Referencing in YouTube Knowledge Communication Videos

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In recent years, there has been widespread concern about misinformation and hateful content on social media that are damaging societies. Being one of the most influential social media that practically serves as a new search engine, YouTube has accepted criticisms of being a major conduit of misinformation. However, it is often neglected that there exist communities on YouTube that aim to produce credible and informative content - usually falling under the educational category. One way to characterize this valuable content is to find references entailed to each video. While such citation practices function as a voluntary gatekeeping culture within the community, how they are actually done varies and remains unquestioned. Our study aims to investigate common citation practices in major knowledge communication channels on YouTube. After investigating 44 videos manually sampled from YouTube, we characterized two common referencing methods, namely *bibliographies* and *in-video citations*. We then selected 129 referenced resources, assessed and categorized their availability as being *immediate*, *conditional*, and *absent*. After relating the observed referencing methods to the characteristics of the knowledge communication community, we show that the usability of references could vary depending on viewers' user profiles. Furthermore, we witnessed the use of rich-text technologies that can enrich the usability of online video resources. Finally, we discuss design implications for the platform to have a standardized referencing convention that can promote information credibility and improve user experience, especially valuable for the young audiences who tend to watch this content.

CCS Concepts: • **Human-centered computing** → *User studies*; **Hypertext / hypermedia**; **Empirical studies in collaborative and social computing**; • **Information systems** → **Social networks**.

Additional Key Words and Phrases: social media, information credibility, human-computer interaction, YouTube, qualitative analysis, video analysis, science and knowledge communication,

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1 INTRODUCTION

Being one of the largest social platforms, YouTube is not only the most influential video-sharing platform of the current time but also perceived as a major search engine [19]. People watch how-tos and tutorial videos, lectures and talks, and critiques on concurrent social issues to gain practical skills, broader insights into life, and domain-specific knowledge. Including traditional news media that references social media posts [75], society as a whole perceives social media posts as meaningful documents.

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At the same time, however, the quality of the information on YouTube has been questioned. While much of the social concern has been concentrated in malicious actors that intentionally produce and spread extremist ideas, hateful content that mislead viewers and leads to real-world consequences [21, 67, 93], it is often overlooked that misinformation and error can occur spontaneously, even by videos that focus on information sharing knowledge communication. For example, in August 2020, CGP Grey, a knowledge communication YouTuber with 4M subscribers, who makes videos about history, societal issues, and language, uploaded an erratum video titled "CGP Grey was WRONG [29]." While pointing out how the error occurred in his previous video [30], he described a dilemma in making knowledge communication videos on social video platforms, between being entertaining, taking a reasonable amount of time, and being credible at the same time. In the erratum video, he explained his video-making process, including the heavy researching and fact-checking phases for validation, but had to admit that some level of error is just inevitable in his videos. For this error, he ended up posting the corrected video and the erratum video while keeping the original incorrect one.

While not all knowledge communication YouTubers react to such errors in the same way as CGP Grey, the concern about making their viewers less vulnerable to unintentional errors or misunderstanding is not new. In March 2019, Kurzgesagt, another knowledge communication YouTube channel with more than 18M subscribers, uploaded a video titled "Can You Trust Kurzgesagt Video?". While explaining their video-making process, Kurzgesagt mentioned that even with their best efforts to make credible videos, making entertaining and educational videos can unintentionally lead to disseminating misinformation or misconceptions. To prevent that, Kurzgesagt said he put references that viewers can check by themselves to have a more complex understanding of the concept and overcome the possibility of misunderstanding. The video ended up inviting its viewers to check the bibliography they attach actively [57]. While these YouTubers are not the only ones on the platform who put references and citations, not much is known about how many people do this or how they do it.

Reference practices on YouTube are attention-grabbing for several reasons. Firstly, it is done entirely voluntarily. YouTube has gained criticism on how its algorithms and monetization policies promote extreme, harmful, abusive, or controversial videos that lead to misinformation spreading [86]. Even after the platform vowed to take action against harmful videos, the topic lingered on how to promote or demote certain videos with its monetization policies or recommendation algorithms [46, 55, 56] and actual practices to promote digital media literacy has been out of concern. This makes the community's voluntary actions stand out. Secondly, referencing is a community action that can effectively counter the spread of misinformation. Much previous research suggests that user interventions to look up the related contents made credibility assessment more accurate against false news [42, 43, 66]. Putting references and inviting viewers to look up to the bibliography is a multi-directional collective action that has the potential to transform the way their viewers consume information. At the same time, such potential can be misused and exploited if not accompanied by close monitoring and validation. As there exists much evidence that source authority cues affect the perceived credibility of online content, we can think of a scenario where references to authoritative sources are falsely put to promote the perceived credibility of a misleading video. Despite such potential benefit and harm, to the best of our knowledge, no formal studies have addressed how references are used on YouTube or social media in general.

In this paper, we investigate the current referencing practice on YouTube. Expanding from a recent study by Xia et al. that expanded the notion of science communication videos to a wider range of topics, namely *science and knowledge communication videos*, we name these videos as *Reference-putting Knowledge Communication Videos (RKC video)* in this paper, as we are focusing on videos specialized in information transfer in general and add citations, references, or other means to trace back the information sources. Our research interest is summarized in three points: *what is the convention*

of putting references?; *who puts references in the video?*; and *how usable are references in videos for general audiences?*. While there exist numerous ways to answer these question, we focus on the following research questions:

- RQ1: How do YouTube RKC video include references in videos?
- RQ2: What are the characteristics of RKC video creators, in terms of educational experience and formation?
- RQ3: How useful are references in YouTube RKC video for a general viewer validating the information?

To address these questions, we conducted a qualitative analysis with 44 English-speaking videos on YouTube where information sources are referenced, and we characterized common practices in adding references in YouTube videos and analyzed how effective or useful they will be for general YouTube users.

The paper is organized as follows. In Section 2, we describe the related work. In Section 3, we describe the data collection and qualitative coding procedure. In Section 4, we present a qualitative analysis of the sample data. Finally, we discuss the main findings in Section 5 and conclude the paper in Section 6.

creative and entertaining space but also as a news outlet and search engine, the norms of treating facts and information in video media should evolve. By employing and adapting what currently takes place on YouTube, we can devise a guideline that applies to video media in general.

2 RELATED WORK

This research is primarily informed by prior work on YouTube as an informational hub and on credibility assessment in online environments.

2.1 Online video platforms as a source of (mis)information

Video sharing platforms are functioning as search engines [19]. YouTube is perceived as a second-largest search engine, following Google [36]. Likewise, the role of TikTok as a search engine is growing, especially among younger generations [47]. On YouTube, a large portion of informational video contains practical tips like do-it-yourself tutorials [59], but also medical information [35, 88, 90], scientific knowledge [74, 84], political ideology [58], or any other topic that people find interesting. Recent products and ideas introduced by Google to provide structured learning experience on YouTube [12, 82] and studies that investigated the knowledge-sharing community on YouTube [63, 92] demonstrate the the importance of video platforms as information platforms.

While YouTube's participatory and bidirectional culture fostered the information exchange in videos, the quality of information remains questionable. There is a growing concern about the quality of information disseminated in the platforms [48, 67]. In the clinical domain, a significant body of research has been conducted on assessing the quality of health-related information on YouTube or TikTok, reporting the uneven quality of information, and claiming the necessity of rigorous quality control [37, 54, 72, 73, 90, 94]. While these studies are in the longer and more general context of assessing the quality of clinical information online [23, 89], the worry around misinformation the video platforms amplified especially during the COVID pandemic crisis in 2020 [61, 76, 80, 86].

Societies' concern about misinformation in online platforms is not new, nor limited to video platforms [78]. Past studies have investigated how political and clinical misinformation spread in Facebook. The spread of misinformation is measured through various engagement interaction metrics, like reach, view, like, or share [22, 50], or investigated through interview-based studies about the users' reaction towards social media misinformation [38]. On the other hand, while the current state of political misinformation in Twitter [41] and its influence to the platform [24] are studied more actively after the 2016 U.S. presidential election, the dynamics and drivers of misinformation have been studied for

different underlying contexts [62, 83]. About misinformation on social video platforms specifically, many of the existing studies are about defining and diagnosing the current state with domain experts about the quality of information available at the moment [61, 76, 80, 86], how the recommendation system amplifies the spread of misinformation [48], or the potential threat of deepfaked misinformation [60]. Misinformation in video platforms should be given additional care and attention because videos are spreading faster [14, 85], more persuasive because of its multimodal narrative power [34, 45, 60]. These approaches however are rather remedial measures that require time to narrowly define the target phenomena [20], the time during which the harmful effects of yet undefined misinformation pattern will spread.

2.2 How heuristic cues affect information credibility perception

Source validation is considered the most basic step in information credibility assessment and digital literacy skills [5, 10, 16, 65]. In computer science and information technology domain, a plethora of questions has been made in digital technologies that assist credibility assessment, taking not only the textual content but also the source reliability into account. In 2006, Rubin et al. proposed a semi-automated analytical framework that combines NLP-based technologies of the time. This combined credibility assessment on the textual blog content and the intuitive judgments of blog-readers [78]. Similarly, Popat et al. proposed a general credibility assessment model under a distantly supervised classification that both assesses languages style and source reliability [77].

While the effects of heuristic cues are important in human-driven and automated information credibility assessment tasks [31, 44, 66], it can have deceitful effects. In their research about detecting online fake images, Kasra et al. found that credibility evaluation of viewers relied mainly on non-image cues, including source cues, than the content depicted [52]. Hoogeveen et al. investigated the information credibility perception affected the perceived credibility of its source [44]. Through their randomized experiment, Mena et al. discovered how endorsement from trusted individuals can affect the perceived credibility of social media message [64]. Such heuristic persuasion effects are not unique to social media posts, but also found in scientific papers and articles. References in scientific paper are used to provide authoritative grounds [71].

There are still disputes about how these heuristic cues interact with each other. In their research, Go et al. focused on two-way and three-way interactions of expertise, bandwagon, and identity cues in credibility perception [39]. Case et al. said that source cue or message framing influence was less significant than the respondents' ideological predispositions, in the context of COVID19 [28]. Shen et al. argued that in evaluating the credibility of forged images, the influence of source trustworthiness and other social and heuristic cues were less significant than the digital literacy skills [81].

2.3 Inoculation against misinformation

In response to the heuristic measures and hacks that can falsely affect credibility perception, there is a growing body of research that examine how to nudge the social media users to be more resilient to misinformation. Some research in behavioral psychology have investigated how encouraging the viewer to do fact-check made them less fallible to misinformation. In recent studies in psychology, inoculation theory is gaining more attention and importance [32, 33, 87]

In their survey-based research over 1000 participants, Pennycook et al. provided evidence that providing an accuracy nudge question positively affected the willingness to share true headlines over false headlines [76]. Nekmat demonstrated in his survey-based experiment that while the willingness to share news from non-mainstream sources was smaller than those from mainstream sources, with fact-check nudges, the likelihood dropped more greatly in mainstream sources. While he suggested that this biased impact of fact-check nudges can have sustained impact on media skepticism for legacy media organizations, his study gave evidence on the effectiveness of fact-check alerts in dampening user sharing

of news misinformation from different sources on social media [70]. Although the association is not made explicitly, the implications of these studies can be related to the measures that Twitter [18], Instagram and Facebook [7] adopted to provide more context to the users and to slow down the spread of misinformation.

In their experiment on a sample of American and Indian populations, Guess et al. demonstrated how nudging users to think of digital media literacy with small indicators can improve discernment between mainstream and fake news [42]. On the other hand, Michalovich et al. discussed how web-searching could offset the positive association between perceived quality of information and periphery factors like perceived video quality and subscribers count[66]. Although the rising interest in digital media literacy and countering misinformation through user actions is even reflected in videos that state the importance of active credibility assessment [4, 9, 11, 68], to the best of our knowledge, no studies have addressed the current practices on YouTube that nudge viewers to check information credibility, and the actions taken by the platform remain vague [15, 91].

3 METHODS

In our study, we collected and qualitatively analyzed 44 English-speaking knowledge communication videos uploaded on YouTube. The data was collected between February and April 2022, and the data analysis started in April 2022. Since several videos belonging to a single channel are expected to show duplicated results, all videos were uniquely chosen from different channels. Once videos were sampled, we observed the general characteristics of each video and investigated the citation methods. Then, we characterized the common referencing practices. Then we arbitrarily chose up to 4 referenced materials from each video and analyzed how accessible the materials are for a hypothetical general viewer. We note that our study was approved by the institution's Human Research Ethics Committee and the qualitative analysis was done by a single person, the first author. To ensure the reliability of the analysis, the went through at least three passes.

In this study, we narrowly define referencing in videos as any action that visually specify the identifiable attributes of an information source material, including titles, authors, publishers, publication date, URLs, excerpted quotes, excluding self-references (i.e. mentioning books, videos, or other materials that are written by the video creators themselves.) Identifiable attributes can be presented in any form of presentation, either annotated inside videos or in metadata, or as the actual object in the video. Our criteria are based on general guides for referencing [8]. Since the online space does not have concrete rules or requirements in referencing, a video containing at least one of the identifier types sufficed.

3.1 Data collection strategy

To the best of our knowledge, there is no official list of knowledge communication channels that put references in YouTube videos, so we had to rely on iterative heuristic approach to expand the target channel list. We acquired our initial set of well known knowledge communication channels based on a science-related magazine [84], an article in scientific journal [51], and online blogs reached by searching "best educational YouTube channels" and "best video essays on YouTube" in Google search engine [1, 3]. To focus on the current trend of referencing on YouTube, we limited the date range of the observed videos as uploaded up to 2 years before the data collection (February 2020) and the end of data collection period (April 2022.) If at least one video posted between this period contained indication to at least 1 source material, we added the channel to our sample set. Out of 49 channels listed in the documents after removing the duplicates, 25 channels met our criteria. To diversify topics and channel scales, we selected additional knowledge communication videos identified in the "Up next" list, where relevant videos were suggested by YouTube and Google searched other YouTube channels based on the topic or name of the newly found channel with the same selection

criteria, adding 19 channels to our sample set. Whether the referencing was consistently done within a channel for a long period of time was not taken into account. Once we settled the sample channel set, we chose arbitrarily one video that fits our selection criteria from each channel. The data was collected in incognito mode, without closing the session throughout the observation. When none of the suggested videos referenced information sources, we went back to the previous video and branched to another. If no additional videos with references were found, we used a video of other channels in the initial list.

3.2 Qualitative analysis

Before the main analysis on referencing practices, we analyzed the videos' general information, the number of subscribers, video lengths, topic, and upload date. Also, we investigated how information was presented through video or other metadata elements. We observed the visual styles of each video according to the common categorization [17] and audio transcript provision. We expected that this investigation would bring us a better understanding of the selected channels and videos.

3.2.1 Characterizing references. To characterize different referencing methods, we watched parts of the videos and observed different methods to put references in the in-frame elements and the video description section. For videos longer than 15 minutes, we arbitrarily excerpted 10 minutes from the middle part of the video and investigated references in the selected duration. For videos shorter than 15 minutes, we observed the entire duration. We took notes on the way how creators mention the existence of resources that were not produced by themselves, whether a commercial product, a document in any form, or a third person that supports or is related to what is being delivered in the video. Based on these initial notes, we conducted our first pass using while adopting an open coding approach to categorize citation methods. We then conducted second and third passes to ensure the consistency of categorical traits and criteria. We note that the validity or quality of each reference was not taken into account in this study.

3.2.2 Characterizing the RKC video creators. In investigating the characteristics of the RKC video creators, the two main points of the investigation were *the number of collaborators* and *the past experience or education level of the creators-in-chef*. The number of collaborators was counted as the number of unique names that appear in the video, description section, or channel websites. We annotated the cases where parts of acknowledgments were given to another team. Considering that the tasks assigned to visual and audio staff are often separate from those who write the content, we separately counted only the hosts, writers, researchers, experts, and fact-checkers. The past experiences of the creators-in-chef were retrieved through visiting personal websites, English Wikipedia articles, YouTube fandom wikis, and LinkedIn profiles associated with principal creators or hosts of the selected channels. If the video was written by a group of one writer and several researchers, we investigated only the profile of the first author, usually the host of the channel.

3.2.3 Usability of references in RKC video. We observed and characterized the availability of source materials for a general viewer. To analyze the availability of referenced resources, we randomly selected up to 4 items per each video from the list of references in the metadata field or from the video in the predefined observed duration. We then searched each reference in the Google search engine and took note of its availability for a general viewer. This review process was done in incognito web browser windows via a non-institutional network, so that the researchers' academic credentials cannot affect the results.

4 RESULTS

In this section, we show the results of this study around our three research questions. In Table 1, we anonymized the videos based on the topic: EN (engineering); HM (humanities); HS (history); NG (news and general knowledge); SC (science); and SS (social science). The length of the videos ranged from 4 minutes to 140 minutes. The number of subscribers ranged from 9K to 20M, while the subscriber count of 25 videos were above 1M.

A total of 31 videos had creator-provided audio transcripts, 9 of them providing transcripts in multiple languages. There was 1 video that used auto-generated closed caption and provided a full-text transcript. We categorized the visual styles based on the common perception of YouTube video styles [17]. The most common visual style was talking head, used in 19 videos, followed by montage in 14 videos, animation in 8 videos, vlog/demonstration in 3 videos. In all videos, audio narrations were the primary element that relays information, while visual elements served supplementary roles. In Table 2, we summarized the usability of the sampled resources that were mentioned in the videos.

4.1 References in YouTube videos (RQ1)

4.1.1 Bibliography list. We found out that 39 among 44 videos used bibliography lists where resource identifiers are listed in a text-based format. Bibliography lists were presented either directly in description sections or via online documents whose access URLs are provided in description sections. In the latter case, the documents were provided in file attachments(e.g., PDF file), online document editor pages in read-only mode (e.g., Google docs), or a simple website(e.g., Google sites or a personal webpage). Since YouTube does not provide edit histories of video descriptions, bibliography lists can be edited after uploads without any notification.

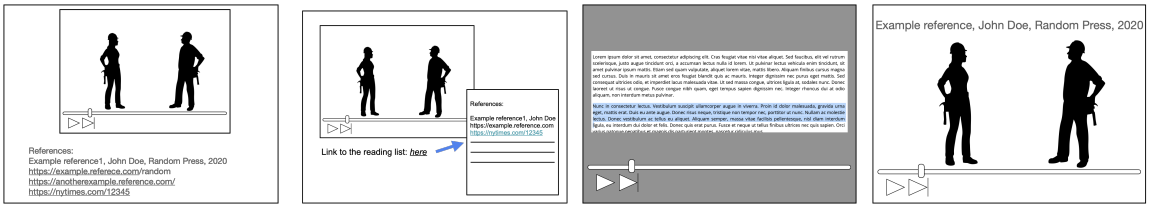
To fetch a referenced resource, a viewer can copy and paste the identifiers into their search engine or by clicking the hyperlink. Depending on the preciseness or ambiguity of the provided identifiers, the search result might contain multiple different resources. References provided in hyperlinks decisively bring the reference resource closer to the viewer unless the availability of the resources changes later on due to, for example, a platform shutdown or deleted social media post. The most basic form of bibliography is simply listing all resources plainly. To indicate a specific location of the video that corresponds with a reference, bibliographies can be used with audio transcript excerpts, numbered indices that appear in the video, or with timestamped hyperlinks of the video. Other supplementary annotation or summary of the resources to specify the context in which each resource can be used in bibliographies, working like appendices. This approach connects a source material and the video more precisely and is expected to reduce the burden of transcribing the video while verifying the contents. With regard to visual styles, bibliographies were used with all types of visual styles - with 13 out of 14 montage videos, 15 out of 19 talking head videos, and for all talking head or animation videos, while 3 of the remaining 5 claimed that they have subscriber-only reading list and additional materials.

4.1.2 In-video citations. Similar to in-text citations in text-based medium, we define in-video as captions that are inserted in the visual body of a video and contain information needed to identify source materials, most basically titles and author names. An in-video citation appears in the video as a text caption, a screen-capture of an online article, a footage of a book cover, or a scanned image of a book. We found 23 videos that used in-video citations. Since YouTube does not let its users edit uploaded videos, in-video citations cannot be edited after the video has been uploaded.

Although viewers perceive in-video citations as text, they are processed as image elements in videos and cannot be directly transferred outside video content. If used alone, in-video citations can be spotted only by watching the video attentively. This requires a high degree of concentration for viewers since captions last in-frame up to only a few seconds. Also, To fetch the references resources, a viewer has to pause the video and manually type in the identifiers

Table 1. Summary of channel & video information and referencing methods. Upload dates in *ddmmyy*
(-: unknown, not mentioned, or not provided; CC: closed-caption; #Tm: number of team members; #Wt: number of writers; V: observed)

ID	upload date	# subs (M)	len (min)	#Tm(#Wt)	experience	visual style	transcript	bibliography	in-video citation
EN1	01/04/22	7.37	12	6-15(1)	grad	montage	CC	V	
EN2	20/03/22	1.29	24	1(1)	-	talking head	-	V	
EN3	25/03/22	0.6	12	2-5(1)	postgrad	montage	-	V	
HM1	16/02/21	1.29	43	6-15(1)	postgrad	talking head	CC	V	V
HM2	02/04/22	0.466	9	-(-)	postgrad	talking head	-	V	
HM3	14/09/21	18.4	38	-(-)	grad	talking head	CC	V	V
HM4	07/08/21	1.64	89	6-15(1)	postgrad	talking head	CC(multi-lang)		V
HM5	29/05/20	1.21	14	1(1)	postgrad	montage	CC(multi-lang)	V	
HM6	31/10/20	0.927	26	-(-)	-	montage	CC	V	V
HM7	23/07/21	1	12	1(1)	grad	animation	CC	V	
HM8	02/08/21	1.66	33	-(-)	postgrad	talking head	-	V	V
HM9	05/02/22	1.23	20	-(-)	field	montage	-	V	V
HM10	16/02/21	0.272	28	-(-)	-	montage	CC	V	V
HS1	25/03/22	1.58	23	6-15(2)	-	talking head	CC	V	V
HS2	11/06/21	0.32	25	-(-)	-	talking head	CC	V	V
HS3	18/02/22	2.08	15	2-5(-)	postgrad	talking head	CC(multi-lang)	V	
HS4	02/04/22	0.91	52	-(-)	grad	animation	CC	V	
NG1	06/02/20	5.76	7	-(-)	grad	animation	CC	V	
NG2	25/06/20	0.224	47	-(-)	-	talking head	CC(multi-lang)	V	V
NG3	21/01/22	0.78	140	6-15(1)	postgrad	talking head	CC	V	V
NG4	26/05/21	1.18	104	6-15(3)	-	talking head	CC(multi-lang)	V	V
SC1	30/03/22	10.3	10	2-5(2)	grad	talking head	-	V	
SC2	01/03/22	20	12	15+(3)	grad	animation	CC(multi-lang)	V	
SC3	22/03/22	13.3	17	6-15(2)	postgrad	vlog/demo	CC	V	V
SC4	13/02/21	4.93	11	6-15(1)	grad	animation	CC(multi-lang)	V	
SC5	22/03/22	4.68	11	6-15(2)	grad	talking head	CC	V	
SC6	10/03/20	2.46	9	6-15(3)	postgrad	montage	CC	V	V
SC7	21/03/22	2.76	4	2-5(1)	postgrad	animation	CC	V	
SC8	01/04/21	0.05	16	-(-)	postgrad	talking head	CC	(subscriber-only)	V
SC9	04/01/22	11	16	15+(1)	postgrad	montage	CC	V	V
SC10	29/01/22	0.19	29	2-5(2)	postgrad	talking head	CC	V	
SC11	14/11/20	1.1	22	6-15(2)	grad	montage	CC	V	
SC12	08/10/21	0.009	42	-(-)	-	montage	-	V	V
SC13	26/02/22	4.82	68	-(-)	-	vlog/demo	-	V	
SC14	30/11/21	0.392	60	2-5(1)	postgrad	montage	-	V	
SS1	23/12/20	0.56	41	-(-)	grad	talking head	-	V	V
SS2	04/04/22	14.4	12	15+(1)	postgrad	animation	CC	V	
SS3	28/03/22	0.735	14	-(-)	grad	montage	-	V	V
SS4	01/07/21	0.97	26	2-5(1)	field	montage	CC(multi-lang)	V	
SS5	22/02/21	1.2	59	6-15(3)	postgrad	talking head	CC(multi-lang)		V
SS6	17/12/20	0.08	12	1(1)	grad	montage	CC	(subscriber-only)	V
SS7	23/08/21	0.43	50	2-5(1)	grad	montage	full transcript	V	
SS8	18/05/21	0.17	22	2-5(1)	grad	talking head	CC	V	V
SS9	27/08/21	0.18	30	15+(1)	grad	talking head	CC	(subscriber-only)	V



(a) A bibliography in video metadata section (b) A bibliography as a file attachment (c) An in-video citation as a screenshot of an online article (d) An in-video citation in open captions

Fig. 1. An illustrative example of basic referencing method

in the search engine. Depending on the preciseness or ambiguity of the provided identifiers, the result might contain multiple different resources, leaving the selection task to the viewer. In our observation, among 23 videos with in-video citations, 19 were used in combination with bibliographies, 2 with nothing else, and 2 allegedly with subscriber-only supplementary materials. With regard to visual styles, in-video citations were used with 7 out of 14 montage videos, 15 out of 19 talking head videos, 1 out of 3 vlog/demonstration videos, and not used with animation videos at least in our observation.

4.2 RKC video creators (RQ2)

Among 44 videos we investigated, 25 videos specified the names and roles of the collaborators(writer, narrator, editor, researcher and reviewer, visual effects and animation, etc.) in description sections, attached documents, or credit rolls, following the convention of legacy media - 4 of which created by a single person. Among 25 videos that were created in teams, 9 were produced by a team of 2-5 people, 12 were created by a team of 6-15 people, and 2 were created by a team of more than 15. There were 2 videos that had an external visual team, which we categorized as *15+(team of more than 15)* in Table 1. Considering that larger YouTube production teams have different different dynamics than smaller teams [53], we name the teams with *15+* people as *organizational* and the others *indie*. While the number of technical or production staff can grow above 30, the number of people who participated as co-writers, whose roles were named as writer, researcher, host, or fact-checker, did not exceed 3. Among 44 creators-in-chef, 34 had university-level experience, 18 of which with graduate school experience. 10 creators did not indicate their educational experience, 2 of them indicated their professional experience in related fields. Indication of writers and researchers is expected to provide a possibility for a viewer to send inquires to the mentioned person or search for further literature produced by the person, in some part, giving responsibility to the person who wrote the script.

4.3 Availability of reference materials (RQ3)

From the bibliographies and observed video excerpts, we fetched 129 references in total. There were 98 bibliography references and 31 in-video citations. We characterized different availability of references in the rest of this subsection. We note that the availability of reference materials is assessed in Switzerland, where good Internet infrastructure is provided. The result can differ if different network conditions were provided with regards to firewall or bandwidth.

4.3.1 Online open access. We found 63 references (46 bibliography elements, 17 in-video citations) whose entire content can be immediately reviewed and accessed by a viewer. Some examples include academic papers in open-access journals, documents archived in digital library databases, public social media posts, publicly available news articles,

Table 2. Summary of availability and accessibility of references

Category	Availability (# of videos)	Description
Immediate	Online Open Access (63)	Immediately available online without any authorization.
Conditional	Conditional Online Access (22)	Immediately available online after authorization or payment.
	Online Catalog (29)	Physically available after payment and delivery delay.
Absent	Not Found (14)	The resource is not found
	Not Available (1)	A message is displayed that the resource is not available.

or organizational reports. The availability of the resource might change depending on the decision of platforms or resource owners. While visiting the destinations, security warnings or disclaimers on possible legal issues might appear in the web browser.

4.3.2 Conditional online access. We found 22 references, all being in-video citations, where a viewer can immediately reach the item but does not have full access to the contents. An organizational or institutional authorization or an account with a subscription was required to access the resource. Once authorization is done, the resource can be reached immediately. In our analysis, news articles behind subscription paywalls and academic papers requiring institutional authorization belonged to this category.

4.3.3 Online catalog. We found 29 (25 bibliography elements, 4 in-video citations) references where a viewer can reach the online catalog page of the physical version of the document. After a payment is made, the viewer can receive the physical copy of the document after a certain delay required for delivery. The delivery fee and delay might vary depending on the viewer's physical location. If digital versions are available, the viewer can get the digital resource right after the payment is made, provided there is no copyright issue. In our samples, online bookstores fell under this category. Regarding textbooks, we observed that PDF versions could be available via copyright-infringing file-sharing platforms.

4.3.4 Not found. We found 14 (4 bibliography elements, 10 in-video citations) references where the original resource is not retrieved with the provided identifiers or related keywords. The viewer cannot verify the existence of the resource unless further investigation and research are done. Broken URLs or binary files, deleted social media posts, or shut-down services can be causes of such cases.

4.3.5 Not available. We found 1 reference where a viewer can click on the provided link and is connected somewhere but has no access to the content inside. Depending on the messages displayed to the viewer, the viewer can speculate that the resource exists or once existed. For example, if a link points to a deleted social media post where the user sees a message "this tweet is deleted", or to an online bookstore catalog that is no longer published anywhere and has no availability in second-hand market. In such cases, a viewer can guess that the resource once existed while not reviewing the contents. In the only sample we put under this category, a message that said "access denied" was displayed, and no further information was provided.

5 DISCUSSION

In this section, we provide answers to our three research questions and discuss the implications of our investigation. We then propose a design idea that could be used to facilitate putting and using references in YouTube videos, not only for the video creators but also the audience in general. We end the section by discussing limitations and future work.

5.1 Transparency awareness of the knowledge communication video creators (RQ1)

Our investigation shows that many of the the video creators not only specified (i.e., named) information sources but also collaborators in video-making and audio transcripts. Collaborator credits include detailed accreditation to video sound and visual team, but also writing teams like researchers or fact-checkers. This opens a possibility for a viewer to send inquires to the mentioned person or search for further literature produced by the person, in some part giving responsibility to the person who wrote the script. In the case of audio transcripts, the accessibility of the content is enhanced not only for blind or deaf audiences [6, 49] but also for general viewers, allowing them to review the whole content at a glance. These lead to better interactions in verifying the contents and reduce the burden of transcribing the video while verifying the contents. While such practices are not new, it is worth noting that the platform does not have any strict rule in specifying names of the technical collaborators or creator-provided audio transcripts. Unlike the platform's various algorithmic tactics to combat hateful or misinformative content, neither a reward nor a penalty system exists in the platform to explicitly promote such actions. We thus say that the knowledge communication community is more motivated and aware of the matter of making the video more transparent.

Although our study does not go deeper into the underlying motivation or factors, we relate this characteristic to the high percentage of postgraduate education experience in the observed group. Half of the *indie* video channels that revealed the number of collaborators was with creator-in-chefs with master level or doctoral level education. This number is not only noticeably greater than the proportion of Master's degree holders in the U.S in 2018 (21.0%) [26] but also than the percentage of graduate degree holders in a previous study that investigated the science and knowledge communication creators in YouTube (29.7%) [92]. This reflects the current landscape of digital literacy practice and referencing training, which is emphasized mainly in higher educational institutes [5, 10]. This implies that the role of institutional instruction and training is still important in promoting awareness in digital media literacy or information transparency in general.

5.2 Mixing the conventions of text-based and audiovisual media (RQ2)

Our investigation shows that references in YouTube knowledge communication videos adopt the conventions of text-based media to cue the audience and list the resource in rich-texts. In addition to enhancing the usability of videos in querying, indexing, and retrieving relevant information, bibliography in YouTube videos allow supplementary paragraphs and annotations to add more context to understand the video in depth, or hyperlinks to resources and timestamps to add navigability.

These text-based practices can be used to complement the ambiguity of audiovisual media. In traditional video-making, whether fictional or informational, different audiovisual elements have been used to figuratively deliver certain feelings and ideas [13, 79]. The distinction between the actualities and reconstructed images was not always made clear. In the current setting of YouTube, where the information spreads rapidly, and the audience is likely to be drawn to more casual and entertaining videos, this might result in disseminating misconceptions or misinformation. By using text annotations, deep and complex context can be provided to the audience while preserving its cinematic narrative impact.

However, it is hard to recognize the bibliography if not said explicitly in the video, especially for general audiences who are not specifically motivated to checking references. This can be overcome by in-video citation cues. Like in-text citations, in-video citations overtly signal the audience about references, breaking the fourth wall of the video. In our analysis, in-video citations were used intensively in talking head videos, where the fourth wall is already broken by the an overtly visible narrator talking directly to the audience, and not used at all with animation videos. This implies that the video creators were aware of the convention in audiovisual media where breaking the fourth wall is considered a breach-of-etiquette-technique and thus used in-video citation limitedly.

By bridging the conventional gap in old and new mediums, the YouTube knowledge communication community is reinventing videos as a structured informational medium that requires active reviews and quality assessment by its viewers. We speculate that shedding more light on these YouTube communities will bring new potential to the platform a high-quality informational hub. We note, however, that the irregular abidance to conventions results in a variety of combinations of referencing styles in YouTube content and not-so-consistent user interaction. From this aspect, we call for platform-driven actions to have structured connections to other resources.

5.3 Varying usability of references

As our results show in Section 4.3, there exists a possibility that a viewer cannot review the resource immediately because of her affiliation or subscription status, or due to economic affluence. Also, in some cases, the bibliography or behind-the-scene materials were only for paid subscription audiences. This imbalance affects the opportunity to assess the content's credibility and, eventually, the effectiveness of referencing on YouTube for the general public. As many previous works have noted, credibility assessment in social media is a heuristic task [69], depending highly on users' aptitude for the specific media [65]. This implies that users can perceive a video with references to be more credible even when verification is not feasible. If such perception exists, it is possible to fake content credibility with a long list of references that viewers cannot have access to. Although this is a hypothetical scenario we have not empirically verified, we state that without the possibility for general users to access and review the referenced materials, references on YouTube might remain ineffective in promoting digital literacy practices, if not resulting in abuse cases.

5.4 Design suggestions to improve referencing in YouTube

From our findings, we speculate about elements that could support the knowledge communication community on YouTube as follows: (1) a list that summarizes the collection of references; (2) hyperlinks to referenced resources; (3) connectors between referenced resources and timestamped video content; (4) flags inside the video that notify the viewers of the information sources.

One possible approach is to manually insert information sources while uploading the video, in a similar way that captions are inserted in YouTube [2]. After letting creators specify each reference during the uploading process, all references can be aggregated into a single list. We can imagine displaying references in video players as clickable hyperlinks, with a button for a viewer can control the playback environment and choose or choose not to display references. Also, the platform can standardize the types of reference identifiers through input fields or templates.

Although our idea is built upon previous design ideas on text-annotation in educational video [40], it is more targeted at referencing and based on the current YouTube landscape. We speculate that this design can enhance interactive credibility assessment while not posing too much labor or cognitive overload to users. Being aligned with previous attempts in education technology to promote referencing skills through e-learning [25], this will lead to better chances of instructing users on how to use references on YouTube and the importance of referencing.

With standardized reference identifier representations, the platform can better manage the references, which can be connected to automated credibility assessment. Also, new technical standards in user interface and experience of large social media platforms can work as a new norm in producing and consuming online content. By suggesting a standardized referencing interface on the platform, we envision its impact reaching beyond the knowledge communication community and spreading to the entire YouTube community, eventually affecting the way people perceive video media in general.

5.5 Limitations and Future work

The first limitation has to do with data collection. While we observed how knowledge communication channels put references in various domains, the number of channels per topic is not evenly distributed. Although we did not exclude candidate videos based on the number of subscribers, the number of subscribers for all but one selected channels exceeded 10,000. Such a sample group may suffer from sampling problems because the videos we investigated may not represent the entire knowledge communication community on YouTube. Moreover, although we assumed referencing and knowledge communication are closely interrelated, whether referencing practices in this specific community can represent general practices is not yet known. Still, we note that other observational studies about YouTube used platform suggestions and recommendation systems and to expand the sample set [35, 54, 61, 73, 90, 92]. It would be beneficial to expand the data collection in the future to have a more comprehensive understanding of reference practices in user-generated content in social media, in parallel to defining the phenomenon concretely. While the impact of the research could be expanded with a larger dataset, we wish to emphasize that our research used qualitative observation with close reading of the videos. Considering the analysis of local standards for sample sizes within the ACM CHI literature, whose mean sample size for observation studies was 18 for in-person studies and 97 for remote studies while the most common sample size was 12 [27], we claim that the sample size was reasonable.

Another limitation is that we were not able to conduct a deeper analysis of various dynamics and factors around putting references in YouTube videos. Although we addressed the practical status quo of references on YouTube, its interplay with the YouTube community remains unanswered. For example, our study does not address the motivations of knowledge communication YouTubers putting references in their video with no tangible, especially monetary, rewards. Moreover, since we did not have enough expertise to assess the relevance of the creators' past experience and the videos they are creating, we had to rely on the known information about the creators' education level. Whether the videos were created by individual creators, well-known organizations, or institutions would have been an interesting point to discuss, but we lacked the contextual background to characterize the channels. Future work could expand the analysis through interviewing the creators of knowledge communication channels of the platform. Finally, we note that the qualitative coding in our study was done solely by one of the authors, being unable to cross-validate the coding results.

As a third limitation, reference usability is assessed on an exploratory level and is not based on user experiments or surveys. Since our argument is built upon our assumption of the good intentions of the users and did not consider possible abuse cases, our analysis and speculation might miss complex real-world problems that can arise around references. For example, a bibliography can contain a link to a phishing or copyright-infringing website. Future work could improve upon this and connect the empirical dynamics around references with our existing knowledge on perceived credibility through participant interviews or experiments.

As a last limitation, we note that this study targeted only English-speaking knowledge communication YouTube channels. The insights we drew from our analysis might differ according to YouTube community dynamics in different languages. Similar studies targeting different language communities or more global scale would be beneficial to understand how YouTube is used as informational hub in a more general sense.

For our future work, we aim to focus on creators and viewers of RKC video to investigate their experience in putting, recognizing, and using references in the videos, and the potential of RKC video as stimuli to promote fact-checking and referencing skills for a greater public.

6 CONCLUSION

In this paper, we characterize common practices and patterns surrounding the phenomenon of putting information sources on YouTube. We developed a taxonomy of referencing using qualitative coding. Further, we characterized the usability of references and accessibility to referenced materials for general viewers. Our results show that YouTube creators incorporate multi-modal aspects of the platform to reference information sources by richly using text annotations and reference conventions of traditional media. Moreover, while online technologies provide technical availability for viewers to reach back to source materials and have immediate access to the contents, their end-level accessibility users' ability to verify the contents depends on publishers' and service providers' policies. We hope these findings may help future research to better understand YouTube as an informational sphere and improve platform affordability to keep up with YouTube's important role in disseminating information.

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