

Video-Mediated Interpreting

A Systematic Critical Review and Pedagogical Implications for Interpreter Education

<https://doi.org/10.3991/ijet.v17i19.31653>

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Abstract—To better understand video-mediated interpreting (VMI) and accordingly offer pedagogical implications to interpreter education, a systematic critical review was conducted on 27 empirical studies concerning VMI and published from 2005 to 2022 in journals listed in either Science Citation Index Expanded or Social Science Citation Index or Arts & Humanities Citation Index. Three major findings were obtained. First, VMI has been explored by researchers from various fields, such as translation studies, medicine, and sociology, and VMI studies have increased in number steadily since 2017 (i.e., two years earlier than the pandemic of COVID-19). Second, VMI research has centered upon six issues: (1) cost of time, (2) financial cost and benefits, (3) physical and psychological costs, (4) communication quality and users' satisfaction, (5) stakeholders' acceptance, and (6) strategies used by interpreters in VMI. Third, the VMI studies published in these 17 years had both strengths and potential problems in the research design. The major strengths were the large sample sizes adopted and the multiple indexes used to operationalize target constructs. The potential problems mainly concerned lack of a control group or control condition, the control of potential confounding factors, and the validity and reliability of the questionnaires employed. Along with implications for future VMI research, implications for interpreter education were discussed, in particular the importance of instruction on VMI strategies and the usefulness of VMI practice for interpreting trainees.

Keywords—video-mediated interpreting, remote interpreting, distance interpreting, systematic review, interpreting training

1 Introduction

Video-mediated interpreting (VMI), which is one specific type of remote interpreting, refers to an interpreting activity during which the interpreter and the other parties at talk are physically separated in no fewer than two sites and the interpreting service is thus provided with the aid of video communication technologies [5]. When interpreting service is needed but an on-site interpreter is not available, remote interpreting is a feasible or perhaps more efficient solution (especially when interpreting service has to be

available on short notice). As VMI provides not only audio but also visual information (both of which are important in communication), VMI has been adopted more widely in recent years than the other type of remote interpreting, that is, telephone interpreting [26], and thus the current study focused on VMI.

Although VMI has been used in a variety of settings (e.g., [3, 32]), it is controversial to what extent it could facilitate communication. For example, the audiovisual quality was found to be insufficient in some cases [30], and for interpreters in particular, VMI was found to associate with a sense of alienation and earlier fatigue during interpreting [29]. In recent decades, however, communication technologies have been advancing greatly, for instance the development from 4G networks to 5G, and the present study thus wonders whether VMI service has improved simultaneously in these years, and whether stakeholders (in particular interpreters and users of interpreting service) have changed their attitudes towards VMI. Due to the desired social distance and remote communication as a result of the spread of COVID-19, these two questions on VMI become particularly important to both interpreting industry and interpreting training. To answer these questions, the current study was aimed to critically review recent empirical studies on VMI and accordingly provide pedagogical implications.

2 The present study

So far in established journals (including the journals listed in Science Citation Index Expanded and/or Social Science Citation Index and/or Arts & Humanities Citation Index), three review articles pertinent to VMI have been published [1, 13, 18], which have helped interpreting instructors and stakeholders in interpreting service understand not only more about VMI but also more about remote interpreting in general. All the three reviews, however, were confined to the VMI used in medical settings. Besides, when they searched for suitable studies for review, they did not confine the search to articles published in the aforesaid established journals, which, as the present study believes, might reduce to some extent the reliability of the review findings. Considering the technology development since the publication of the earliest review article [1] and the wider use of remote communication precipitated by the pandemic since 2019, the current study focused on the VMI studies published from 2005 to the time when the present review article was written (i.e., March, 2022). Besides, the current review focused on the studies published in either SCIE or SSCI or A&HCI journals and those providing primary empirical data.

To provide a review as comprehensive as possible, the present review covered VMI adopted in different types of settings (e.g., medical settings, judicial settings, daily briefings for football matches). Besides, the current review covered both sub-types of VMI, including (1) video remote interpreting (i.e., the VMI in which the interpreter is not at the same site as any of the primary interlocutors in communication) and (2) videoconference interpreting (i.e., the VMI in which the interpreter is located at the same site as one of the primary interlocutors) [6]. The present review also covered a specific sub-type of video relay service for deaf or hard-of-hearing users, in which all the parties at talk can see one another via visual links [31].

3 Method

To obtain suitable studies that were mutually exclusive and collectively exhaustive, the author searched for articles published from January 1st, 2005 to March 31st, 2022 in the Web of Science (WoS) citation database and the Google Scholar (GS) database. When the author searched in WoS, the following parameters were used: All: (“video” AND “interpreting”). The results were refined by DOCUMENT TYPES: (ARTICLE); Timespan: from 2005-01-01 to 2022-03-31; Indexes: SCI-EXPANDED, SSCI, A&HCI. This returned 2,406 results, from which the author manually removed the studies unrelated to VMI, the studies that did not report primary empirical data (e.g., reviews and book reviews), and the non-English literature [9]. Finally, altogether 19 studies were retained. When the author searched in GS, the author respectively used “remote interpreting”, “distance interpreting”, and “video interpreting” as the search term. Afterwards, the author manually removed the studies that did not meet the same screening criteria used in WoS, and finally 18 articles from the GS database were retained, among which 10 overlapped with the articles obtained from WoS. Hence, the author collected altogether 27 suitable articles for the current review.

The upcoming Section 4 reports the results of a systematic critical review of these 27 articles, in which descriptive statistics on the publication and citation of these articles are first provided, followed by critical reviews of their research designs and research findings. Based on the critical review, implications for future VMI research and implications for interpreting training are both discussed. In Section 5, the major findings in the present review are summarised and a conclusion is provided.

4 Results

4.1 Descriptive statistics on publication and citation

The number of empirical studies published each year from January 1st, 2005 to March 31st, 2022 is shown in Figure 1, which demonstrates that in the last five years (i.e., since 2017), there has been at least one VMI empirical study published each year in an either SCIE or SSCI or A&HCI journal. Besides, the year of 2020 witnessed the largest number of relevant articles published in these established journals (i.e., in total five articles). It is not certain whether the relatively high number of VMI articles in 2020 was related to COVID-19, given that none of these five articles mentioned the pandemic. In the years of 2021 and 2022, however, four of the six reviewed articles did use the expression “pandemic” and/or “COVID-19” in their main texts [10, 11, 19, 22].

Among all the authors of these 27 articles, Sabine Braun, who is a professor of translation studies, and Christian Licoppe, who is a professor of sociology of information and communication technologies, can be considered the most active VMI researchers, given that they authored the first and the second largest number of articles selected for the current review (i.e., altogether five articles by Professor Braun and three by Professor Christian). In terms of the authors’ affiliations, the University of Surrey (to which Professor Braun was affiliated), the Telecom Paris (to which Professor Licoppe was affiliated), and the University of Vienna are the three most commonly seen. Of the

authors’ affiliations, almost a half (around 13) were medical universities or medical organizations such as hospitals, which indicates medicine-related stakeholders’ and researchers’ strong interest in VMI.

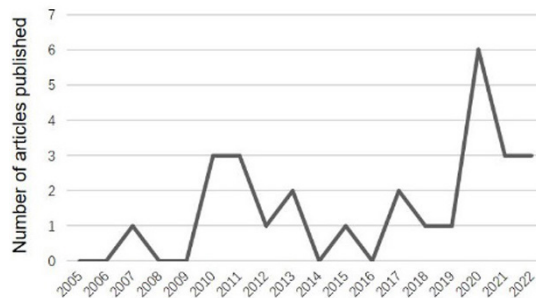


Fig. 1. Number of empirical studies published each year from January 1st, 2005 to March 31st, 2022 on video-mediated interpreting in the journals listed in either Science Citation Index Expanded or Social Science Citation Index or Arts & Humanities Citation Index

In terms of citation, [27] was the most cited article by March 31st, 2022, which was cited for 85 times according to WoS and 193 times according to GS. Among the 85 citations in the WoS database, 55 were still included in this database by March 31st, 2022, and there was only one self-citation among these 55 citation records. Another highly cited article was [2], which was cited for 96 times according to GS (of which 69 times were the citations by other researchers), although its citation record was not available in WoS. The articles with over 10 citations since the publication year according to WoS is shown in Table 1.

Table 1. Empirical studies on video-mediated interpreting (published from 2005 to 2022) that have been cited for over 10 times since the publication year, based on the statistics provided by Web of Science by March 31st, 2022

Article	Total Citations	Average Citations/Year	Article	Total Citations	Average Citations/Year
[27]	85	6.54	[3]	39	3.90
[33]	60	5.45	[4]	16	2.67
[34]	47	3.62	[23]	13	1.30
[32]	46	3.54	[28]	13	1.08
[26]	41	5.13	[24]	11	1.83

To interpreter education, the steady increase in VMI publications since 2017 indicates both researchers’ and stakeholders’ strong interest in this mode of interpreting service. Given the social distancing guidelines as a result of the pandemic, it is probably wiser for both interpreting instructors and interpreting trainees to accept VMI as, at least, something they have to “live with” [35]. Hence, it is probably necessary for interpreting instructors to at least introduce VMI for interpreting trainees, and if possible, to devise specific exercises for trainees to practice in VMI. To obtain an overview

of VMI research or to know about frontiers of the relevant research, one can start with the aforementioned most active authors' works and the most cited articles.

4.2 Review of research designs and research findings

There are in total six research topics sorted out from the 27 VMI articles selected for the current review, that is, (1) cost of time, (2) financial cost and benefits, (3) physical and psychological costs, (4) communication quality and users' satisfaction, (5) stakeholders' acceptance, and (6) strategies used by interpreters in VMI (see the sub-section "Research findings" for the specific articles concerning each of these topics). Among these topics, *physical and psychological costs* and *strategies used by interpreters in VMI* were not even mentioned by the previous VMI review articles [1, 13, 18]. On the four topics that were reviewed previously, new research findings were obtained by these 27 studies. These indicate how the frontiers of VMI research are being pushed back in recent years.

This section first reviews the research designs commonly found in the 27 articles. Second, it summarises and reviews the major findings (especially new findings not reviewed previously) on each of the six research topics. Based on a critical review of VMI research designs and research findings, possible directions for future studies and pedagogical implications for interpreter education are discussed.

Research designs. In the 27 VMI studies, especially the more recent ones since 2012, there were two major strengths in the research design. First, these studies usually adopted large sample sizes (e.g., over 280, 000 medical encounters in [36]). Second, most of these studies operationalized its target construct into multiple indexes instead of a single index, and therefore these studies were able to obtain richer data and provide us with more informative findings. For example, [33], which operationalized communication quality facilitated by VMI into specific communication qualities in various types of medical scenarios, found that the effectiveness of VMI might vary in different scenarios. To be specific, VMI was considered to be more effective than telephone interpreting in scenarios such as inpatient nursing teaching and hospital discharge instructions, but not in other scenarios such as obtaining consent for complex procedure and performing occupational therapy.

There were, however, three potential problems commonly found in the VMI research design. First, the lack of a control group or control condition. Six of the 27 studies adopted either the method of naturalistic observation, or ethnographical observation, or tracking technologies of eye and pen movements to explore the process of VMI or the process of VMI-based communication (e.g., [19, 22]). They did not, however, have any control group receiving or offering on-site interpreting, or have the on-site condition as a control condition in a within-subject design. Hence, what these six studies observed about VMI process or VMI-based communication process may not be unique to VMI but some common features shared by all modes of interpreting (or all types of remote interpreting). Due to this lack of control group or control condition, it is necessary to interpret the relevant findings with caution.

Another potential problem in the research design was the control of potential confounding factors. Among the 27 reviewed studies, 17 conducted a certain comparison

between different interpreting conditions, of which only eight studies clearly stated or suggested that they acknowledged potential confounding factors in their research designs and had thus taken measures to prevent these factors from confounding the results (e.g., [26], which used the design of a randomized clinical trial to control the possible confounding effects of a series of factors, such as medical complexity of the child patient). For the other nine comparison studies that did not discuss adequately on confounding factors or did not take adequate measures to control these factors, the credibility of the results can be reduced. For instance, in one of these comparison studies that adopted within-subject designs to compare the interpreting quality between VMI and on-site interpreting, the break between these two conditions was not long enough (e.g., 10–15 minutes in [3]), which increased the likelihood of practice effect that could confound the results. To control the potential practice effect, these comparison studies could have counterbalanced the order of different interpreting conditions or the order of interpreting materials as a between-subject variable, or could have provided longer breaks between conditions.

The third problem in the VMI research design was questionnaire validity and reliability. Among the 27 studies selected for the current review, 10 studies used questionnaires (also referred to as “surveys”) as their major or the only tool for data collection, while only two of these 10 studies (i.e., [26, 32]) had reported the reliability and/or validity data of the questionnaires they employed (e.g., the Cronbach’s α estimates, the construct validity, the criterion-related validity; see [7]). The other eight studies based on questionnaire data did not mention any psychometric property of the questionnaires they developed or adapted, which to some extent reduced the reliability and validity of the results obtained. For future research that plans to design a new questionnaire for data collection, it is essential to report its validity and reliability data. For the research that plans to use a questionnaire adapted from a previous study, it is not only necessary to check the questionnaire’s validity and reliability reported in the previous study, but also to test (as well as to report) the psychometric properties of the adapted questionnaire by a pilot study.

Research findings. From the 27 studies selected for the current review, six research topics were sorted out, ranging from *cost of time* to *strategies used by interpreters in VMI*.

Cost of time. In the 27 articles, *cost of time* referred to three specific issues: (1) how much travel time interpreters could save by offering VMI instead of on-site interpreting service, (2) how long users had to wait until they could actually enjoy VMI service, and (3) how long VMI-based communications took.

Regarding the first time issue, the major finding was that VMI did save travel time for interpreters since they did not need to shuttle between places to offer interpreting service (e.g., [20]), which suggests practical benefits for interpreters when VMI is used.

With respect to the second time issue, it was mainly found that the waiting time (i.e., the period after one has sent out a service request and before one can actually enjoy the service) was longer in VMI than on-site, although the waiting time was not significantly different between VMI and telephone interpreting (e.g., [11]). The longer waiting time in VMI was probably due to the time needed for setting up VMI facilities, especially when the camera used was fixed and all the other VMI facilities and people involved in the communication had to change their routine positions to suit the fixed

camera [31]. Besides, in order to facilitate VMI, extra time may be needed for briefing all the parties at talk about technical issues (e.g., who is where) and about linguistic issues (e.g., the use of space in Australian sign language) [31]. Of note is that the relatively long waiting time in VMI tended to increase the stress of VMI users [11].

Nonetheless, when VMI was used in a healthcare setting, the waiting time was not necessarily long. For example, Havelka [14] reported that in Austria interpreters for VMI service were required to be available within 120 seconds. Besides, the time it took users to schedule interpreting service (i.e., the period after one sends out a service request and before one successfully books the service) seemed to be shorter in VMI than on-site, since in VMI one did not have to waste time for rescheduling when no on-site interpreter was available in the initial desired time and/or place [15].

To interpreting instructors, these research findings indicate that it is necessary to inform interpreting trainees about the typical waiting time in different scenarios when VMI is used. Besides, it is necessary for interpreters, especially novice ones, to know how long their clients usually have to wait before VMI service is available to them so that interpreters can be better prepared for relevant questions and even complaints from their clients. It is also important for novice interpreters to know more about the waiting time involved in VMI so that they can develop strategies accordingly to reduce possible awkwardness or embarrassment during waiting time.

In terms of the third time issue, that is, time length of interpreting-mediated communication, the findings were inconsistent across studies on whether the encounter time was longer or shorter in VMI than on-site. Braun [3], who adopted a within-subject design and asked each of eight interpreters to offer both VMI and on-site services on a series of comparable materials, found that the VMI-based encounters took five minutes longer on average than the encounters mediated by on-site interpreting. By contrast, two studies [26, 27] that employed between-subject designs and used inferential statistics did not find significant difference in encounter time between VMI and on-site (or between VMI and telephone interpreting). A third study on this issue [36], which compared the encounter time between over 240,000 cases of on-site interpreting and overall 32,000 cases of VMI conducted in the same hospital, showed a shorter average encounter time in VMI than on-site (mean of on-site [SD] = 41.72 [36.1]; mean of VMI [SD] = 30.72 [26.0]). As this study did not use inferential statistics in data analyses, however, the present review was still not sure whether the encounter time in VMI was significantly shorter than on-site. Of note is that the scenarios in [3] (i.e., police-suspect interviews), which was the only study that found the encounter time was significantly longer in VMI, were different from the scenarios in the other studies on encounter time (i.e., medical scenarios). Hence, the current review wonders whether the encounter time can be modulated by the encounter type or scenario. These questions are worth further exploration, since encounter time or working duration is closely related to interpreters' stress [29], and therefore can be related to VMI service quality and interpreters' acceptance of VMI. Besides, interpreting service users may be also concerned with the encounter time of VMI, given that the financial cost of the service is usually correlated with the encounter time [1].

Financial cost and benefits. Another important topic of VMI research is financial cost of VMI and extra financial benefits that interpreters and/or users of interpreting service can obtain by using VMI instead of on-site or telephone interpreting, on

which the relevant findings so far were comparatively consistent. According to the reviewed articles (e.g., [11, 15]), VMI reduced overall financial cost for organizations (e.g., hospitals, police stations) that had a constant need of interpreting service and usually required the service to be available on short notice, although the capital cost for VMI devices could be expensive; to interpreters, as VMI saved travel distance and travel time, this interpreting mode could help them not only save the financial cost for travelling, but also better meet the high demand in interpreting work and thus get more financial benefits; to individuals who needed interpreting service (e.g., a patient who was a sign language user and had to communicate with a healthcare provider who did not know the sign language), VMI was less expensive than on-site interpreting. Even in some cases where VMI was more expensive than telephone interpreting, patients were still more willing to use VMI since it provided more visual information than telephone interpreting, which is important in communication.

Based on the existing findings, the current review believes that more detailed analyses of the VMI financial cost are still needed, for example, the cost of training VMI interpreters. Besides, it is also necessary to investigate the labour costs of employing technicians to set up and maintain VMI facilities. These financial cost issues are needed by administrators who have the potential power to decide whether to use VMI systems or not, and are thus important in the promotion of VMI service. In Fiedler et al. [10], the rate of using VMI was found low even when refugees had huge demands for interpreting service in medical settings, and on-site interpreting was almost impossible for them. As this study found, it was probably due to the vague cost assessment for VMI service in the relevant settings.

Physical and psychological costs. Another focus in the 27 reviewed articles is whether interpreters had to pay any extra physical and psychological costs in comparison with on-site interpreting (e.g., [34, 35]). In terms of the physical cost in VMI, Roziner & Shlesinger [34], which adopted a within-subject design and collected various types of data (e.g., interpreting output, interpreters' physical conditions and mental conditions) at different stages of a two-week period from 36 professional interpreters who offered real interpreting service in both VMI and on-site modes for the European Parliament, found that not all the working conditions in VMI were so good as in on-site interpreting (e.g., the thermal and the lighting condition). Probably due to the overall poor working conditions in VMI compared with on-site, in VMI the interpreters used incorrect sitting positions for a longer period of time, and three out of five optometric indexes were less satisfying, which, to some extent, may lead to what the interpreters complained as earlier fatigue and increased physical pain in VMI.

With respect to the VMI psychological costs, so far the findings were less consistent, particularly between the findings based on self-reports and the findings based on more objective assessments. Based on interpreters' self-reports, it was found that VMI was more fatiguing, isolating, and stressful than on-site, especially when interpreters were required to be available on short notice and/or when interpreters were not offered necessary preparation materials (e.g., [2]). On the other hand, objective indexes of fatigue and stress (e.g., index of drowsiness and index of concentration) that were widely accepted showed no significant difference between VMI and on-site interpreting [34]. Moreover, there were interpreters who found VMI *less* stressful than on-site. According to these interpreters, in a remote mode (1) they were not exposed to the scrutiny of

the audience, (2) they did not have to worry about the dress code or to experience the tension in the conference room, and (3) they were less interrupted by other conference participants [35]. Some interpreters also mentioned that high-tech VMI facilities and professional help from technicians reduced the stress they experienced in VMI (ibid.).

On such a discrepancy between interpreters' subjective reports about fatigue/stress in VMI and the relevant objective assessment results, an explanation given by [34] probably makes sense: in remote interpreting, interpreters felt more alienated and isolated, which may have negative impacts on some (but not all) interpreters' satisfaction with this interpreting mode, and may thus lead to higher levels of stress and/or earlier fatigue, particularly to those who were more used to or even attached to the traditional working pattern of interpreting (i.e., on-site interpreting).

Based on the aforesaid explanation, the following two measures may be helpful for interpreters (especially interpreting trainees and novice interpreters) to reduce the fatigue/stress they may experience in VMI: (1) practise in VMI and familiarize oneself with this mode of interpreting, so that one can be prepared both physically and psychologically for VMI; (2) develop individualized strategies to deal with the potential physical and psychological costs in VMI; (3) even in remote communication, find a way to cooperate with colleague interpreters to whom the same or similar interpreting task was assigned. By so doing, the interpreters can become a team and members can consult with each other [35]. To interpreting companies and users of interpreting service, it is important to let interpreters understand their interpreting quality is rated as good as in on-site mode according to objective assessments [34], and therefore their work is appreciated the same as in on-site interpreting.

Due to COVID-19, the present study also wonders whether the pandemic, in which social distance is required and remote communication becomes more widely adopted (or even become a must in some cases), may change interpreters' a prior biased attitude towards VMI if any, and whether a different attitude towards VMI may in turn reduce the stress or other psychological costs that interpreters have to pay in this interpreting mode. Our prediction is a confirmative answer according to [21]. In this study, interpreters' more frequent use of telephone interpreting had a potential positive relationship with their acceptance of telephone interpreting. Besides, after a period of telephone interpreting practice, the interpreters reported that they had overcome fatigue and stress and had increased in their spans of concentration. On potential change of psychological costs (as well as physical costs) in VMI during relevant training or practice, more studies on a larger scale with a longitudinal approach is warranted.

Communication quality and users' satisfaction. This research topic mainly referred to the quality of communication facilitated by VMI or the effectiveness of VMI in facilitating communication (e.g., [3, 4, 5]). Most of the relevant studies relied on subjective judgements (e.g., patients' satisfaction with VMI-based communication), while four of the reviewed studies adopted more objective assessments [15, 16, 26, 34].

The findings based on the objective assessments were comparatively consistent, that is, the communication quality was not significantly different between VMI and on-site or between VMI and telephone interpreting. For instance, [34], which asked two independent judges to rate the quality of 570 excerpts of interpreting output delivered by 36 professional interpreters either in VMI and on-site interpreting, found that the quality of interpreting service was not significantly different between the two

interpreting conditions. Besides, Hwang et al. [15], who conducted comparable cognitive assessments both in VMI and on-site conditions within subject, did not find significant difference in the assessment scores between the two interpreting conditions.

By contrast, the findings on communication quality based on subjective judgements (i.e., users' satisfaction with the communication) were less consistent across studies. Before the relevant findings are reviewed, it should be noted that this line of research adopted questionnaires as their major or even only data collection tools. As reviewed in the sub-section of "Research designs", these studies did not report the reliability or validity data of the questionnaires they used, and thus the findings should be interpreted with caution. Besides, it should also be noted that in this line of research, there were three different types of subjective judgements: (1) the judgement given by the users who needed interpreting service to better perform their jobs (e.g., healthcare providers, police officers; named "User A" for short hereafter), (2) the judgement given by interpreters, and (3) the judgement given by the user who needed interpreting service to facilitate their communication with User A (e.g., a patient in a medical setting or a suspect in a police interview; henceforth User B).

Based on User A's or interpreters' subjective judgements, the communication quality was considered in general better in on-site interpreting than in VMI (e.g., [27, 33]), although one of the reviewed studies (i.e., [32]) did not find relevant significant difference between the two interpreting conditions, as long as the interpreting service was provided by professional interpreters instead of untrained ad hoc interpreters like family members or friends.

With regard to User B, their satisfaction with VMI-based communication was found less consistent across studies, especially between the relevant quantitative studies and the qualitative ones. By quantitative analyses, no significant difference was found in User B's perceptions of the communication quality between VMI and on-site, although User B believed that on-site interpreting might be more effective in helping User A understand their cultural background (e.g., [32]). According to qualitative analyses (mainly substantiated by interview data), however, User B considered on-site interpreting more effective than VMI in facilitating their communication with User A (e.g., [17]). User B also pointed out the reasons for their negative perception of VMI-based communication. First, it could be due to unpleasant previous experiences of using VMI where the audiovisual quality was poor. Second, in medical settings the negative perception of VMI could be due to the extreme pain User B suffered from or their lack of mobility, which prevented them from focusing on the small screen when VMI was used. The negative perception could also result from the fact that User B was blind or had low vision and thus needed a hand-over-hand tactile sign language interpreting service (*ibid.*). Third, in order to communicate effectively in VMI, both the interpreter and the deaf user had to take a series of measures, such as adjusting their sign language to suit the limited image size or image range, or interjecting a conversation frequently to get attention and take the floor. All of these extra measures, however, were probably unnecessary in on-site interpreting, and therefore User B may consider VMI troublesome [31].

On the discrepancy between subjective and objective evaluations of VMI communication quality or effectiveness, or the inconsistent findings between quantitative and qualitative studies on User B's perceptions of VMI, further studies are needed to explore

the reasons for these discrepancies. Specifically regarding different stakeholders' different perceptions, future research can try to explore potential factors that modulate people's relevant perceptions, for example, previous experiences of offering or using VMI and the language pair involved. To take the language pair as an example, the present study found that in all the reviewed qualitative studies where VMI was not considered effective, the User B involved were all sign language users. Since remote communication involving a sign language may have high or special requirements on visual quality, it is not difficult to imagine the important role played by VMI facilities in sign language users' satisfaction with VMI service. That is to say, whether the language pair involves a sign language can be a modulating factor of User B's perception of VMI.

To interpreting instructors and interpreting trainees, the research findings on VMI communication quality or effectiveness indicate the importance of understanding the nature of VMI-based communication and reasons for users' potential complaints about VMI. Only when interpreting trainees and novice interpreters sufficiently understand the elements of successful and unsuccessful VMI services can they truly comprehend the requirements for VMI interpreters in different scenarios. And only in this way can interpreting trainees or novice interpreters develop possible strategies of improving VMI performance.

Stakeholders' acceptance. A research topic closely related to all the other five topics of VMI research (especially users' satisfaction with VMI) is people's acceptance of VMI or their preferred type of interpreting service. So far it was mainly found that most of User A, interpreters and User B preferred on-site interpreting to VMI, but most of them considered VMI an acceptable alternative when on-site interpreting was not available (e.g., [20, 35]). Particularly in the settings involving non-critical medical care, Yabe [37] found that healthcare providers did not have significantly different preference for either VMI or on-site. Some interpreters even preferred VMI to on-site because VMI provided them with more financial and practical benefits (see the research findings reviewed above on *financial cost and benefits*). Nonetheless, in the scenarios where accuracy of rendition was strictly required, most of the three parties (i.e., User A, interpreters, and User B) believed only on-site interpreters (but not VMI) could provide adequate interpreting service, for example, in the communication involving critical medical care [37] or cognitive assessments for people who are already cognitively impaired [11].

There were four possible reasons why people did not seem to accept VMI as much as on-site interpreting. First, User B's acceptance level of VMI tended to be low when they felt they were forced to use VMI without being consulted about their preferred mode of interpreting, especially in medical settings [17]. Second, interpreters' acceptance of VMI was found to be associated with their worries about the working condition, working duration, and financial compensation of VMI [35]. Third, User A may not prefer VMI when the order of turn taking had to follow strict guidelines in some scenarios (e.g., in legal proceedings), while VMI could bring in turn transition troubles [25]. Fourth, in some occasions of cognitive assessment, VMI was considered inappropriate because during this mode of interpreting, the assessor and the one to be assessed were required to sit close to the screen or lean in to see the screen, which made them feel uncomfortable or awkward [11].

For promoters of VMI, the reviewed findings on the acceptance issue suggest that technical problems such as bandwidth and transmission of audiovisual signals should be addressed as quickly as possible. For future studies, it is warranted to explore which scenarios are suitable for VMI and which are not. Such information will be not only important to VMI researchers, but also useful to users, interpreters, and companies that offer interpreting service.

Strategies used by interpreters in VMI. The last research topic of the recent VMI studies is interpreters' use of strategies in VMI, which is a topic that none of the three previous VMI reviews discussed. Seven out of the 27 studies selected for the current review explored interpreters' strategy use in VMI [2, 4, 6, 14, 22, 24, 25], of which the major findings are summarised below. The strategies identified by these studies could be roughly categorized into four types, that is, strategies for source language (SL) comprehension, strategies for note-taking, strategies for target language (TL) production, and strategies for turn management in VMI.

To facilitate SL comprehension in VMI, interpreters were found to use two strategies: (1) leverage all available resources to facilitate SL comprehension [2]; (2) increase time lag between hearing the SL and delivering TL output, or win time by employing the strategies of *addition* and *expansions* so as to get more information from subsequent SL segments and thus to resolve comprehension problems [4]. To take notes during a consecutive mode of VMI, professional interpreters were found to use more non-ellipsis strategies than interpreting trainees, which were believed to be helpful in maintaining interpreting performance [22]. To deliver TL output more efficiently and reduce cognitive load, interpreters were found to compress TL output based on the relative importance of SL information, or to compress their output by leveraging the resources available to the primary interlocutors [2]. Besides, some interpreters were also found to prioritize a complete rendition of SL information and logical TL delivery over "best" translation of some individual SL expressions [2, 4, 6].

As the process of VMI shares common subtasks with the process of on-site interpreting [12], some of the strategies summarised above can also be found in traditional on-site interpreting [8]. The following strategies for turn management, however, can be unique in remote interpreting, or play a more important role in remote interpreting than in on-site interpreting, since how information is delivered and what information one can receive in remote interpreting are not identical with the case in tradition face-to-face interpreting. The turn management strategies in VMI included: (1) increase pitch in TL output to signal that someone's turn has not been finished yet; (2) add discourse markers such as "well" to indicate that someone's turn has already begun; (3) use clauses like "I am back to you" to take the floor of conversation; (4) use a medium shot showing the head and upper body of the interpreter, along with the image of the user for whom the interpreter was translating, in order to help all the parties at talk understand *who* was saying *what* and helps maintaining the turn-taking order (e.g., [24, 25]).

Of note is that some strategies like in-breath or directly producing the initial words or sounds of the rendition may not be effective to help the interpreter to take the floor in VMI, or this behavior may cause awkwardness in communication. It should also be noted that in legal or judicial settings, more turn management strategies could be adopted when the interpreter was co-located with User B than when these two parties were not co-located. In the former case, strategies such as reorientation of body and

gaze, non-verbal touching, using body language like looking at a screen could be used; when the interpreter and User B was not located at the same site, strategies like non-verbal touching and microphone manipulations could not be used [25]. Also of note is that when interpreters were at a standby mode in a medical setting, there were two useful strategies for interpreters to figure out when patients needed interpretation and what were needed to be interpreted, that is, (1) pay attention to the patient's nonverbal information, like head turning, and (2) observe the patient's facial expressions [14].

All the strategies aforementioned are important in VMI-based communications. To interpreting trainees and novice interpreters, it is first of all necessary for them to understand the nature of VMI-based communication and why it is not easy for User A or User B in VMI to predict when the current turn is to finish (which, according to [2], can be due to, for example, loss of some visual information, or time lag for the interpreter to render, or transmission delay). When trainees have comprehended these essential issues pertinent to VMI strategies, interpreting instructors may try to introduce to them the turn-management strategies and devise specific exercises for them to acquire these strategies.

On their research designs, the reviewed studies on VMI strategies mainly relied on interpreting output and interviews to code and analyse the strategies adopted by interpreters. Future research on VMI strategies can add interpreters' retrospective protocols as another type of data to explore the process of VMI strategy use (see [8]). For instance, based on interpreters' retrospective protocols, future studies can explore interpreters' motivations to choose or not to choose a certain strategy in VMI, which can be particularly informative and helpful to interpreting trainees. Moreover, future studies may consider using inferential statistics instead of simple comparisons between percentages when comparing the strategy use between groups or within group.

5 Conclusion

To better comprehend empirical findings on VMI and accordingly offer pedagogical implications, the current study identified and critically reviewed 27 VMI empirical studies published in SCIE and/or SSCI and/or A&HCI journals from 2005 to 2022. Three major findings were obtained. First, VMI has been explored by researchers from various fields, such as translation studies, medicine, and sociology, and the number of VMI studies have increased steadily since 2017 (i.e., two years earlier than the spread of COVID-19). Second, the reviewed VMI studies focused on six topics, that is, (1) cost of time, (2) financial cost and benefits, (3) physical and psychological costs, (4) communication quality and users' satisfaction, (5) stakeholders' acceptance, and (6) strategies used by interpreters in VMI. These studies mainly found that although VMI could be expensive due to its required facilities, it was an acceptable alternative when on-site interpreting was not available. Inconsistent findings or unanswered questions, however, still exist concerning each of these six topics, such as the encounter time and labour costs of VMI compared with on-site interpreting, potential changes in physical and psychological costs that VMI interpreters may have to pay after a period of training and/or practice, and reasons for the discrepancy between subjective and objective evaluations of VMI quality. Third, the research design of the recent VMI studies had strengths such

as large sample sizes and multiple indexes reflecting different dimensions of target constructs, while the design also had potential problems, such as lack of a control group or control condition, inadequate control of potential confounding factors, and lack of validity and reliability data of the questionnaires used. Along with implications for future research, the current study mainly discussed pedagogical implications for interpreter education based on the existing research findings, in particular the importance of VMI practice and the usefulness of VMI strategies for interpreting trainees.

6 Acknowledgment

The research was supported by a grant of the thirteenth “five-year” plan of philosophy and social science in Guangdong, China (GD20CWY15) awarded to Yinghui Li.

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Article submitted 2022-04-13. Resubmitted 2022-07-05. Final acceptance 2022-07-11. Final version published as submitted by the authors.