



Live Online Education Efficiency Mediators From the Actor Network Theory Perspective

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Purpose: The purpose of this research was to explore the conceptual network of live online education efficiency from the Actor Network Theory perspective to reveal different aspects influencing the quality of online training less accounted for in previous research.

Methodology: Actor Network Theory was used to analyse the qualitative feedback from 100 live online education sessions. Responses from 90 educators and 556 participants were coded into enablers and inhibitors of education quality and further clustered into different actors that might mediate learning success.

Findings: The key finding of this research is a visual representation of the complex network of actors potentially affecting live online education quality, revealing the interplay of non-human aspects (e.g., hardware, software, session design, and descriptions), as well as human elements (participants and their expectations, educators and their emotional reactions attributed to different actors of the network, organisers, and external mentors/experts).

Limitations: The piloting qualitative research was conducted within the framework of one educational event, where participants opted in voluntarily to attend and participate in the study. It is a specific educational context different from workplace training and other non-formal education.

Practical Implications: Learning and development practitioners can find 10 recommendations designed to support the instructional design and delivery of their (online) sessions based on the collective experiences of the study participants and authors.

Originality/value: It is the first research in the field of live online education, acknowledging and mapping the role of multiple actors posited to play an influential role in the overall quality. It also calls for a transition from “content-focused and controlling” to “contextually-aware and responsive” educator in future research.

Keywords: live online education, webinar, adult learning, Actor Network Theory (ANT), learning outcomes

INTRODUCTION

There are two truisms about the world we live in, that, when brought together, opened the inquiry that led to this research project. On one hand, the global COVID-19 pandemic and resulting work-from-home necessity has created an enormous demand for digital education that presented both educators and learners with an ultimatum to get accustomed with the novel learning environment. New reports show that this world is here to stay, with only 8% of companies stepping away from live online education after COVID-19 pandemic (Freifeld, 2021). It was most likely the most disruptive change in the way education operates in the past century.

On the other hand, rapid development of technologies enabling synchronous communication and collaboration, as well as the multitude of devices we use every day, created a complex environment, that amplify challenges that educators face. Synchronous online learning was treated almost synonymously with webinars, while multiple formats have been recently proposed to expand and differentiate the scope and aim of diverse learning sessions, including workshops, trainings, mastermind sessions, group coaching, etc. (Czahajda and Černko, 2021). Moreover, different technologies assist the educator over the entire process of instruction design, delivery and transfer to an extent that is only enabled now, due to rapid technological advancement.

This new interest in online learning has sparked the creation of multiple papers aiming to better understand synchronous online learning (Ebner and Gegenfurtner, 2019; Gegenfurtner et al., 2020c; Hari Prasetyono and Christian, 2020; Hodgetts et al., 2020).

Despite all this research, based on established instructional approaches and extending former research in the field, one question remains unanswered: *What is it that we do not understand about how webinars are affected—what are the unknown unknowns?*

Since most of the recent research was validating hypotheses from the past, it has been a while since truly exploratory research was conducted in the field of synchronous online learning. The aforementioned question is deeply exploratory in nature, which can be fruitfully addressed by Actor Network Theory (ANT)—a framework to help us understand complex networks (Carroll, 2018). In live online education a lot of emphasis is placed on the technology, software, internet connection, and other skills that are not needed in a physical environment and even the participants seem to have more control of how the instruction is delivered, through the physical space they arrange for themselves on the training, how they decide to allocate their attention or simply by deciding if they will turn their cameras on or not. The main purpose of this research is to employ ANT to illuminate the relevant actors, and the way they might mediate the quality of an online educational session.

Moreover, the disruptive growth of synchronous online communication technology during the pandemic could have also affected the way education is happening online. In order to address these gaps, this research was aiming to explore the relations between different actors within a live online

educational session. This broad perspective should also advance the knowledge on online education efficiency.

RESEARCH DESIGN

Actor Network Theory

Actor Network Theory can be used to evaluate different actors that are involved in a network around a certain phenomenon. We are not assuming or ignoring any of them, but rather observing and describing what we see Kamp (2018). As Latour originally explained, when using ANT we are taking the perspective of an anthropologist discovering an unknown network for the first time (Woolgar and Latour, 1986). An important assumption from Latour's approach to ANT is that there are plenty of interactions between the actors in a network. Each node and link can be just as important as any other in light of the purpose the network is operating for Latour (2007). It helps to understand how projects are completed in networks consisting of both human and non-human elements. There is a certain symmetry in such networks—each of these actors has equal agency. Red traffic light is stopping the drivers with the same authority as a police officer directing the traffic. This empowering perspective lets us more carefully investigate the influence of factors normally disregarded in research on online education efficiency.

If we look at a synchronous online session as a complex network, following Callon (1999), ANT can be a useful lens to identify elements of significant importance. In online training non-human aspects include the hardware technology, the IT software used, the gadgets and actual rooms from which participants are attending, whereas human actors include trainers, trainees and other people involved in (or externally interfering with) the training process (Zeelie, 2017).

What is unique for ANT is that it also emphasises relationships that are not necessarily systematic in nature, but can also occur unpredictably (Ellis and Larsen-Freeman, 2006), which is especially suitable when trying to illuminate the (currently) unknown and unexpected.

In ANT the nature of an actor is not rigidly prescribed. It's size, psychological make-up and/or motivations are not predetermined (Callon, 2007). This provides great flexibility to take a fresh perspective in terms of what is treated as a separate actor in the network. Each such actor can then be treated as a black box—a collection of elements that form a sub-network within a larger network, assumed to interact so tightly, that we can justify treating them as a single actor. As Carroll (2018) describes, a book can be viewed as a black box, when we take into consideration that it represents the perspectives of multiple people, including people the author took inspiration from. ANT grants the researcher the freedom not to define the actors before delving deeper into the field. The network's composition is revealed through observation and analysis (Hardy and Williams, 2008).

As Fenwick (2010) describes, ANT is especially relevant to define how parts of the network are included and excluded, and how some connections work and others do not. The interesting

aspect of it is that not only humans, but objects alike have the power to persuade, coerce, compromise, or resist the other actors.

This capacity of actors to influence each other was defined by Latour (2007) as mediation, further broken down into four types: interference, composition, black boxing, and delegation. Interference appears when one actor interferes with the goal of another. In composition, the actors influence the common goal of the network together. Black-boxing is when gradual complexification of actors (and their interrelations) reaches a point where treating the constellation as a single actor becomes more meaningful, and delegation is when meaning and expression is delegated to non-human objects.

Actor Network Theory in Education

Actor Network Theory has already been used in multiple educational settings. Fenwick and Nerland (2014) used it to emphasise the importance of non-human aspects in professional learning. In an earlier piece, Fenwick and Edwards (2012, p. 99) presented that ANT “offers concepts that illuminate dynamics of educational reform often left aside by these more structural or socially focused analyses—including how actors emerge within the play of heterogeneous linkages among humans and non-humans, and how the different actors that appear are performed into being by these linkages.”

Broad (2016) was analysing what types of non-human actors affect professional development of vocational teachers—these included student competitions or artefacts containing knowledge without physical representation, like the curriculum. The author was following the thought process of Polanyi and Sen (2009), in which tacit and explicit knowledge are not easily separated and even a written piece requires some interaction with its author to fully comprehend the knowledge it includes. Edwards and Nicoll (2007) used ANT to describe the relation of practices, spaces, trends, and other actors within workplace learning.

Actor Network Theory was used for both small classroom size networks, as well as an entire national ecosystem, following the principle of black-boxing. Kamp (2017) used ANT to describe the complexity of workplace learning in Ireland, including both human and non-human actors and underlining the importance of latter, suggesting some interventions that would include these actors in vocational learning design to increase control over the process.

Slade (2013) argued that in order to fully understand the world of professional learning, it is necessary to examine social and material relations alike. In her study on police officers, she underlined the context of work they do that has an effect on the professional education they engage in.

The problem of curriculum as a network was addressed by Latour (2007) and Law (2009). They presented the curriculum as a network that consists of humans and physical objects, including classrooms, documents, computers, etc., Carroll (2018) expressed that the actors can be as fine-grained as individuals in a given community, where a positive relationship between one teacher and another may leave one connection in the network, whereas animosity between other teachers may leave a different trace. Actors in such networks can even include excitement or dislike for specific activities, like using computers or drama.

Actor Network Theory was already used in some online learning settings. Esnault (2007) emphasised the utility of ANT to understand the relation between people and technology in e-learning settings. In the network she proposed, the Learning Management System (with all its features), the technological infrastructure at the learner’s homes, as well as the tools the educator had available when preparing the course, come together to give rise to the learning effects. In the author’s view, understanding this actor-network is essential for the success of e-learning development as each node plays a significant role for educational success.

Rowan and Bigum (2003) used ANT to evaluate the durability and quality of online learning, including multiple actors. They have associated the quality of online learning with the use of online teaching platforms, whereas different actors, including the educational institutions mediated this connection by either enabling or discouraging it. The success also depended on the utilisation of already existing and operating networks, rather than creating new ones. While normally we evaluate online learning as it occurs, Rowan and Bigum (2003) also considered its predecessors, like university policy discouraging the use of this form of distance education.

In her review on the use of ANT in adult education, Thompson (2015) has concluded that it may be credited with allowing researchers to raise questions and discover areas that were never touched upon before. Building on the work of other researchers operationalising ANT, this study aims to investigate what contributes to the success of live online education sessions organised in an open “anyone can register” format.

Research Purpose

The purpose of this research was to investigate different actors and the way they interact with each other in synchronous online learning sessions. The emergence and increased prominence of this form of learning has brought new interest in what it has to offer. New technologies and the work-from-home disruptions created by the COVID-19 pandemic might have shifted the way learning in such an environment works.

Data Collection and Analysis

Data Sample

The context of this research was a live online learning event (the Online Training Festival) comprising 100 live synchronous online learning sessions, organised in April 2021 by Trainers’ Forum. Each of these sessions was between 1, 5–2, and 5 h long and they focused on diverse knowledge and skills in six focus areas: personal growth (31 sessions), career development (22), learning design (20), well-being (12), entrepreneurship (12), and digital skills (3). The data used for this research come from two groups: the educators and the participants of their sessions. The organisers invited educators to deliver sessions during the event through an open call shared in different training related communities of practice. They were subsequently selected to deliver their session in the event based on their expertise in the proposed session topic and previous experience with training in general (especially in English and in online setting). All educators who proposed sessions, met these minimum criteria (as judged

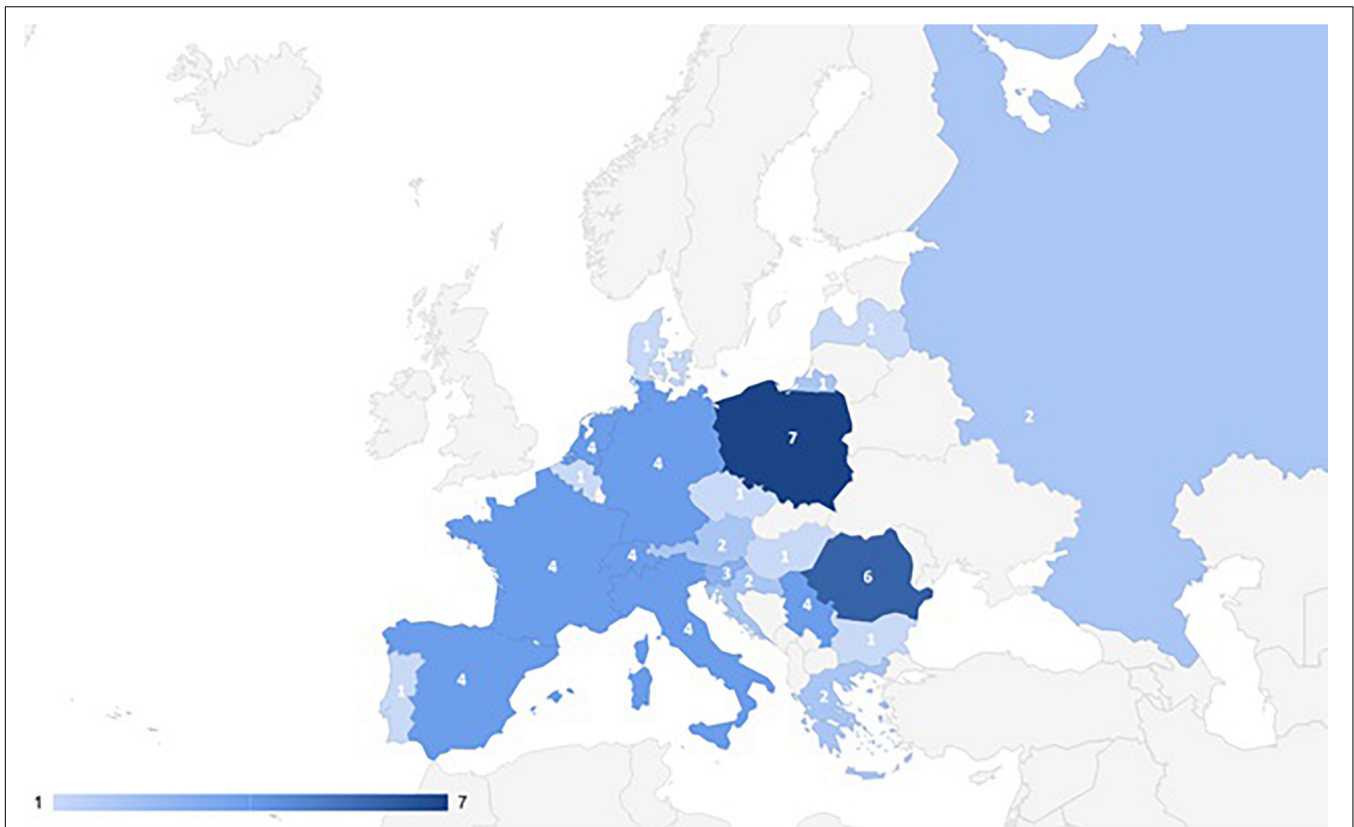


FIGURE 1 | Distribution of educators per countries (two educators were from the United States, not shown on the map).

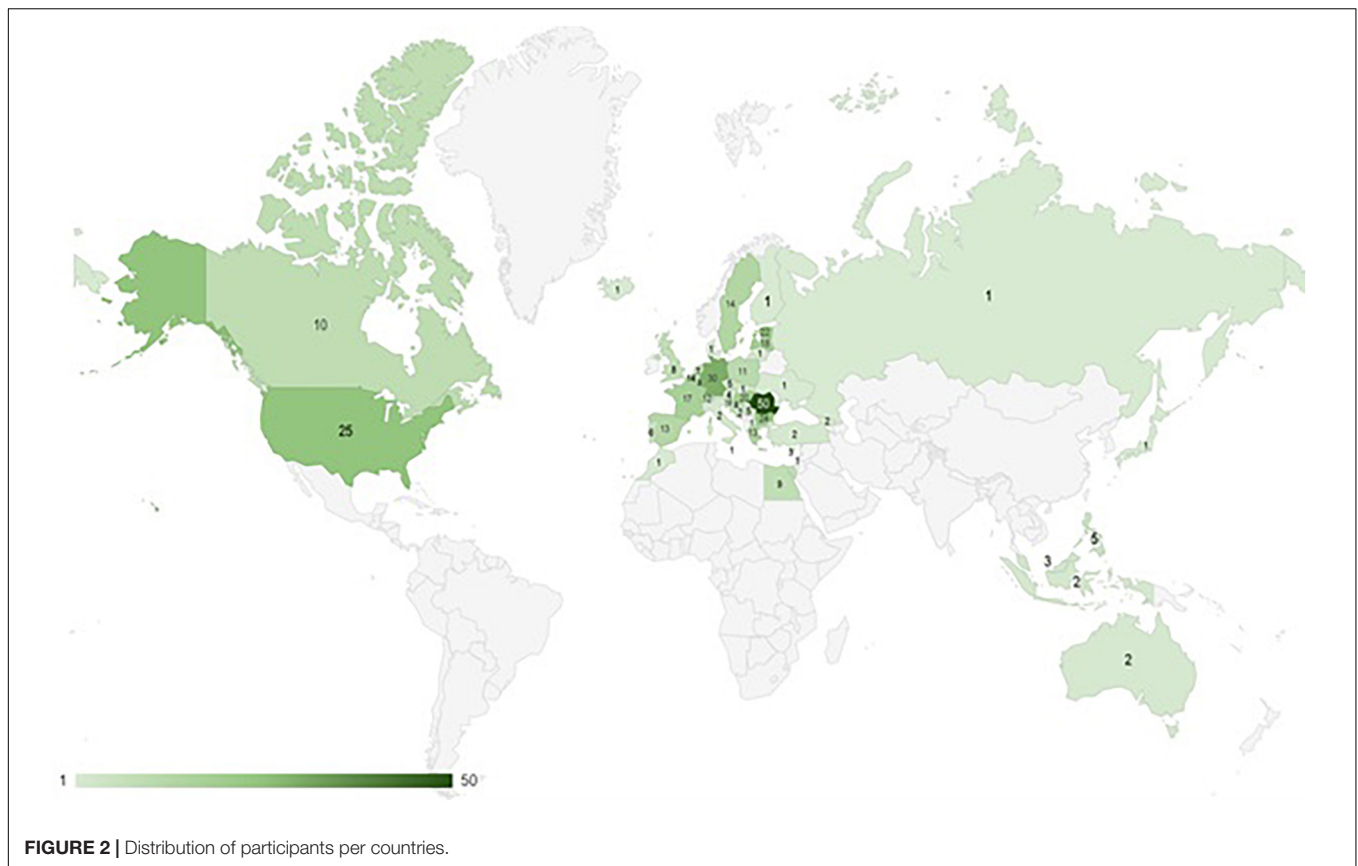
based on their application answers, training portfolios, and/or LinkedIn profiles), and were thus allowed to contribute their sessions to the event. They were free to choose the topic of their session, instructional methods and IT tools, with Zoom as the base platform. Once they were accepted, organisers provided optional quality assurance materials about the design and delivery of their sessions, as well as suggested optional improvements based on their descriptions of the session and learning goals to those trainers who submitted their sessions for evaluation. This unrestricted creativity, originally intended to increase the diversity and range of choices of sessions available at the festival, also allowed us to get a wide sample of approaches educators operate by. At the end of the session, they received a self-evaluation form (described below), and those who completed it formed the final sample of educators ($N = 62$), who delivered 89 sessions in total. They were based in 23 countries (depicted in **Figure 1**), and 35 were female (56.45%). Unfortunately, no other demographic data were gathered.

The sessions were open for everyone (with a description of possible prerequisites or desired background provided by the trainers themselves). Excluding the pre-event promotional sessions, the event was attended by a total of 393 unique participants from 46 countries across the world (**Figure 2**), many of them participating in more than one session. The total number of confirmed attendances across all sessions was 698 (with a mean of 1.78 sessions per participant, standard deviation of

2.05, and a maximum of 13). Unfortunately, no demographic data about participants were collected when booking session tickets. A form unrelated to the purpose of this article involved demographic information from a sub-sample of 158 participants in relation to their employment status (51% university students, 31% employed, 14% self-employed, and 4% unemployed), age (44% between 18 and 24, 50% between 25 and 34, and 6% between 35 and 44), and sex (65% female, 33% male, and 2% undisclosed).

Data Collection

Immediately after each session, the educators were asked to fill out a form consisting of 15 questions inviting both a quantitative rating of their satisfaction with a particular aspect of the session (using a 7-point Likert scale) and a qualitative reflection on the same aspect, together with a final open-ended question. The 15 focal aspects were: session preparation, emotional state of the trainer, framing of the session, adaptation of the outline, connection with participants, energy-level management, answering of questions, way of providing examples, online tool use, facilitation of group processes, degree and kind of interactive activities, exchange between participants, skill building support, encouragement of learning transfer, and realisation of intended outcomes. The item wordings from the questionnaire are presented in Appendix. The design of this trainer self-reflection questionnaire was one part during a larger process of questionnaire development conducted by four



researchers. It was developed in conjunction with two other instruments, which will be the subject of future publications—a form to assess the perceived session quality from participants’ point of view (expanding on Czahajda and Černko, 2021), and a form assessing learning transfer, implementation and goal attainment. In brief, this process consisted of a literature review of topics related to educational design (e.g., Tannenbaum et al., 1991; Sitzmann et al., 2008; Zoumenou et al., 2015; Chauhan et al., 2017; Ford et al., 2018; de Rosa and Johnson, 2019), learning transfer (e.g., Ruona et al., 2002; Bhatti and Kaur, 2010; Grossman and Salas, 2011; Soerensen et al., 2017; Gegenfurtner et al., 2020a), and learning evaluation (e.g., Wang and Wang, 2005; Harris et al., 2014; Renta-Davids et al., 2014; Gegenfurtner et al., 2020c), generation of a starting pool of 107 items, narrowed down to 36 based on ratings and ultimately a consensus among the four researchers, and identification of 15 aspects deemed to be within the sphere of influence and/or responsibility of the educator.

From the side of participants, they too were invited to fill in a feedback form at the end of the session, which included an open-ended question “You’re written feedback to the session and the trainer” that was used for the purposes of this study. 284 unique participants filled in the feedback form about sessions they attended amounting to 554 feedback entries, 447 of which included answers to the open-ended question mentioned above (a final response rate of 64.04% relative to all confirmed attendances). We wanted to use the approach that Latour (2007, p. 251) explained as “following the actors”—using

the perspective of both human actors involved in the study to better understand their interaction as well as their perspective on non-human actors.

This approach was selected in order to make sure we have sufficient data to identify all relevant actors that affect the quality of synchronous online education, as some other papers in the field using semi-structured interviews as data collection had as little as 12 (Teles and Joia, 2011) to 34 subjects (Slade, 2013).

The analysis was conducted by an interdisciplinary team of three educational researchers and practitioners, who performed an independent in-depth review of responses to the open-ended questions, which were then combined to formulate the actors and their mediation in the context of a synchronous online session, treated as a project with a goal to maximise learning efficiency.

RESULTS

In the first part of the analysis, a list of different actors was identified. The second part of the analysis was devoted to identifying the relations between them.

Types of Actors in the Field

The research has identified multiple actors within the network of an individual live online educational session that might have an important influence on the overall success of its educational goals. The most prominent human actors include educators,

participants, event organisers, and external experts, while non-human actors include the virtual sphere in general, the specific hardware and (the primary and supportive) software used throughout the session, the description and actual structure of the live online education session, and finally, the broader context of the personal lives of educators and participants.

Hardware

Unlike in a physical training room, where the “hardware” (whiteboard, markers, paper utensils...) are supporting the session, in virtual education these can *decide* if the session will happen or not and *mediate* the level of quality it achieves. Apart from the issue with internet speed, that was frequently mentioned in earlier studies (e.g., Zoumenou et al., 2015; Gegenfurtner et al., 2020c; Biradar, 2021), one educator participating in this study has encountered problems with battery in their mouse, preventing him from facilitating the session for several minutes before he was able to regain his agency to engage with the session. Needless to say, this situation affected their mood and impacted their overall performance. Some of the more experienced educators mentioned, that they like to make sure, they have a back-up computer and other important peripheral devices available (especially in the context of important, high-stakes sessions).

Other educators mentioned investing in special equipment they didn’t require before. These include things like an additional monitor, external microphone, new light source, and a high quality camera. Each of these actors enabled them to deliver the session in better quality and have more possibilities to manage the virtual space in real time. A notable best-practice example is integrating a tablet with the main software in a way that it can serve as a “digital flipchart,” allowing for easy improvisational visualisation of ideas and models.

Whenever hardware was mentioned in educators’ answers, agency was naturally attributed to them (e.g., *The external monitor helped me; My microphone decided to stop working*), showing the educators may not feel in control of this part of the education in virtual setting.

Primary Software

In some ways, the main software used for the sessions was just as much influential on the session progress as the hardware. It is a virtual representation of a training room, with challenges analogous to losing keys, forgetting to prepare chairs for participants, or wondering where the light switch is. Such difficulties, that are relatively unlikely in physical space, happen frequently in online setting.

Some educators mentioned they lost their password for the platform and struggled to start the session on time, which affected their capacity to cover all material prepared for the session. Others mentioned issues with the way the tools are designed, making it difficult to find their way and thus feeling incompetent. Indeed, the participants also mentioned it was annoying to see the educators not knowing the tools they were using and recommended some improvements in this area as the only feedback point for the session they attended, like if it didn’t cover any substantial content.

One of the factors that had a particular influence on the quality of the session was the way participants managed their microphones. Turning the microphone on takes time and in certain situations is forgotten about, which influences the dynamic of the discussion and creates “*you’re muted*” situations, which participants found irritating.

The research also revealed an under-covered issue, related to the “*cameras on/off dilemma*” of virtual education events and meetings. Educators participating in the study mentioned that they unintentionally omitted the participants without cameras when choosing a person to speak. The software used also did not display the people without camera by default to some educators, so they weren’t even aware of their presence at times.

On the other hand, multiple features were resolving issues that educators normally faced in the physical setting, including tools to engage introverts in the session (e.g., via chat), efficient ways to divide participants in groups, support in remembering the names of participants or a tool allowing to raise hand for questions. The software providers are also introducing features that allow to resolving major issues of virtual space, such as indicating if participants are engaged with other windows on their computer, and thus likely not paying attention to the session itself. The privacy and personal safety considerations of such practice are still to be addressed.

Supportive Software

The majority of research participants found using additional software was helpful in achieving the learning goals. It introduced a certain level of novelty to the session, allowed free expression for participants, created a space for collaborative note-taking (which, if facilitated well and conducted by skilled participants/graphic facilitators, can capture an even richer trace of the collective insights generated in the group), enabled the educator to assess various alternatives for how to proceed by getting instant feedback while the session is still happening, created space for a participant support/accountability group after the session, and easy moderation of simple activities, like choosing a person to speak, or monitoring the time.

Few educators also mentioned the difficulty of deciding how many different tools to incorporate in their session, as each of them requires time for the participants to on-board and adds extra cognitive load. This implies that educators should have a very strategic approach when choosing the software, guided by the purpose of the session instead of pure novelty and attractiveness.

This difficulty was also mentioned by participants, as they mentioned some sessions were “overcomplicated” by too many tools. Some participants also refused to attend exercises that required registration of an account in order to use the tools. Interestingly, none of them mentioned the major platform used for the sessions (Zoom), which also required an account, but was widely adopted during the pandemic.

The educators perceived the software as flawless, getting surprised when it crashed due to too many participants using it simultaneously or the font being too little for some participants to see.

Educator

The participants of this research attributed a significant proportion of the session success to the educators' skills, behaviours and traits. Some educators mentioned struggling with multiple stressors, which decreased their capacity to perform well, such as including too much content into a session, devoting disproportionate time to conveying information, or running over time and needing to drop certain parts of the session along the way. Getting overtime during the session was a stressor, decreasing the capacity of educator to perform well. The source of such stress was also allocated in different external actors included in this research, but in all the cases the performance was mediated by this feeling, which remains within educator as an actor in this network.

Other feelings that were accompanying educators and inhibiting the quality of the session include tiredness, burnout, insecurity, fear and anxiety. Just like stress, each of these feelings were related with concrete external factors, like not knowing the tool, the participants' expectations, lack of sleep, wrong timing of the session, lack of experience, etc.

On the other side, the sense of mastery of the topic was boosting educators' confidence and mood, giving them the sense of control over the session progress. Some of the best practices revealed in this study included pre-testing of the technical setup for the session, breathing and meditation exercises to control mood, sleeping well, eating early, and mastering online tools.

Participants of the study especially appreciated when educators' exercised strong facilitation of the discussion and took an inclusive attitude, regularly kept bringing the discussion back to its topic and goal, frequently summarising its progress, etc.

Overall, the major influence over the session quality from the educators' area of influence included their mastery in the topic, mastery in the use of online tools and their emotional self-regulation capacity.

Co-trainer

Several educators mentioned the tremendous help they received from co-trainers they were delivering the session with. It is an advantage of a dyad practice model widely adapted in formal education (Pancsofar and Petroff, 2013; Gallo-Fox and Scantlebury, 2016; Faraclas, 2018; Souto-Manning, 2019), but not that common in non-formal contexts (Williams, 2014). The co-trainer helped during instructional design, by taking parts of the responsibility and enabling mutual rehearsal, as well as during the delivery, by taking over when some issues appeared, over-viewing the chat while the other educator was speaking and allowing for some brainstorming during breaks to find the best approach to adjust the session to the needs and demands of the moment. Thus, the co-trainer was mitigating several difficulties posed by the virtual environment.

Event Organisers

Since all sessions considered in this research were organised as one event, multiple educators mentioned the role organisers played in the overall quality of their sessions. The session times were determined by the organisers, which didn't match some educators' chronotypes, who consequently felt tired during

their session. Centralised needs assessment and GDPR policies prevented some educators from reaching out to their participants, which is their standard procedure in the sessions they have full control of.

On a positive note, the organisers took some responsibility on the promotion and administration (including technical support for each session), so the educators could focus more on the educational aspects of their sessions. Several educators also favourably mentioned the possibility to attend a training on online delivery provided by the organisers and the event quality guidelines as sources of inspiration.

Mentors/External Experts

Several educators involved in the research were using the support of their mentors or external experts not directly involved in the session. They consulted their program, got feedback on planned activities and contents of the session, and rehearsed the flow to get another point of view on potential pitfalls. Some also included the external experts as special guests in their sessions, and the virtual environment served as an enabler for all these activities, simplifying the logistics. Additionally, the sources they based their content on could be considered as important pillars of credibility.

Personal Lives

Some participants of the study mentioned dealing with (relatively serious) personal struggles, including burnout and depression that affected their performance. Some others mentioned that it simply *wasn't their best day* and thus they felt like they underperformed. The educators also allocated lack of time to prepare the session well in external factors with expressions like *"I did not have time"* appearing more frequently than *"I did not find time,"* thus delegating agency over planning their work to external factors.

Many studies in different branches of business (Gilmeanu, 2015; Khoza et al., 2016; Prasetyo, 2020; Usman and Zahrotun Nisa, 2021) confirm performance is not constant or linear, but can be affected by multiple variables, including personal life. Such approach should also be taken in adult learning settings.

The diverse spatiotemporal contexts from which people attend sessions from are a major challenge when designing and hosting live online education sessions (i.e., the actual rooms and how they are furnished, other people in the proximity, different time zones. . .). Unlike in a physical setting, where the educator can make sure the space is welcoming, comfortable, and conducive to learning (e.g., by preparing snacks, decorating the space, making sure it is properly air-conditioned. . .), this responsibility falls on participants themselves. These challenges are further amplified if they share space with others who are not engaged in the same session. Finding ways to ensure participants of synchronous online learning sessions establish suitable environments for learning for themselves is something that merits additional attention.

Instructional Design

In their responses, educators took ownership over the instructional design of the session, which had a cascading

influence on the session as a whole. They mentioned two major pitfalls in this area, including planning too much content for the allocated time, and splitting participants into too many breakout rooms given the time or size of the group. Participants added multiple more to the list, including not planning enough breaks, switching group compositions too frequently, not setting the rules on how to speak up during the session, giving too little time in breakout rooms for exercises, missing some silent reflection time that happens more naturally in physical training rooms, overwhelming visual and audible cues at once. The fact, that the majority of inhibitors in this area were mentioned by participants might show that the educators are not as aware of the issues virtual environments bring to their instructional design and do not adjust the way they plan for online delivery, as compared to physical sessions.

This is also supported by the educators' practices. In terms of enablers, only a handful mentioned activities aiming to adjust the session to the virtual setting, including some risk assessment, planning time for introducing the technical ground rules in the beginning of the session (e.g., addressing the guidelines for using cameras, microphones, and IT platforms).

Training Description

A certain level of agency was also given to the way the session was described on the website, where participants were registering to attend. Both educators and participants mentioned that the descriptions informed their expectations about the learning outcomes. Some educators mentioned they failed to write an appealing description and attracted lower numbers of participants to join their session. On the other hand, some mentioned they used too much persuasive language and overpromised the potential outcomes of the session, attracting the participants with expectation levels well above what they were able to provide.

Multiple participants mentioned this issue with terms like *"I expected something different based on the session description,"* or *"It wasn't mentioned on the website that the session is on an introductory level. I wasted my time."* The way we describe our educational sessions has an important influence on participants' expectations and this wasn't sufficiently addressed in prior research.

Participants

This research highlighted the enormous (and often underappreciated) power participants have over the course of the session and over the performance of the educator through what they (don't) do. Before the session, participants registering massively to the session boosted educators' confidence and their motivation to perform well. In contrast, participants registering in low numbers, (or registering and failing to attend) decreased this confidence and upset the educators from the very beginning. The educators claimed being late, or not joining at all is a phenomenon occurring much more frequently in online sessions, and very rarely experienced in physical training session. Other destructive trainee behaviours, including abruptly leaving the session without notice, or doing some unrelated activities in the background are also much easier to engage in a virtual

educational setting. This lack of attention and lack of feedback from participants attending with their cameras turned off made the educators self-conscious, and constantly wondering if they are actually engaged and present, thus decreasing their capacity to perform up to their potential. Educators also complained about participants not doing the requested preparations or not filling in the needs assessments as behaviours that negatively influenced the overall quality of the session.

On a positive note, getting feedback from participants and meeting their expectations half way through the session boosted the mood of the educator and motivated them for extra effort in the second part. Participants asking questions, and looking for ways to apply knowledge in practice also increased the confidence of the educators delivering the sessions. Some educators mentioned that due to extended periods of social isolation necessitated by the pandemic, just being around the participants was positively impacting their mood.

Interestingly, the participants also affected each other, as some mentioned the session went bad because other participants didn't engage, lacked English proficiency, or side tracked the discussion by asking irrelevant questions. Meeting participants from different backgrounds, and the subsequent exchanges and connections were also mentioned as some of the most important benefits from participants' standpoint.

Virtual Environment

Several responses to the feedback referred to the general internet-mediated environment of synchronous online learning that provides multiple challenges for delivery. According to educators—it is harder to read participants' reactions and emotions, especially when their cameras are off. It makes it more difficult to adjust the session to the actual and diverse needs of participants, and opportunities that arise during the session. This also increases the difficulty of creating a safe, comfortable, and trusting group atmosphere that might be required for facilitating deeper learning/sharing processes. The possibility to ask questions in multiple ways (writing them in the chat, asking them directly, or raising a virtual hand using a special feature in the software) was also distracting and demanded attention from the educator to more communication channels compared to in physical training. The virtual group setting also inherently poses novel challenges for designing and organising pragmatic skill practice exercises, and providing feedback on performance.

In a virtual setting, participants are more equally positioned with respect to the educator and other participants, in contrast with a physical meeting, where the size of the group often decreases learning quality and increases the logistical challenges. Educators mentioned it is easier to organise an interactive session for 100 people online, than in a physical space, but it still takes more time to manage it at scale as some actions need to be arranged repetitively. This decreased distance dissolves geographical barriers, as in some sessions people from Europe and United States met together to discuss and exchange, while organising such meetings in person would increase the budget disproportionately.

The virtual also environment enables us to engage in multiple forms of interactions, including quizzes, collaboration,

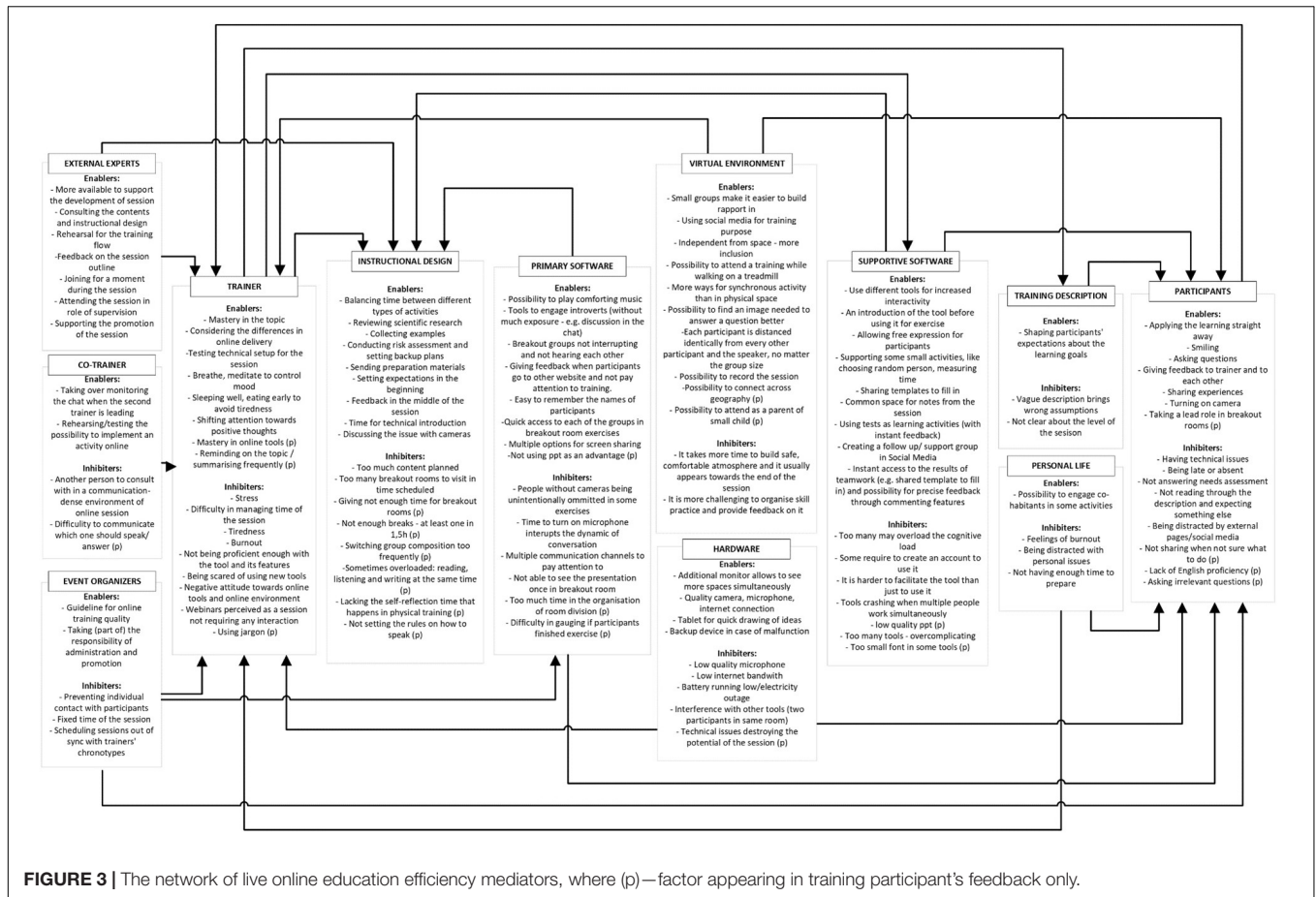


FIGURE 3 | The network of live online education efficiency mediators, where (p)—factor appearing in training participant’s feedback only.

discussion, reflection, feedback, or even finding creative ways to engage with the physical and social surroundings of participants as a distributed group (e.g., engaging other people nearby into an activity, thus allowing the session to “spill over” into the broader context much easier). Moreover, the fact that participants are attending through some sort of an electronic device allows for seamless sharing of digital templates and working materials, bypassing the need for printing and thus reducing the carbon footprint. Comparing the carbon footprint attributable to internet traffic, data storage, and electricity consumption of a typical synchronous online learning session, with a more traditional, physical version of the same session, might yield interesting insights.

The majority of feedback points on the virtual environment were rather positive, implying that the possibility to deliver sessions online was perceived as an enabler, rather than an inhibitor to adult education. Some notable examples include the ease of access for participants that have small children (a demographic would otherwise find it much harder to attend physical sessions), and the possibility of walking on a treadmill while attending a session, challenging the notion that online meetings need to be sedentary by design.

An often over-looked point relates to the assumed ubiquity of high-bandwidth internet access and stable electricity supplies, which are not an everyday luxury for many people, thus

inherently limiting the accessibility of the medium (at least in its information dense, video-mediated form).

DISCUSSION AND THEORETICAL IMPLICATIONS

The complex network of live online education efficiency interactions described in this study is presented in Figure 3. Each element of the graph is a separate actor influencing the efficiency of live online education, either directly, or by moderating the effect other elements have on the network goal. Despite its complexity, the graph is already a simplification of the relationships between actors in live online education network as in many occurrences, the participants of the study were mentioning specific ways one actor influences the other (e.g., the trainer is inhibiting the capacity of participants to achieve their learning objectives because of having difficulties to use the IT tools).

The arrows on the graph represent the direction of moderation mentioned by participants of the research. They can be more or less impactful, either in an enabling or inhibiting manner, based on the specific session-educator-participant system in question. With enough time and scientific sensitivity many of these could be gradually teased apart, isolated, and empirically tested.

While some of these relations were covered in the literature a long time ago (e.g., educator → instructional design), others were more prominently highlighted for the first time (e.g., session description → participants' expectations). The main implications of these interactions are discussed below.

Multiple Actors Affecting Each Other

The actual network of actors affecting the session quality is complex and in many ways beyond the control of the educator. Recent works in the field (e.g., Smirnova et al., 2019; Gegenfurtner et al., 2020c; Reyna et al., 2020; Czahajda and Černko, 2021) have focused mainly on the educator and their role in instructional design, delivery and transfer design as the major factors determining learning success.

We call for expanding this point of view, by acknowledging the broader contextual factors, that at best, we have only marginal influence over, and at worst, can substantially derail even the most experienced and best prepared educator. Other human actors involved in the learning process, including external experts, co-educators, organisers and participants sometimes influence the quality of the session as much as the educator does (or even more so). Non-human aspects are equally important to pay attention to, ranging from unexpected updates to IT learning platforms of choice, to a malfunctioning mouse grinding the entire session to a halt. The interactions between these actors and the way the educator reacts to them should be explored to address the lived challenges educators face when practicing their craft in virtual spheres.

Multiple Independent Actors

In our research we discovered that in some scenarios educators neglect the influence they have on some non-human actors in the network, giving them undue agency over the session quality and final result. The most independent factor in this research was the hardware, that, whenever malfunctioning, expresses its “*bad will*” and decreases chances for session to succeed. In some other contexts same agency was given to software or other events “*stealing time*” from the session.

In most research to-date, educators were treated like rational consumers in a traditional economy (Fumagalli, 2020)—making reasonable decisions and taking control of every aspect of the educational process. In reality, although this is a reasonable aspiration, the lived experience of educators reminds us this is far from easy, and needs to be acknowledged and accounted for in future research. Educators have skills, attitudes and affective states that can be influenced by the extended network of live online education. A practical implication of this is to invest more time, energy, and resources into ensuring the relevant contextual aspects are conducive, rather than corrosive to learning and optimal performance of educators, as well as learners.

The Power of Mood and Emotions

This research revealed the central role of mood and emotions of the educator in determining the result of the session. We identified 28 different affective states attributed to external factors within the live online education setting and associated with

the educators' performance. The most common included stress, anxiety, tiredness, calmness, playfulness, flow, engagement, and presence. Fairly few studies explored antecedents and consequences of affective states of the educator in a virtual setting, which is a gap that could be explored in future research. For example, while Glerum et al. (2021) analysed the feedback of over 10,000 training participants, suggesting that educator mood affects the participants and their reaction to the session, the dataset and/or analyses did not enable a closer examination of how, for example, this mood relates with the educator's performance (e.g., capacity to provide relevant examples). This focus on a narrow set of variables, most often presumed to be in a linear relationship, while having its place, needs to be complemented with more contextual and complex perspectives of networks and dynamic systems—initially in a qualitative manner, but eventually testing them quantitatively as well. The work of Dennis et al. (2018) was one of the first to consider the impact of educator emotions on training delivery (in particular—providing feedback to trainees). Certainly, more research is needed in this area, as nearly every educator interviewed in our research was either influenced positively or negatively by different actors within the online education network.

Virtual Environment as an Education Enabler

In contrast with the research in formal education contexts (Schweinsberg and Garivaldis, 2020; Altindag et al., 2021; Maison et al., 2021), showing that the virtual environment reduces the chances for overall educational success, the majority participants of this research mentioned mainly the positive aspects of its influence on learning results. Both educators and their participants were listing multiple benefits the form brings, while already managing to address some of the drawbacks before/during the session itself (e.g., asking the co-educator to monitor the chat, or discussing the problems that turning cameras off introduces into the learning process). Based on these results we suggest that the virtual environment, when landscaped properly, is an education enabler, that should be explored with even more effort to advance the adult education field. Needless to say, that there might be an age effect present, with ever novel forms of virtual interactions becoming harder and harder to adapt to for those not familiar with them and their predecessors.

Software as a Virtual Training Room

In a virtual environment, the software plays an even more significant role than the training room does in a physical setting. Not only does it act as the space in which interactions unfold, but is analogous to the digital vocal cords, eyes, and limbs attendees require to exist in and engage with the space and others in it. Multiple participants mentioned the difficulties with using the software as the inhibitors of learning progress, flow and results. On the other side, only a handful of educators incorporated a consideration of tools, and its features in their instructional design and dedicated time to pre-testing the essential components (especially ones they were not familiar with).

Educators experienced with the hardware and software used to host a session, we argue, expend an equal amount of attention as they would in the physical training room when delivering face-to-face. But when it comes to the session as a whole, including other participants and unforeseen factors, the differences between and limitations of software features, the general user experience, and differences in familiarity with and mastery of the IT tools employed, are novel factors infringing on learning performance and learning outcomes and should also be taken into account as such. Operating a physical room is also far more natural to most than operating a virtual room, so the educator should dedicate time to achieve a desirable level of fluency in this skill, before proclaiming the medium itself as a problem.

In recent studies, the evaluation of software used for webinars and online training sessions was considered mainly from the participants' perspective (Scanga et al., 2018; Serhan, 2020). In one research from the educator perspective, de Oliveira Dias et al. (2020) pointed to the general issues with online meetings of internet bandwidth, background noise or security concerns, rather than issues specific to online facilitation. More research investigating the relationship between educator and the software is needed. It should also be explored how the quantity of (and interaction between) different tools used affects cognitive load of the participants.

Session Description as a Powerful Actor

The final realisation from this research we would like to highlight was the impact of the session description on the expectations and attitudes of the participants. Multiple negative feedback comments from the participants mentioned they expected different contents based on the description. Despite different interventions organised by the educator during their sessions to manage the expectations and adapt to the needs, participants provided feedback almost exclusively in light of expectations formed before the session. Additional research to understand how exactly educational sessions descriptions shape expectations would be useful.

PRACTICAL IMPLICATIONS

This research gave rise to multiple suggestions for learning and development practitioners to develop more agency over the quality of their online educational sessions and become better stewards of live online learning spaces. We list them as best-practice recommendations, phrased as questions to reflect on during session design.

1. Aim and goals

Why is this session important, how does its aim break down into subgoals, and what are the participants' intended learning outcomes?

2. Audience and expectations

Who is the session for, what expectations would I like to set with the invitation, and how can I test how it's perceived before publishing?

3. Preparation and materials

How much time will I take to prepare the outline, learning and follow-up materials, and where will I make this space given my current life context?

4. Content and structure

What content and activities will provide the biggest value for the session aims, and how can they be arranged to help the experience flow and build on itself well?

5. Primary and supportive tools

Which (virtual) platforms and tools are essential for the session to unfold well, and what extra tools could enrich the session, while justifying the increased complexity?

6. Constraints and opportunities

What are the relevant aspects of the session's broader context (e.g., timing, virtual space properties, cultural zeitgeist. . .), I need to account for?

7. Skills and practice

What (general and platform specific) skills are required to host this session well, and how can I practice the lacking ones beforehand?

8. Enablers and promotion

What aspects would improve the session's quality, to what degree are they within my sphere of influence, and how can I promote their benefit?

9. Inhibitors and mitigation

What aspects would hinder the session's quality, to what degree are they within my sphere of influence, and how can I mitigate their risk?

10. State and self-regulation

What's the attitude and state I'd like to host the session with, how can I cultivate it, and how can I bounce back if (external) disruptions arise?

To reiterate, a major impetus resulting from this study is to acknowledge that the live online education is a complex dynamic network with multiple interacting elements, many of which slip beyond our control or influence, and engage with it as such. Practitioners would do well to learn from the stoics, embrace this fact (Pigliucci, 2020), divest our precious energy from overthinking (potentially only marginally influential) aspects of session design and delivery we couldn't have meaningfully influenced or known about beforehand and rather invest it into those aspects that have a better chance of making (or preventing)

a substantial impact, and are well within our sphere of influence—thus humbly and curiously moving on from session to session—be they disasters or triumphs—treating perfection as a direction, and not a destination.

LIMITATIONS

The educational events included in this study were all a part of a single education festival that imposed certain limitations on the educator (and the instructional designs), including time, main software chosen, needs assessment process, etc. Research could be replicated across contexts, and compare the actors and interrelations that appear to form more complete framework. These could include participants' managers and colleagues as well as sponsors of the training in corporate settings as we already know they play an important role in the training process (Botke et al., 2018; Reinhold et al., 2018; Blume et al., 2019).

The participants of this study self-selected themselves to reply, and thus, there is a potential risk of self-selection bias (Heckman, 1990). Additionally, potentially relevant demographic characteristics of educator and participants were not accounted for (e.g., age, nationality, education, occupation. . .) which might play an important role in the substance that is then organized into a conceptual network. Given the piloting and exploratory nature of the presented research, the elements and connections identified and organized into the proposed network should be treated as preliminary starting points, and expanded on both qualitatively and quantitatively in future research.

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DATA AVAILABILITY STATEMENT

The anonymized data supporting the conclusions of this article will be made available by the authors, without undue reservation.

ETHICS STATEMENT

Ethical review and approval was not required for the study on human participants in accordance with the local legislation and institutional requirements. The patients/participants provided their written informed consent to participate in this study.

AUTHOR CONTRIBUTIONS

RC designed the study and wrote the manuscript. MČ was responsible for manuscript proofreading. All authors designed the questionnaire design and analysed the results.

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APPENDIX

Questions in the Educator Form

Please comment on the following aspects of your session design and delivery:

1. Level and kind of preparation you invested into the session.
2. Mood you were in throughout the session.
3. Framing for participants (e.g., expectations, goals).
4. The way you adapted the session to participants' needs, expectations, reactions, background experiences.
5. Connection/rapport you developed with participants.
6. Attention and energy levels of participants.
7. Way you answered questions and provided feedback.
8. Amount and way of providing examples.
9. Use of online tools during the session.
10. The way you facilitated group processes during the session.
11. Amount and types of interactive activities.
12. Relationships and level of sharing among participants.
13. Activities (if any) to support the practice of skills.
14. Support for participants to transfer insights into their lives.
15. Degree to which planned session outcomes were realised.
16. What other observations have you made, about anything relevant to the success of the session?