key topics and characteristics of the extant research [146]. For *Open Coding*, the authors identified key sentences from the

[1] https://scholar.googleblog.com/2021/07/2021-scholar-metrics-released.html
[2] https://serpapi.com/

abstract that described the paper topic and pasted them into digital cards. The papers were evenly divided between the two authors. The notes were then converted into 106 digital cards on Miro. Then the two authors used the affinity diagramming approach [65] for the *Axial Coding* by re-reading the cards and taking turns to move the cards into groups. This process was iterative and inductive – the authors progressively compared and categorized the cards, created and revised small groups, and connected small groups into higher-level themes. After axial coding, the authors performed *Selective Coding* by reflecting on every paper and adjusting the theme categories and definitions so that each publication properly belongs to the designated theme. We explain the research themes in Section 6.1.

4.2 Research Method (RQ2)

For RQ2, we conducted a multi-categorical encoding of the research methods based on Snelson's classification of data collection techniques [173]. *Qualitative observation* takes place in the user's natural context, which entails observation of user behaviors or a set of videos. *Interviews* involve the researcher directly discussing with the participants, including free-form, structured, and semi-structured interviews. A *survey* is a defined set of questions to collect participants' responses. *Big data analysis* encompasses quantitative methods for collecting and analyzing the VSP data. Lastly, we add *user study and evaluation* to include user research methods that evaluate new systems or interaction designs.

The authors read each paper's introduction and method sections, made notes of research methods, and classified them into each method code. The methodology encoding was multi-categorical since a paper may use multiple research methods. For qualitative observation, the authors included techniques such as grounded theory analysis, thematic analysis, qualitative content analysis, and observational, and ethnographic approaches [173]. The big data analysis methods consisted of computer vision, machine learning, and quantitative content analysis. When a paper conducted a user experiment, a field test or deployment, or a lab study, the research method was encoded as *user study and evaluation*. Results will be described in further depth in Section 6.2.

4.3 Research Findings (RQ3)

The two authors analyzed the research findings following the three grounded theory steps [203]. As opposed to a paper's findings being compiled into a single category, the authors separated sub-findings into different categories. For *Open Coding*, the two authors worked individually and extracted excerpts from each paper's result, finding, and discussion sections. We used the sub-sections or paragraphs in papers to guide open coding; therefore, multiple codes could apply to one paper's finding section. Each card had the section header or a few sentences directly from the paper to describe a finding. For *Axial Coding*, the two authors gathered all cards, reflected on each other's cards, used affinity diagramming to develop small groups of paper findings, and then related them to sub-categories. During this step, the authors identified five broad components on which the findings were discussed, including *creator*, *viewer*, *video*, *community*, and *platform*. Identifying VSP components facilitates the organization of research findings and the identification of design elements in VSP research. For cards related to multiple components, the authors grouped them into the connections between the five components. In the *Selective Coding*, we revisited and verified that the finding cards were properly categorized into a component or a connection. After defining and connecting the components, the authors generated a framework of video-sharing research in HCI, which will be discussed in Section 6.3.

5 PAPER INFORMATION

As shown in Figure 1 top, video-sharing research has grown rapidly over the past decade. 19 papers and 16 papers were published in 2019 and 2020, respectively. In 2021, 32 papers about video-sharing were published. The growing number of video-sharing papers is consistent with the growing popularity of VSPs [7]. The bottom sub-figure in Figure 1 shows a word cloud generated by all author keywords. The 106 papers were published across nine different venues (Figure 2 left). CHI and CSCW were the top two places where the papers were published, with 47 and 32, respectively.

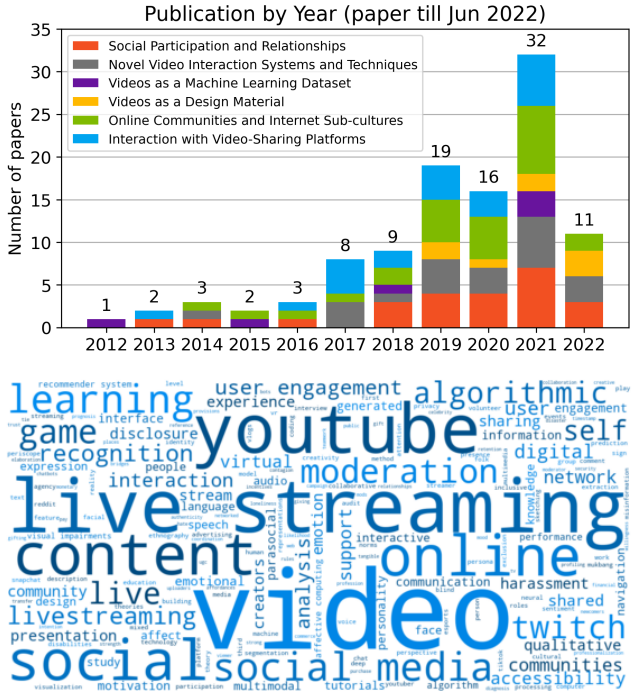

Figure 1: Top: Publications over the years since 2012. Bottom: A word cloud made by all the keywords of papers in our review pool.

We also counted the number of papers studying each VSP platform. The distribution can be seen in Figure 2 right. A paper was considered to study a particular VSP if the paper mentioned that it collected data from the platform, recruited the platform's users as participants, designed and evaluated new features primarily for the platform, or leveraged the web or mobile app of the platform as the study site. If a paper merely mentioned a platform in passing, it was not counted. We found that 79 studies were conducted with

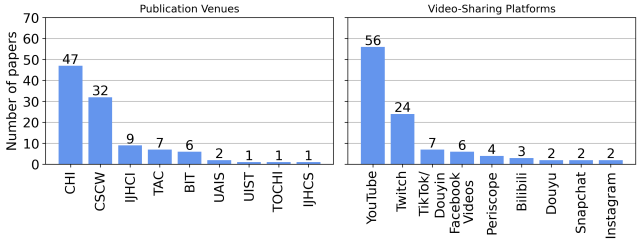

Figure 2: Left: Venues where papers were published. Right: Social media platforms studied by the papers.

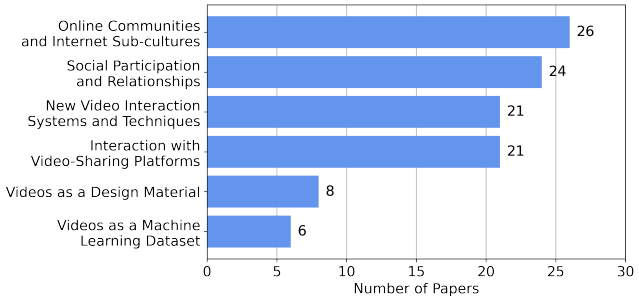

Figure 3: The distribution of six research themes.

a specific platform. 56 papers studied YouTube, 24 papers studied Twitch, seven papers studied TikTok (or Douyin), and six papers studied Facebook videos. 19 papers studied VSP in general without mentioning a particular platform, such as designing new video interactions or systems for all VSPs [84, 107], or studying a user group across different platforms [102, 104].

6 LITERATURE REVIEW

6.1 RQ1: Research Themes

The review of the 106 papers revealed six descriptive research themes. The themes are summarized in Table 2. Figure 1 shows the distribution of research themes over the years. The research theme analysis was bottom-up by grouping papers into similar sub-themes and then grouping sub-themes into significant themes. Therefore, one paper belongs to only one theme. As noted by Wolfswinkel et al. [203] and Peters et al. [146], the basic coding of papers to particular categories can be a useful approach to identifying and clarifying concepts within a field. Mutually exclusive categories allow us to present key VSP topics at a conceptual level. However, it should be noted that a paper on one theme may touch on elements in another theme (e.g., a paper studying online communities may explain social interactions with VSPs). We chose to provide a multi-categorical representation of the research components in RQ3.

Overall, we observed that studies in our review were concerned with social activities, video-based or VSP interactions, and using VSPs as a source of information or data. In our analysis, we grouped papers seeking to understand social and community activities into the themes *Online Communities and Internet Sub-Cultures* or *Social Participation and Relationships*. We assigned a paper to the former or latter theme depending on whether it studied a particular community within VSPs. If the main theme focused on interactions with videos or the design of social features, the paper fell under the *New Video Interaction Systems and Techniques* theme or the *Interaction with VSPs* theme. If the paper proposed a new technique or system, it was assigned to the former theme. For papers using VSP data to identify design opportunities or develop ML methods, we grouped them into either the *Videos as a Design Material* theme or the *Videos as a Machine Learning Dataset* theme.

6.1.1 Online Communities and Internet Sub-Cultures. This theme consists of papers examining the characteristics, behaviors, and experiences of certain VSP groups or communities. A paper belongs to this theme if it specifies an identity, hobby, interest, or culture-based community. With 26 papers, this theme provides knowledge of people and their characteristics, behaviors, and experiences in various VSP communities. VSP communities can be formed based on a shared hobby or interest. As an example of VSP gamers, Pellicone and Ahn studied the practice of being a Twitch video game streamer [144]. Li et al. explored how gamers manage personal information disclosure in live streams [98]. Studies also looked at communities that share or teach a niche interest, such as computer programming [33, 52], outdoor activities [106], eating shows (or *Mukbangs*) [6], as well as internet sub-cultures such as Incels (INvoluntary CELibates) [143] and Otakus (anime and comics) [109]. Studies on this theme also examined groups with common identities or personal experiences. For example, a few papers examined the content and experiences of VSP users with disabilities or long-term health conditions [16, 35, 70, 115, 161]. Huh et al. studied health vlogging and explained how YouTube users with chronic illnesses seek and provide social support [70]. Borgos-Rodriguez et al. studied parents of children with developmental disabilities on YouTube, examining how they create, share, and connect through videos [16]. Studies also examined the VSP experiences of members of the LGBTQ+ community. Example topics include understanding the everyday experiences of LGBTQ+ users' on TikTok [167], how LGBTQ-identifying users disclose bullying [59], and how LGBTQ+ streamers navigate their gender presentation and sexuality in streams [56].

6.1.2 Social Participation and Relationships. This theme comprises papers that studied common social interactions, activities, and behaviors in video-sharing (24 papers). In contrast to the *Online Community and Internet Sub-cultures* theme (in 6.1.1), these papers focused on the social participation and interactions that are enabled by VSP and occur between general creators and viewers. For example, Sheng and Kairam studied how online strangers evolve into in-real-life friends through live streaming [163]. Courtois et al. studied how video creators define their network of viewers and receive feedback [39]. Some papers on this theme sought to understand commenting behaviors. Yarmand et al. examined how, when, and why people make time-based references in comments [212]. Luo et al. compared live streaming comments during and after streaming, probing factors that simulate collective emotional amplification [112]. Xiang and Chae examined perceived belongingness and interactivity with Danmaku – an emerging video format with real-time user commentary [209]. A couple of studies were interested in moderators' relationships with viewers. For example, Wohn et al.

Theme	Definition	Sub-themes of 106 papers
Online Communities and Internet Sub-cultures	Examining the characteristics, behaviors, and experiences of specific hobby-based or interest-based groups, communities, or cultures that are enabled by or formed on VSPs.	gamers [31, 51, 97, 98, 117, 144, 164, 176], eating (Mukbang) [6], studying together [93], learners and mentors [33, 52], internet sub-cultures [109, 143], hobby streamers [105, 106], people with disability or illness [16, 35, 70, 115, 161], seniors [54], LGBTQ [56, 59, 167], rural women [182]
Social Participation and Relationships	Understanding the general social interactions, activities, and behaviors on VSPs through which users connect to and engage with each other.	social relationships and networking [9, 27, 39, 45, 48, 64, 99, 110, 163, 192, 202, 209], commenting on videos [112, 158, 159, 212], user-led content moderation [21, 22, 200], social movements and crises [66, 133, 134, 153, 195]
New Video Interaction Systems and Techniques	Designing a new video interaction system or tool; or an improvement of current video features on VSPs.	video navigation and recommendation [14, 23, 24, 84, 187, 191, 207], live streaming support [38, 55, 107, 108, 127, 152, 179, 211], closed captions [69], user protection techniques [74, 118, 129] accessibility features [125, 193]
Interaction with Video-Sharing Platforms	Understanding interactions with videos, video playing features, and VSP algorithms.	video watching experiences [32, 63, 100, 102, 104, 123, 180], video and live-streaming creation [10, 28, 36, 96, 120], video display features [85, 111, 215], interaction with VSP algorithms [2, 18, 72, 80, 113, 205]
Videos as a Design Material	Analyzing VSP data to understand users and derive design knowledge.	autonomous vehicle [214], accessibility design [50, 95, 197], VR [41], weather radio [157], insertable device [86], ASMR [132]
Videos as a Machine Learning Dataset	Incorporating VSP data to train machine learning models	emotion [13, 183], leadership [196], first impression [61], facial expression [71], affect [162]

Table 2: The definitions and papers in the six themes of video-sharing research in HCI (RQ1).

examined how Twitch moderators navigate the labor, collaboration, and relationship building involved with the role [21, 22, 200]. Studies also examined the gifting and donating behaviors of live-streaming viewers. Li and Peng examined the role of emotional attachment in virtual gifting intentions [99]. Wohn et al. sought to relate viewers' motivations for gifting to social provisions [202]. Other studies examined how VSPs mediated social participation during crisis events [153] and social movements [133, 134].

6.1.3 New Video Interaction Systems and Techniques. Our analysis grouped 21 studies into the *New Video Interaction Systems and Techniques* theme, where studies designed a new interaction system or tool or improved on existing features on VSPs. For example, towards new video-based learning experiences, Kim et al. [84] and Troung et al.[187] proposed novel approaches for video navigation, interaction, and segmentation. Wu et al. offered new techniques to understand how recommender systems impact collective social attention [207]. Some studies reimagined live-streaming interactions through new designs. Miller et al. designed a live chat system aimed at reducing overwhelm and improving social interactions in live streaming [127]. To support remote participation in live events, Tang et al. designed a system that clusters multiple live streams together [179]. Comparatively, Lu et al. aimed to support collaborative knowledge building, proposing a tool called StreamWiki that enables collaborative stream archiving [107]. Studies also created new computational and automated approaches to support users of VSPs. Mariconti et al. proposed a technique that determines the likelihood of a video being the target of a hate attack [118]. Swart et al. proposed AdIntuition, which automatically discloses any online endorsement in YouTube videos [177]. A few studies aimed to improve the accessibility of online videos for people with disabilities. Mehta et al. designed a system that generates 3D sign language captions for people who are deaf or hard of hearing [125]. For blind or visually impaired people, Wang et al. built a system that automatically generates audio descriptions for videos [193].

6.1.4 Interaction with Video-Sharing Platforms. This theme comprises studies that investigate how and why users interact with videos, algorithms, and features on VSPs. The 21 studies in this theme differ from the theme in 6.1.3 in that they analyze VSP features and interactions instead of designing or prototyping new systems. Papers on this theme focused on understanding viewers' video-watching motivations and practices. Examples include Haimson and Tang [63], Long and Tefertiller [104], and Tang et al. [180], who examined viewers' watch motivations and interactions with live streams. Other examples investigated the motivations and behaviors around watching multiscreen videos [100] and watching movies through Danmaku videos [32]. McRoberts et al. studied how people share Snapchat stories and use ephemeral timelines for self-presentation [123]. Papers also examined content creation activities and norms such as involving affiliate marketing information [120], co-performing [96], and presenting selves [36]. Other papers investigated viewers' perceptions and evaluations of displaying features on VSPs, such as viewers' trust evaluations with the YouTube sidebar [215] and viewers' perceived waiting times with video loading symbols [85]. VSP algorithms that rank, filter, and recommend content have also gained the attention of researchers. Several studies have investigated users' interactions with and perceptions of VSP algorithms [2, 18, 72, 80, 113, 205]. For example, Wu et al. examined how YouTube content creators make sense of the algorithms and form algorithmic personas [205]. A recent paper by Karizat et al. explored the interplay between algorithmic processes and users' identities, beliefs, and behaviors [80].

6.1.5 Videos as a Design Material. Papers in this theme analyze online videos, audio, or comments to derive design knowledge or identify new design opportunities (eight papers). Research on this theme leveraged VSP content as a design material to probe people's perspectives and inform design. To investigate people's opinions on autonomous vehicles, Zhou et al. analyzed the YouTube comments about "takeover transition of automated vehicle" events in videos [214]. Duval et al. analyzed videos on TikTok to discover new opportunities for playful experiences for people with disabilities [50]. Dao et al. examined VR failures in YouTube videos to understand interaction breakdowns with the technology [41].

6.1.6 Videos as a Machine Learning Dataset. This theme consists of six papers that utilize video and audio data for training and evaluating machine learning models for artificial intelligence. These studies used videos as training data to build computer vision and other statistical models. For example, Teijeiro-Mosquera et al. extracted facial expressions from YouTube vlogs to study the connections between emotional expressions and personality traits [183]. Weninger et al. used the YouTube audio data to build a speech-based system that detects leadship emergence in voices [196]. Güçlütürk et al.

leveraged multiple modalities of YouTube videos to train models for apparent personality trait recognition [61].

6.2 RQ2: Research Methods

We annotated the qualitative observation, interview, survey, big data approaches [173], and user study and evaluation methods used in video-sharing research. To inform future video-sharing studies about applicable research methods, we give examples of how HCI research on different themes utilizes different research methods. We illustrate the theme and method associations in Figure 4.

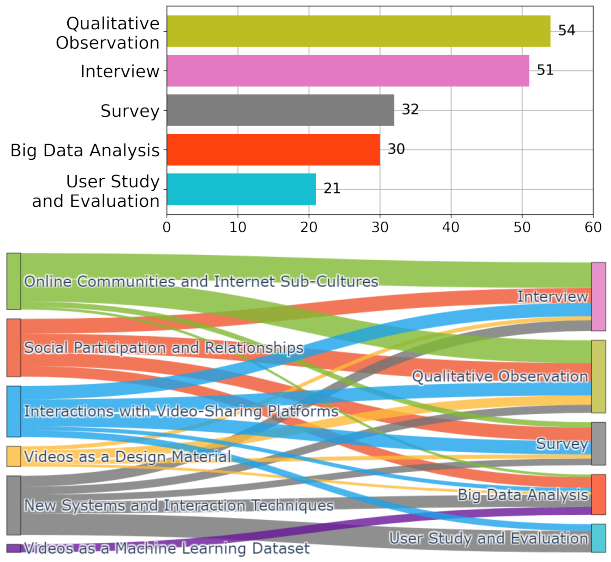

Figure 4: Top: The distribution of research methods. Bottom: The association between research themes and research methods.

6.2.1 Qualitative Observation. Qualitative observation was the most applied method in video-sharing research [173], which appeared in 54 papers. Qualitative methods for studying VSP videos and users included qualitative content analysis [41, 86], thematic analysis [211, 212], grounded theory analysis [95, 214], and observational and ethnographic studies [5]. They were applied to study video content [16, 41, 59], comment and forum data [66, 144], and interview data [45, 117]. Qualitative observations were applied in all themes except for the *Videos as a Machine Learning Dataset* theme. 17 papers on *Online Communities and Internet Sub-Cultures* used qualitative observations (e.g., [98, 117]). 14 *Social Participation and Relationships* papers and 10 *Interactions with VSPs* papers also used qualitative methods (e.g., [21, 163]). Qualitative methods were also performed at the early research stage to generate an initial codebook before conducting quantitative analysis [66, 132–134, 214]. These approaches help build conceptual models to explain video content [44]. In analyzing VR fails in YouTube videos [41], the authors viewed 16 video clips to refine the coding scheme, analyzed 20 videos to calculate inter-rater reliability, and then encoded 233 videos. Green et al. performed a grounded theory analysis of 151 videos to examine the bullying and self-disclosure of LGTBQ videos [59]. HCI researchers have also applied ethnographic methodologies in studying VSP communities. To gain an understanding of live streamers' lived experiences, Faas et al. conducted a participant-observation study on Twitch over the course of two months [52]. Ferreira et al. drew on a three-year ethnographic study to examine how older people create and share videos [54].

6.2.2 Interview. Interviews were a common research method in our review and were used by 51 papers to understand the practices, experiences, and perspectives of creators and viewers. Of the studies that used interviews, 19 studies belonged to the *Online Communities and Internet Sub-Cultures*, 11 belonged to *Social Participation and Relationships*, and ten were from the *Interactions with VSPs* theme. Interviewing VSP community members is a direct way to understand creators' and viewers' online experiences. For example, Simpson and Semaan conducted an interview study with 16 LGBTQ+ people to explore their everyday engagement with TikTok's "for you" algorithm [167]. In a TikTok study, Barta and Andalibi drew on semi-structured interviews with 15 frequent users and examined how authenticity is constructed and enacted [9]. The types of interviews found in this review were focused groups (e.g., [32]), semi-structured (e.g., [96]), and formative (e.g., [191]).

6.2.3 Survey. Surveys were another frequent method used by 32 papers. Surveys were conducted through online forums (e.g., Reddit or Facebook), online survey instruments, or in-person to gather information about the target population. The research themes that utilized surveys the most were *Interaction with VSPs* (ten papers) and *Social Participation and Relationships* (ten papers). To examine how creators manage their identity, Chou and Lu surveyed 312 Twitch streamers [36]. As examples of papers on the *Social Participation and Relationships* theme, Xiang and Chae conducted surveys of 397 VSP users to study the effect of belongingness on users' continuance intention [209]. Besides these two themes, surveys were also used in studies of *New Video Interaction Systems and Techniques* (five papers, e.g., [127, 179]), *Online communities and Internet Sub-cultures* (4 papers, e.g., [51, 115]), and *Videos as a Design Material* (three papers, e.g., [86, 197]). These surveys collected participants, users, and community members' responses about VSP features.

6.2.4 Big Data Analysis. In our review, we categorize quantitative and statistical research methods for analyzing VSP data as Big Data Analysis. 30 papers have used quantitative methods on VSP data. Though in contrast to text-based social media, VSP data has multiple modalities and sources, including video content (e.g., [72, 132–134]), metadata (e.g., titles and descriptions, [120, 177]), frame images (e.g., [13]), audio (e.g., [118, 196]), and text posts or comments (e.g., [159, 212]). Quantitative data analysis has been used to examine *Social Participation and Relationships* in eight papers. Researchers leveraged audio-visual and textual data as indicators of VSP social activities. To explore how YouTubers provide social provisions during COVID-19, for example, Niu et al. crawled and performed quantitative data analysis on 1,488 YouTube videos and their comments [133]. Seering et al. scraped and analyzed 138 million messages from Twitch live-streaming chatrooms to investigate the factors which encourage first-time participation [159]. In nine papers proposing *New Video Interaction Systems and Techniques*, video data was used to track user interactions and build new tools.

Mariconti et al. analyzed multimodal data of 428 raided videos, including video metadata, audio, and thumbnail data, to build a new technique that detects coordinated hate attacks on YouTube [118]. In the study of AdIntuition, Swart et al. built a video advertisement indicator with 174,885 training videos [177]. All six papers on the theme of *Videos as a Machine Learning Dataset* used big data approaches. There were also three studies on *Interactions with VSPs* [18, 72, 120], two studies on *Videos as a Design Material* [132, 214], and two studies on *Online Communities and Internet Sub-cultures* [31, 143] that used quantitative data analyses.

6.2.5 User Study and Evaluation. As a common research method in HCI, user studies and evaluations were applied in 21 of the papers in our review. Study designs include formative user experiments (e.g., [23, 108]) and field deployments with creators and viewers (e.g., [108, 177]). 16 papers on *New Systems and Interaction Techniques* performed user studies and evaluations. After implementing the system StreamSketch, Lu et al. deployed the tool in six streaming sessions to evaluate the system [108]. Swart et al. evaluated AdIntuition through a survey, a field deployment, and a diary study [177]. User studies and evaluations were used in five papers to study *Interactions with VSPs*. These studies built user-tracking tools to gain VSP interaction data. For example, Chen et al. examined how multimedia tools enrich live streaming interactions by deploying a mobile application and tracking viewer interactions [28]. Zimmermann and Jucks explored the YouTube sidebar through an online experiment with 147 participants [215].

6.3 RQ3: Video-Sharing Components in Findings

The categorization of the paper findings led to a framework encompassing the five components – creator, viewer, video, community, and platform (Figure 5). *Viewer* and *creator* center the framework as the main actors of VSPs. This section describes how viewers and creators interact with videos, communities, and platforms.

6.3.1 Creator and Viewer. Video-sharing research in HCI contributes findings on creators and viewers (Figure 5). These two roles reflect the participatory styles of VSPs – some users actively share content while others consume others' feeds but do not regularly post [57, 155]. Research findings provided insights on the motivations and characteristics of creators. Studies found that creators were motivated by social connection and community [16, 64, 105, 144], social impact and raising awareness [16, 105], and economic and performative motivations [144, 192]. Other findings related to the characteristics or identity of a creator. Lu et al. found that being positive, welcoming, and good-tempered were important traits for a streamer [110]. For LGBTQ and female creators, presenting identity has played a role in their experiences as creators: sometimes being a source of empowerment, affirmation, and agency, and other times leading to discrimination or stigmatization [56, 167, 182].

Papers provided findings about viewer-creator dynamics relating to engagement and attachment, gifting and donating behavior, and viewers' perceptions of creators' authenticity and trustworthiness. Some papers report on how creators drive viewer engagement and how viewers develop emotional attachments to creators. For example, Wohn et al.'s and Li et al.'s studies found that regularly watching and supporting a creator's live streams can lead viewers to develop emotional attachments to streamers [99, 202]. Video creators were shown to provide social provisions such as attachment and nurturance, alleviating feelings of loneliness for viewers [133]. However, a study by Wang et al. showed that some creators intentionally draw lines between themselves and their viewers, such as using private social media accounts and avoiding calling fans "friends" [192]. Gifting and donation have been identified as unique VSP interactions between creators and viewers. For viewers on Chinese live-streaming platforms, virtual gifting was positively correlated with the need for partnership and social interaction [104]. Many viewers interpreted their donations as a form of tangible support and encouragement [202]. Another pertinent topic in creator-viewer relationships is authenticity and trustworthiness. A YouTube study showed that user perceptions of YouTubers' trustworthiness might be influenced by linguistic language style and thematic references on the platform [215]. A culture of authenticity on TikTok propels viewer expectations for emotional rawness and intimate self-expression from creators [9]. In a study of video-sharing during the Syrian civil war, Rohde et al. noted that when the authenticity and trustworthiness of uploaders were unclear, online videos could become problematic and manipulative [153].

6.3.2 Video. In contrast to other social media platforms, the video is the primary vehicle of all interactions on video-sharing platforms [19, 67]. For studies examining video content, researchers analyzed (1) the content, theme, and style of the videos, (2) emotion, action, and movement in the videos, and (3) multimodal content in the videos (video, audio, speech, etc.). Papers in this theme also provided findings on viewer interactions with videos and creators' creation practices. Some papers contributed knowledge about viewer-video interactions, such as viewing motivations and reactions, video navigation and watching, and challenges with accessibility. Others identified creators' video and live streaming practices.

Content analysis was performed to understand video themes and styles [44]. For example, in a study about LGBTQ-identifying YouTubers, Green et al. identified and coded the experiences, opinions, beliefs, empathy, exhortations, and general information in videos [59]. Seo and Jung [161] and Duval et al. [50] outlined video themes of content by creators with disabilities. Another thread of studies focused more on the visual information of users, such as emotions, actions, and body movements. Chen et al. proposed an engagement estimator from game videos [31]. Bhattacharya explored multimodal emotion recognition in videos [13]. VSP data is multimodal in that it consists of video, audio, and closed caption data, as well as peripheral quantitative and qualitative user interactions (e.g., likes and comments) [39]. For example, Chen et al. noted the importance of multimodal channels, including audio and visual interactions [28]. Niu et al. examined how ASMR is produced and supported by multimodal interactions of videos [132]. Machine learning research found that multimodal data can be incoporated to improve the accuracy of machine learning models [13, 162].

Studies that examined viewer-video interactions largely focused on viewers' motivations and reactions to certain types of videos. For example, Lee et al. found that viewers watched "study-with-me" videos to avoid distractions and to obtain a sense of togetherness [93]. Anjani et al. examined Mukbang viewers' motivations

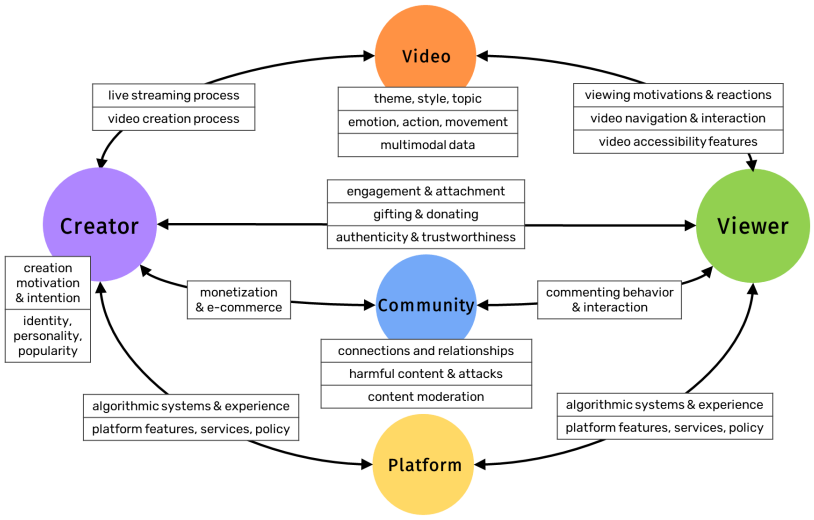

Figure 5: Video-sharing research framework with five components, which summarizes the research findings in the papers.

[6]. Design studies also had implications for video navigation and watching techniques. Chung et al. found that viewer interaction and engagement in live streams were augmented by their system, VisPool [38]. Wang et al.'s system Soloist offered a novel way for viewers to learn music with videos. [191]. Other studies reflected on design opportunities for accessible videos for users with disabilities. Automatic audio description could be promising for people with visual impairments [193]. Mehta et al.'s automated 3D sign language caption generation for online videos was shown to improve the academic performance of visual-impaired users [125].

Many studies identified challenges and designs for live streamers. Multiple studies found that streamers valued professionalism and the production of polished, high-quality streams [97, 106, 106, 144]. Streamers track the number of viewers and view count as a performance measurement [144]. Live-streaming can be demanding [105]. Streamers need to obtain necessary skills [52, 97], be creative [108], connect to the viewers [38, 144], manage their identities [56], and protect other people's privacy [98, 106]. Therefore live streamers need new designs to support streaming activities and interactions [38, 107]. Papers mentioned challenges in creating videos. Huh et al. found that health vloggers had an unmet need for information organization techniques and advanced editing features [70]. For blind or visually impaired vloggers, Seo and Jung identified particular accessibility challenges with video-editing tools [161].

6.3.3 Community. A sense of community and membership is attributed to identification and common social bond [122]. Studies in our review discussed findings on community relationships, harmful content and attacks, and content moderation. Studies on creators' interaction with communities emphasized monetization and e-commerce phenomena. Others also revealed viewers' interactions with the community through VSP social features.

With the significant theme of *Online Communities and Internet Sub-cultures*, papers in our review pool contributed new knowledge on how VSP community members interact with each other. Communication through video-sharing and commenting on videos allow users to share experiences, ask questions, and seek and gain social support [70, 133]. Sher and Su found that cultural-social aspects of online subcultures were amplified by collocated gatherings in live-streaming marathons [164]. Papadamou et al. discovered a growing presence of the Incel community on YouTube, including a substantial increase in incel-related videos and comments [143]. Mallari et al. outlined key skills of successful streamers, such as community building and management [117]. Papers also emphasized the social connection both on and off of VSPs. In programming mentorship communities on Twitch, members interact with each other through non-VSPs such as Discord [52]. Sheng and Kairam found similar results, where users turn to secondary services to continue communication and deepen ties [163]. Researchers addressed the presence of harmful content in VSP communities, such as harassment [185], hate attack [118], and misinformation [18]. Studies also contributed the knowledge on user-led moderation. Researchers identified the roles of volunteer moderators in Twitch communities, including general moderation tasks, collaboration, and dealing with violations such as attacks [21, 22, 200]. For community newcomers, Seering et al. found that moderators and subscribers encourage newcomers to participate in community activities [159].

Besides studying community interactions, researchers were interested in how creators navigate monetization and e-commerce within their subscriber community. Some streamers may feel underprepared and uninformed regarding marketing strategies [117]. Similarly, Wang et al. found that while making money was a primary goal of some streamers, it can be challenging to solicit gifts from viewers [192]. Besides gifting, some creators opt to use e-commerce and video-based marketing. Lu et al. found that ICH streamers leverage streaming to promote their business and sell products [105]. Tang et al. found that rural Chinese women use live-streaming to promote their local economy and make a living [182]. Chen found two main routes through which consumers trust creators and purchase the products they promoted [27]. However, Mathur et al. found that many YouTube creators do not disclose affiliate marketing despite endorsement guidelines [120].

Viewers connect to VSP communities mostly through commenting. To augment community engagement, HCI designers offered knowledge on commenting and its designs. For example, when comparing commenting styles on crisis videos, He et al. found that viewers were more emotional and expressive in Danmaku-style comments [66]. Live-streaming comments are more individual-level and emotional than comments posted retrospectively [112]. In the study of Snapstream, Yang et al. found that viewers annotate video snapshots to create suggestions and make jokes with creators [211].

6.3.4 Platform. Platform refers to video delivery mechanisms and services implemented by VSPs. Studies around this component examined recommendation algorithms and video presentation features. Video search and recommendation algorithms significantly impact information consumption and viewer experiences [34, 80, 92]. One core topic among papers was examining human-algorithm interactions, including how VSP algorithms affect both creators and viewers. Creators make sense of the YouTube algorithm by assigning human characteristics [205]. For middle-aged users on YouTube, Alvarado et al. found them to perceive four actors in video recommendations – the current user, other users, the algorithm, and the organization [2]. However, VSP algorithms could bring uncertainty, unfairness, and misinformation. Ma and Kou found that YouTube's moderation algorithm was a source of uncertainty for creators [113]. In a TikTok study, content creators reported that TikTok's algorithm suppressed specific social identities while amplifying others [80]. Hussein et al. found that once a YouTube user develops a watch history, personalization affects the amount of misinformation being recommended [72].

Platform services and video display features were also platform attributes. For example, Chen identified barriers to learning on live-streaming platforms, including finding quality streams and retrieving information from chatrooms [33]. When studying perceptions around different YouTube mechanisms, Lukoff et al. found that YouTube's "auto-play" feature makes viewers feel less in control of their agency [111]. Another YouTube study was centered around creators with disabilities and found that they felt dissuaded from disclosing their disability due to concerns about the demonetization of disability-related content [35]. To support blind or visually impaired VSP users, Seo and Jung recommended future accessibility services such as tutorials, improved navigation, and accessible editing tools [161].

7 POST-HOC JUSTIFICATION

We conducted a post-hoc justification with 20 papers in five other HCI venues to justify our summary of video-sharing research themes, methods, and components. The venues include "New Media & Society (NMS)," "ACM Transactions on Social Computing (TSC)," "ACM International Conference on Supporting Group Work (GROUP)," "IFIP Conference on Human-Computer Interaction (INTERACT)," and "ACM International Conference on Interactive Media Experiences (IMX)." We randomly sampled 20 papers (see Appendix A) from 74 papers collected from these five venues using the same paper search and filter procedures. The two authors annotated papers independently regarding the themes, methods, and components, then met to solve discrepancies and determine the categories.

Among the 20 papers, eight papers fall into the *Online Communities and Internet Sub-cultures* theme for studying communities of music [12, 121], gaming [3, 148], knowledge production [30], students and teachers [171], and marginalized groups [147, 188]. *Social Participation and Relationships* comprises eight papers. These papers explored user-led content moderation [184], chatting and commenting [1, 66, 87, 137, 186], managing live-streaming audience [201], and social media challenges [83]. Three papers study *Interaction with VSPs*, which examine the motivations or experiences of watching political videos [17], algorithmic lore videos [114], and live comments in night mode [103]. One paper analyzed YouTube videos to learn how people use physical space while cooking together, an example of *Videos as a Design Material* [140].

Qualitative analysis (14 papers) is the most applied research method. Studies applied qualitative methods to categorize and conceptualize videos [12, 114, 140, 147, 148, 171], interview and survey responses [3, 188, 201], chats and comments [83, 137, 184, 186], and observations of creators [121]. Five papers leveraged interviews, one paper used a survey, and one conducted a user study. Big data and quantitative approaches were applied in six papers for analyzing video statistics [30, 87, 171] and comments [1, 128, 206].

Our framework well-explains the VSP components on which the papers described their findings. As many papers in the post-hoc pool focused on video commenting and live-streaming chatting, the commenting behaviors and community interactions between the *viewer* and *community* components are discussed most frequently (9 papers). Another significantly discussed component is the *creator*, with seven papers examining the creation motivations and intentions (e.g., of female gamers [3] and reaction video creators [121]). Seven papers which reported on the *video* component studied video themes, styles, and topics, such as school vlogs [171], algorithmic lore videos [114], and challenge videos [83].

8 FUTURE RESEARCH DIRECTIONS

We map the future work and design recommendations from papers to the five components in our framework (Figure 5).

8.1 Support Creator-Viewer Interactions

Our review recognizes creators and viewers as two primary user types on VSPs. The creator-viewer relationship depicts users' interactions built upon video sharing and consumption [189]. In HCI literature, studies have examined the creators' personalities, identities, motivations, and emotional, financial, and authentic relationships with viewers. Studies employed interviews and surveys (e.g., [22, 99, 153]), qualitative observations (e.g., [52]), and quantitative analysis (e.g., [112, 133]) to understand creator-viewer interactions. Our review shows that HCI researchers have focused on communities and sub-cultures created through viewer and creator interactions. Creators connect to viewers through video uploading [39] and live-streaming [106, 144]. Viewers interact with creators by way of commenting [112, 212], Danmaku [32, 66], and gifting [99, 144, 192]. Video-sharing research examined creators with regards to their identity [56, 161, 167], personalities [110], and popularity [134]. Social connection and community were key motivators for video creation [16, 64, 105]. Interacting with videos can lead viewers to form emotional attachments to creators [133, 200, 202] and increase

a desire to give gifts or donate [99, 144, 192]. To sustain community relationships, creators may need to emphasize authenticity and trustworthiness [9, 99, 153, 164, 215]. Reflecting on the creator-viewer interactions, HCI researchers suggested future directions for understanding and supporting creator-viewer relationships in three main directions.

Understand Motivations, Expectations, and Practices of VSP Creators and Viewers. HCI studies have recommended a deeper understanding of VSP users. Researchers need to understand the motivations, expectations, and desires that viewers have when participating in VSP interactions [85, 164, 179, 192]. Future studies may consider interviewing and surveying creators and viewers [70] to identify important factors for VSP interactions [85, 98, 100]. Gaining knowledge on creator and viewer experiences, including their practices for sharing, streaming, and consuming videos [70, 98] will continue to be central to VSP research in HCI. Also, with the increasing use of AI in VSPs, further investigation is necessary to understand users' beliefs and perceptions about algorithmic systems [80].

Involve Diverse and Under-represented Populations. Studies in our review recognized the importance of centering video-sharing research around diverse populations and under-represented groups. Future research should include users and video data from different countries [27, 72, 99, 153], of different demographics [13], and with different engagement levels [97, 159]. In addition to diversifying the users and video data, future work must emphasize populations that are marginalized or under-represented. Papers in this review provided new knowledge on the experiences of marginalized groups on VSPs [54, 70, 188]. HCI practitioners can draw from these studies to design new video-sharing technologies to improve the inclusiveness of VSP experiences.

Support Creator-Viewer Social Interactions. Understanding and supporting creator-viewer interactions is another prominent area for future research. Studies in this review recommended new interaction and communication tools to foster streamer-viewer interactions [6, 38, 52, 105, 152, 163]. Gifting and donating, for example, is an emerging creator-viewer interaction that requires further investigation [99, 110, 192, 202]. The social and emotional impacts of creator-viewer interactions also deserve future study. Future research should further investigate the nature of communication [59], emotions and affect [70, 109, 112, 195, 200], and normative authenticity and trust [9, 107]. Our review also suggests the presence of harmful activities on VSPs. Studies examined exposure to harm and attacks [118, 143, 185], presence of stigma and stereotypes [16, 167], and existing and new moderation efforts [18, 74]. These studies call for future designs that bolster fair and effective moderation to protect users.

8.2 Video Interaction and Video Data

Research about the video component examined video themes, user information, and video modalities. Studies also discussed viewers' watching motivations, interactions, challenges, and practices around live streaming and video creation. Videos as the primary media type are not only central to VSP content [19], but also support various interactions with information in different modalities (e.g., video, audio, speech, emotion, body movement). HCI researchers have examined various video interactions, including video timeline interaction [84, 123, 187], live-streaming video commenting [107, 179, 180], immersive experiences [6, 93, 132], algorithm interactions [2, 18, 72, 80, 113, 205], etc. Accessibility researchers have examined new approaches to accessible video watching, such as automatically generating captions and descriptions [125, 193]. HCI research has also leveraged online videos as a pathway to understanding people with disabilities [50, 197], LGBTQ creators [59, 167], virtual reality users [41]. The rich and multimodal video information has been used in machine learning models to recognize emotion and affect [13, 169], facial expression [71, 183], and tone of speech [196]. To understand multimodal video content, qualitative observation [59] and quantitative analysis of videos [72, 132–134], video metadata [120, 177], video frames [13], audios [118, 196], and comments and posts [159, 212] were used. For the video component, we discuss three future research directions.

Design for Watching Experiences, Accessibility, and Video Creation. Videos contain rich information and interaction modalities. HCI designs may augment VSP experiences through new video navigation techniques [23, 90, 187], live streaming features [107, 152], immersive experiences [6, 109, 132], problem reporting methods [177], and personalizations [111]. The accessibility of VSPs also requires future investigation, especially for people with visual [102, 161] and hearing [115] impairments. To support creators and streamers, new creator-supporting features are needed for vlogging [70], identifying topics and content [123, 134], tailoring content for different viewers [106], and collaborative streaming [166].

Leverage Multimodal Video Data. Researchers interested in video data and analysis should pay attention to and leverage the multimodal information in online videos. Studies in our review suggested incorporating video [23, 118], audio [183, 183, 191], facial [31, 70, 71], motion [191], emotional [13, 112], comment [112] information in data-driven research. HCI researchers should consider leveraging various statistical and machine learning analysis methods in processing the multimodal video data [71, 193]. Meanwhile, some researchers noted that fusing multimodal video data is a challenge that needs to be addressed in future research [13, 118, 193].

Consider Diverse Video Types and Genres. VSPs share videos of various categories and styles. One direction is to examine and compare videos of different types and genres. For example, researchers suggested investigating Danmaku in different video genres [66], comparing videos with different sales strategies [27], exploring the interaction design in various live streaming contexts [6, 152], and applying AI techniques to diverse videos genres [84, 191].

8.3 Design for Video-Sharing Communities

Engaging viewers and forming online communities is central to social activities on VSPs [154]. Research topics on VSP communities include the interactions and relationships of community members [70, 133, 164] and user-led content moderation [21, 22, 159]. HCI research also examined monetization and gifting – the unique VSP community activities which benefit and motivate creators [27, 99]. Studies proposed video and live-streaming interactions that support communication and socialization between viewers [32, 66, 211]. One theme found in our review was examining *Online Communities and Internet Sub-cultures*. Communities were

established based on a particular interest [52, 106, 144], with a shared identity [16, 59, 161, 167], or as a part of internet subculture [109, 143]. Surveys, interviews, and qualitative approaches were common research methods to understand VSP communities [16, 106, 167]. Reflecting on the future directions for the reviewed papers, we summarize four potential research topics for studying VSP communities.

Examine Community Activities, Norms, and Dynamics. As VSPs are attracting creators and viewers of various interests, it is essential to perform empirical and grounded studies to understand VSP communities. Future studies may explore the community habitus and boundaries [144], formation process [163], relationships and dynamics [22, 163], and professional development [45] to gain a deeper understanding of VSP communities.

Design for Viewer-to-Viewer Interactions. Besides promoting creator-viewer interactions, VSP researchers also emphasized increasing interactions and socialization between viewers, especially through new tools for commenting and chatting. Opportunities for research were identified to enhance spectators' co-experiences [96], reward community members [36], address communication barriers [105, 127], and improve inclusion of older adults [110] and newcomers [70]. It is also promising to promote viewer collaboration and engagement during highly participatory live streaming (e.g., game and creative live streaming) [98, 108, 182]. HCI designers have exemplified ideas such as incorporating data visualizations [106, 108] and comment filtering techniques [28, 32, 66].

Facilitate Community Moderation, Create Guidelines, and Regulate Monetization. Content moderation and community guidelines are critical approaches toward a healthy and cohesive VSP community. Research has suggested understanding and designing for user-led moderation. Future research should design tools for collective governance mechanisms [74], communicating about and collaborating on moderation [22, 74, 108], and presenting moderator identities [21, 159]. Researchers also recommended offering community guidelines for platform resource management [36] and promoting healthy video content [6]. For creators who rely on VSPs as an income source, community guidelines and disclosure mechanisms are needed to regulate marketing and endorsement activities [27, 120].

Generalize to Different Communities. Researchers have noted the importance of considering community differences when designing or studying video interaction techniques. For example, investigators who studied StreamSketch [108], Chatbots [158], Danmaku [209], and the hate attack detection method [118] noted future work would examine their VSP designs for different communities.

8.4 Investigate Platform Algorithms, Features, and Policies

VSPs are video management and distribution service providers [189]. HCI research has emphasized the importance of algorithms and automation to viewers' information consumption [72] and creators' video-making and streaming motivations [80, 113, 205]. The video display and accessibility features applied on VSPs affect how viewers find and engage with the videos [35, 111, 161]. VSPs are evolving video interaction and streaming techniques [179, 215] to engage creators and viewers. HCI research may leverage VSP data in different types to interpret interactions with the platform or the community [36, 50, 133, 134, 183]. As discussed below, HCI literature has five main implications for VSP algorithms, features, and policies.

Design Recommendation and Moderation Algorithms. VSP researchers suggested investigating how to recommend and deliver live-streaming videos [32, 180], match videos with viewers' knowledge levels [33], display videos through sidebar and playlist [111, 215], and personalize video recommendations [2, 111]. Researchers also call for human-centered algorithm design. Example approaches include incorporating cognitive and emotional factors such as the rawness and authenticity [182], intimacy and friendship [133], and interests of other people [14] into the video recommendation mechanism. Another direction is to delve deeper into creator-algorithm interactions [80], especially to protect marginalized groups [35, 143, 167]. VSPs can design algorithms to detect misinformation [72], violent offenses [143], embedded endorsement [113, 120], and emotional amplification effects [112].

Design Activity Tracking and Live-Streaming Management Tools. Papers in our review pointed out the need for new VSP tools to support interaction tracking and streaming management. Streamers may benefit from tools that present user engagement metrics [202], important messages during a stream [117], responses to questions [127], and badges that show viewer engagement [159]. Streaming management tools could also notify streaming status [98], summarize events during the stream [106], and enable leaving and rejoining streams [127]. Researchers recommended developing tools for video annotation [33], performance recording [96], and evaluating work quality [45].

Design for Disclosure, Authenticity, and Privacy. Managing platform identities and ensuring real content is critical for creators to manage their relationships with viewers. VSP researchers have identified design opportunities for disclosing advertisement [120, 177], supporting authentic self-presentation [9, 182], and declaring moderator roles [33]. As videos disclose more information than images and texts, privacy protection and security are also key concerns. Researchers recommended VSPs offer privacy settings [33, 98], hide identifiable information [106], and increase account security [185].

Improve Platform Services and Governance. Besides technological innovations, platforms may leverage supporting services and governance policies to support creators, viewers, and communities. For example, VSPs may support visually impaired vloggers by providing accessible tutorials [161]. Otaku communities may benefit from VSP-provided guidelines and actionable strategies for live streaming [109]. For offenders that violate platform policies, VSPs may explain penalty rationales to help fix the problems [113]. Offering APIs, plugins, and databases may facilitate designing new governance services and tools [27, 74].

Consider Differences in Platform Culture. Although VSPs share commonalities, researchers noted it essential to validate designs on different platforms [50, 55]. Researchers noted a need for future work to compare streaming activities on various platforms [104] and perform a cross-platform analysis of community activities [143, 200]. Researchers acknowledged some social and moderation activities are tied to a single VSP; future research needs to validate the knowledge by studying other platforms [21, 22, 45, 112, 200].

9 CONCLUSION AND FUTURE WORK

Our literature review provides a summary of video-sharing research in HCI. Through a scoping review of 106 papers, we outlined the themes, methods, and findings of HCI studies on video-sharing. Our review identifies the following:

- Six themes emerge in video-sharing literature in HCI: (1) *Online Communities and Internet Sub-culture*, (2) *Social Participation and Relationships*, (3) *New Video Interaction Systems and Techniques*, (4) *Interaction with Video-Sharing Platforms* (5) *Video as a Design Material*, and (6) *Videos as a Machine Learning Dataset*.
- The most used research method in our review pool is the *qualitative observation* of videos, comments, and user feedback. Researchers also applied *interviews* and *surveys* to understand VSP users. *Big data analysis* is performed on video content, metadata, frames, audio, comments, and posts from other social media. *User studies* are conducted to examine video interactions.
- Findings on video-sharing surround five VSP components: *creator*, *viewer*, *video*, *platform*, and *community*. Creators and viewers center the VSP research. We frame the findings around the five components and their relationships in an HCI video-sharing research framework (Figure 5).
- Video-sharing research pointed to the following future directions:
  - Support creator-viewer interactions through: Understanding motivations, expectations, and practices of VSP creators and viewers; Involving diverse and under-represented populations; Supporting creator-viewer social interactions.
  - Examine video interaction and video data by considering: Designing for watching experiences, accessibility, and video creation; Leveraging multimodal video data; Considering diverse video types and genres.
  - Support video-sharing communities through: Examining community activities, norms, and dynamics; Designing for viewer-to-viewer interactions; Facilitating community moderation, creating guidelines, and regulating monetization; and Generalizing findings to different communities.
  - Investigate platform algorithms, features, and policies by: Designing recommendation and moderation algorithms; Designing live-streaming management tools; Designing for disclosure, authenticity, and privacy; Improving platform services and governance; Considering differences in platform culture.

Drawing on the future directions found across the papers, we further recommend the following. While our review addresses VSPs altogether, cross-platform comparisons could create interesting insights into the varying affordances of different VSPs. Future work can compare and contrast the unique platform features such as TikTok's short-form videos and Twitch's live streaming. Additionally, HCI researchers can examine the creator-viewer interactions and community activities from platform to platform. For example, how does one platform shape creator-viewer social interactions versus another? How do the VSP community's activities and practices extend to other social media such as Twitter, Facebook, and Reddit? Videos are also a popular media format used in other applications, such as video conferencing, video-based lecturing, and movie/show streaming services (e.g., Netflix and Hulu). Our review's research themes, methodology, and design components could inspire research on those applications. With the advancement of video-sharing design and interaction techniques, we believe platforms and video modalities will continue to evolve and emerge across social media. The five components are not the entire VSP ecology. With the increasing influence of VSPs, video-sharing research also draws the attention of government [120, 182], third-party organizations, and advocacy groups [74]. Future VSP research should take emerging platforms and stakeholders into consideration. By delineating the nature, extent, and future of video-sharing in HCI, we hope this review can inform researchers in and outside of HCI and inspire future work in this flourishing area.

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A PAPERS IN POST-HOC JUSTIFICATION

Venue	Paper	Platform	Theme	Method	Video-sharing Components
GROUP	Wu et al. [206]	Bilibili	Social Participation and Relationships	big data analysis	*Video*; *Viewer*; *Community*
IMX	Wohn & Freeman [201]	Twitch	Social Participation and Relationships	qualitative observation; interview	*Creator*; *Video*; *Viewer*; *Community*;
IMX	Uttarapong [188]	Twitch	Online Communities and Internet Sub-cultures	qualitative observation; interview	*Creator*; *Video*; *Platform*; *Community*
INTERACT	Paay et al. [140]	YouTube	Videos as a Design Material	qualitative observation	*Video*
INTERACT	Löffler et al. [103]	Twitch	Interaction with Video-Sharing Platforms	user study and evaluation	*Video*; *Viewer*; *Platform*
NMS	Chen et al. [30]	YouTube	Online Communities and Internet Sub-cultures	Big data analysis	*Creator*; *Video*
NMS	Snelson [171]	YouTube	Online Communities and Internet Sub-cultures	qualitative observation	*Creator*; *Video*; *Viewer*; *Platform*; *Community*
NMS	Trott [186]	YouTube	Social Participation and Relationships	qualitative observation; big data analysis	*Video*; *Viewer*; *Community*;
NMS	Ksiazek et al. [87]	YouTube	Social Participation and Relationships	big data analysis	*Video*; *Viewer*; *Community*
NMS	Bowyer et al. [17]	YouTube	Interaction with Video-Sharing Platforms	survey	*Video*; *Viewer*
NMS	MacDonald [114]	YouTube	Interaction with Video-Sharing Platforms	qualitative observation	*Creator*; *Video*; *Platform*; *Community*
NMS	Moussa [12]	YouTube	Online Communities and Internet Sub-cultures	qualitative observation	*Creator*; *Video*; *Viewer*; *Community*
NMS	McDaniel [121]	YouTube	Online Communities and Internet Sub-cultures	qualitative observation; interview	*Creator*; *Video*; *Community*
NMS	Peterson-Salahuddin [147]	TikTok	Online Communities and Internet Sub-cultures	qualitative observation; interview	*Creator*; *Video*; *Platform*
NMS	Piittinen [148]	YouTube	Online Communities and Internet Sub-cultures	qualitative observation	*Video*
NMS	Thach et al. [184]	Twitch	Social Participation and Relationships	qualitative observation	*Creator*; *Viewer*; *Community*
NMS	Obreja [137]	Twitch	Social Participation and Relationships	qualitative observation; interview	*Creator*; *Viewer*; *Community*
TSC	Aldous et al. [1]	YouTube	Social Participation and Relationships	big data analysis	*Video*; *Viewer*; *Community*
TSC	Alvarez & Chen [3]	General	Online Communities and Internet Sub-cultures	qualitative observation; interview	*Creator*; *Video*; *Viewer*; *Community*
TSC	Khasawneh et al. [83]	YouTube	Social Participation and Relationships	qualitative observation	*Creator*; *Video*; *Viewer*; *Community*

Table 3: Papers along with their annotations from post-hoc justification.