Engagement, Participation, and Liveness: Understanding Audience Interaction in Technology-Based Events

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Keywords: Engagement, Audience Participation, Liveness, Events.

Abstract: Technologies have been changing how the audience participates in different events. This participation is distinct in each type of event. For example, in educational settings, polls with clickers and word clouds are usually used to involve the audience. For music festivals and other musical performances, organizers opt out of providing led sticks, necklaces and wristbands. Different uses for the smartphones, such as using them as lanterns aiming at obtaining crowd effect, are other ordinary and spontaneous ways of interaction. Recently, more research has been published in journals and scientific conferences discussing the use of these technologies, with techniques for fostering interaction and collaboration. Therefore, we conducted a literature review using forward and backward snowballing, looking for articles about how researchers use new technologies to increase audience experience in different contexts of events and what concepts are raised from that perspective. As a result, we propose a taxonomy of those concepts related to audience experience through three lenses: engagement, participation, and liveness.

1 INTRODUCTION

Events are spacial-temporal phenomena with unique characteristics, differing from environment interaction and audiences (Getz, 2008). In this sense, there are many types of events ranging from rituals, and conference presentations, to music performances (Johnny Allen, 2010; Getz and Page, 2016).

In several types of events, especially entertainment events, the massive use of technologies to engage the audience creates opportunities for interaction with the event. Performers and event managers seek technological alternatives to improve interaction and audience engagement. It is necessary to provide the audience different experiences for different contexts and for different spaces, such as virtual, physical (face to face), and hybrid(Webb et al., 2016).

In this sense, audience participation has been explored in different ways providing technological interaction. For instance, in competitive and collaborative settings (Martins et al., 2020; de Freitas Martins et al., 2020; Martins et al., 2021), music creation (Wu et al., 2017; Hödl et al., 2020), or visual effects in the crowd (Gomes et al., 2020; Vasconcelos et al., 2018). In virtual spaces, the audience can interact with the streamer using poll sections during live streamings (Striner et al., 2021). Besides, remote audience interaction can be mediated by interactive platform resources, for example, reactions such as *likes* (Li et al., 2019; Tang et al., 2017; Miller et al., 2017; Bründl and Hess, 2016), text comments (Lu et al., 2021; Tang et al., 2017; Yang et al., 2020; Li et al., 2019) and stickers (Lu et al., 2021; Chen et al., 2019). All these previous works explore different aspects that impact technological event interaction. Such aspects include audience distribution (Webb et al., 2016), engagement facets (Latulipe et al., 2011), or competitive, collaborative and cooperative aspects (Martins et al., 2021).

Investigating how interactive technological experiences occur in events makes it possible to understand how to design technologies to support new experiences. Likewise, it is relevant to consider different contexts of events, whether face-to-face, virtual or hybrid (Webb et al., 2016); the event type being experienced or the audience attending the performance. Therefore, this interaction can promote engagement and audience participation during the event.

Previous studies already presented different engagement and participation aspects, such as Wu et al.

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Gomes, G., Conte, T., Castro, T. and Gadelha, B.
Engagement, Participation, and Liveness: Understanding Audience Interaction in Technology-Based Events.
DOI: 10.5220/0011848600003467
In *Proceedings of the 25th International Conference on Enterprise Information Systems (ICEIS 2023) - Volume 2*, pages 264-275
ISBN: 978-989-758-648-4; ISSN: 2184-4992
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(2017) by establishing a framework to classify participatory live music systems. Striner et al. (2021) present a thematic map considering audience participation from live streaming. Apart from those work, there is a need for more research regarding a greater variety of events and interaction forms, starting with the perspective of how interactive technology affects the audience experience. Therefore, based on this context, we aim to answer the following question: How do research in HCI and CSCW areas approach technological interaction in events?

To answer that question, we conducted an exploratory literature review using a snowballing technique to map concepts regarding technology interaction in events. Those concepts were organized through three primary lenses: Engagement, Participation, and Liveness.

From the three lenses perspective, we aimed to obtain a general vision of how interactive technology is present in different events. By identifying the concepts associated with the lenses, this paper provides a taxonomy to understand the factors affected by the experience related to interaction technologies in events.

2 BACKGROUND

To better understand events with technological interaction, we need a theoretical basis regarding types of events and audience. Events are planned to specific special occasions, reach objectives and social meters, cultural and corporative (Johnny Allen, 2010). Events are commonly explored by tourism as an entertainment alternative and promote the local economy. In this sense, we used the Getz (2007) proposed typology involving eight types of events, being: recreative Events, political and state events, cultural celebrations, arts and entertainment events, sporting and competitive events, commercial events, educational and scientific events, and private events.

Just as events have distinct characteristics, audiences have goals that drive them to participate. Therefore, audiences are groups of people who participate in the event. An audience can be recognized according to size, purpose, and interest level (Mackellar, 2013). Exploring audience behaviors concerning the event helps to identify characteristics of the technological interaction (Martins et al., 2021). Mackellar (2013) builds on audience goals to categorize them into five different types: mass audience, special interest audience, community event audiences, incidental audiences, and media audiences.

2.1 Related Works

Previous works address several methods to promote audience participation mediated by technologies, exploring characteristics such as interactivity and immersion in distributed performances (face-to-face, remote and hybrid)(Webb et al., 2016; Martins et al., 2021). From this perspective of technological interaction, researchers observe factors that affect audience behavior in different contexts, whether expressiveness (e.g.: actively or passively) (Cerratto-Pargman et al., 2014; Hödl et al., 2017; Yang et al., 2020; Gomes et al., 2020), the degree of participation (Cerratto-Pargman et al., 2014) or audience expectations from technological interaction (Li et al., 2019).

Wu et al. (2017) present a framework for classifying participatory live music performances. The framework is inspired by participatory art forms and based on audience participation levels. The framework was used to classify a tool's characteristics to promote audience participation, the *Open Symphony*. Features such as modalities, media, and motivation affordances were identified in the tool.

Cerratto-Pargman et al. (2014) seek to understand audience participation in interactive theater performances. Audience members were encouraged to interact and contribute to the performance by answering questions related to the plot of the theatrical scene. To understand the audience participation experience, the authors designed a framework to identify the qualities that emerged during the performance. Three main qualities were identified: Constitutive, Epistemic, and Critical. As a result, the authors identified different individual and collective audience behaviors and reactions.

The works described above concepts related to specific contexts of technological interaction: musical interaction in concerts and live-streaming of games and plays. Although they have been described in specific contexts, we can observe their application to other events. In this paper, we sought to organize such concepts considering events of different purposes where some technological interaction occurs. Thus, we present a taxonomy that organizes such concepts and guides researchers and technology developers to foster the audience experience at different events.

3 A TAXONOMY OF CONCEPTS RELATED TO TECHNOLOGICAL INTERACTION IN EVENTS

This research investigates the factors affected by the user experience associated with interaction technology at events. We propose a taxonomy of concepts related to technological interaction at events based on an exploratory literature review using backward and forward snowballing techniques (Kitchenham et al., 2015). By definition, a Taxonomy is "a controlled vocabulary with each term having hierarchical (broader and narrower) and equivalent (synonymous) relationships" (Whittaker and Breininger, 2008). The taxonomy supports the identification and understanding of the concepts that characterize the technological interaction in various events. Besides this, it can help designers and researchers as a basis to conceptualize how technology can affect audience behavior.

To create a taxonomy, we followed a sequence of five steps: 1st, exploratory literature review; 2nd, snowballing; 3rd exploratory search in national and Latin American events, 4th concepts extraction; 5th, concept synthesis.

In the 1st step, we carried out an exploratory literature review starting with a manual review of the proceedings of the main event in the area of Collaborative Systems (CSCW), considering the last six years (2016-2021). Due to the audience's spontaneous collaborative actions in events being a joint initiative, we used the main proceeding of the area (CSCW) as a starting point.

As inclusion criteria, we selected papers that explore concepts related to audience interaction, experience, and participation through artifacts and technological resources at events. In total, 1382 papers were analyzed by reading the title and abstract. From the reading of the title and abstract, we selected 21 papers to read fully. The inclusion criterion was applied again, and as a result, five papers were selected. From these works, we carried out a backward and forward snowballing (2nd step) to complement the research on definitions and concepts related to technological interaction in events.

Backwards snowballing is when we use the reference list to identify new papers to include in the review. Forward snowballing is a locating process of all papers citing a known article (Kitchenham et al., 2015). For the forward snowballing we used Google Scholar[1] virtual library.

Snowballing technique made it possible to analyze 63 new papers, 40 returned from backward snowballing and 23 from forward snowballing. The papers returned are from important vehicles, such as Conference on Human Factors in Computing Systems (CHI), Nordic Conference on Human-Computer Interaction (NordiCHI), Symposium on Computer-Human Interaction in Play (CHI PLAY) and Conference on Experiences for TV and Online Video (TVX).

In a complementary way, we conducted an exploratory search in the main proceedings of the Brazilian and Latin American events of HCI and Collaborative Systems to dialogue with previous works already published (3rd step) where 5 papers were selected. The selected papers are listed in a report available as supplementary material[2].

From the set of papers obtained from this process, we conducted the identification and organization of concepts related to the interaction and experience of the audience at events (4th step). In 5th step, four researchers followed the selection, analysis of these papers, concept extraction, and taxonomy consolidation. The process of consolidation occurred through meetings with the authors of this paper. In these meetings, we discussed how the concepts obtained affected the audience's experience, how we can explore them in the future in other contexts, and how technology evidence/affects/provides such a concept.

During the analysis, we noted several concepts related to engagement, participation, and liveness. Concepts associated with audience excitement and emotions were grouped in the engagement lens; the concepts that describe audience behaviors were grouped in the participation lens; the concepts that describe the experience of living a real-time event were grouped in the liveness lens. We defined these lenses in the concept synthesis step, using them as perspectives to organize the identified concepts in a taxonomy. In this sense, specific papers were analyzed to characterize these lenses better conceptually. Not all of these specific papers are about the context of events with technological interaction, but they were necessary for theoretical deepening[3].

The taxonomy presented in Figure 1 shows the organization and relationship between the concepts from three lenses: Engagement, Participation, and Liveness. The following sections cover each of the lenses in detail.

[1] https://scholar.google.com.br/

[2] Supplementary material: https://doi.org/10.6084/m9.figshare.20001641

[3] These papers are also available in the supplementary material

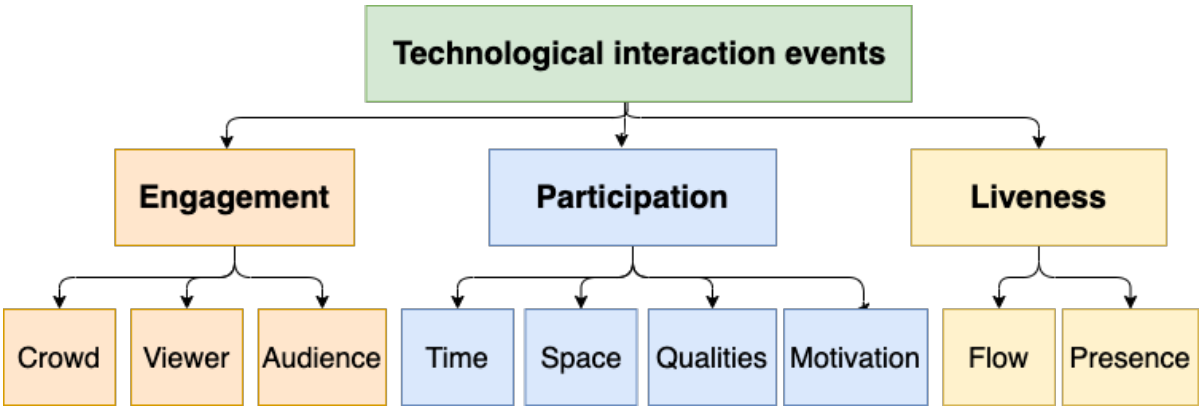

Figure 1: General overview of taxonomy.

3.1 Engagement

The literature points out different concepts for engagement (Doherty and Doherty, 2018). We consider engagement as "a quality of user experiences with technology that is characterized by challenge, aesthetic and sensory appeal, feedback, novelty, interactivity, perceived control and time, awareness, motivation, interest, and affect" (O'Brien and Toms, 2008).

Engagement concepts are explored from different perspectives, such as cognitive, emotional, and behavioral. The cognitive perspective relates to attributes such as effort, energy, awareness, and attention. The emotional perspective emphasizes the nature of experience involving attributes such as identification, belonging, values, attitudes, and emotions. The behavioral perspective highlights the action and participation of the actors involved. Constantly, the concept of engagement is also associated with phenomena of immersion, motivation, involvement, and experience (Doherty and Doherty, 2018).

In the context of technological interaction in events, Latulipe et al. (2011) define engagement as "a complex phenomenon that involves both valence and arousal". The representation of these concepts can be seen in Figure 2. Considering the perspective of technological interaction in events, we organized the engagement phenomenon based on three unit analyses: Crowd, Audience, and Viewer. These unit analyses synthesize different behaviors, emotions, personalities and how engagement is affected by technological interaction at events. In crowd unit analyses, collective engagement is observed from large masses (Veerasawmy and McCarthy, 2014; Vasconcelos et al., 2018). In Audience unit analyses, engagement is perceived from smaller audiences, not necessarily characterized as crowds (Latulipe et al., 2011; Araújo et al., 2022; Cerratto-Pargman et al., 2014). In the Viewer unit analyses, individual experience is observed (Haimson and Tang, 2017), even if the viewer finds himself participating in an audience or crowd.

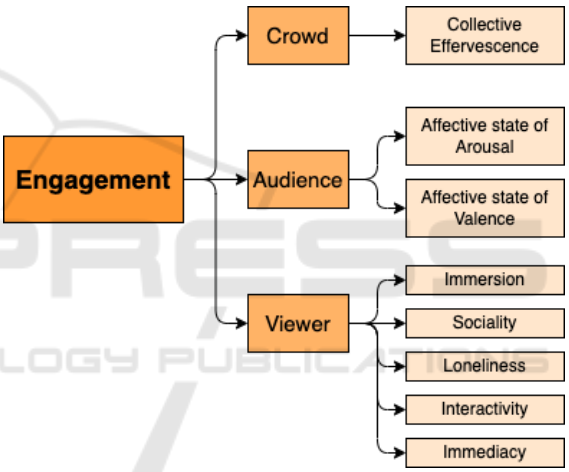

Figure 2: Representation of concepts associated with Engagement.

3.1.1 Crowd

According to Vasconcelos et al. (2018), Crowd Engagement can be understood as "a branch of crowd dynamics, but with a focus on how the crowd interacts with each other or as a group in a given event." The authors use this concept to encourage mass participation, providing public engagement in performances and art installations, such as applause and cheering.

Crowd Engagement is typical at events with large masses, such as sporting events or music festivals, where people collectively come together for a common goal, such as raising a smartphone flashlight, cheering, or crowds joining in singing the team's anthem. The characteristics of this type of engagement are associated with the concept of Collective Effervescence (Durkheim and Swain, 2008).

Collective Effervescence is a concept that emerged from psychology and conveyed the idea that groups gathered in a single place share the feeling of collective exaltation and emotion. Durkheim and Swain (2008) describes Collective Effervescence as: "The very fact of congregating is an exceptionally powerful stimulant. Once the individuals are gathered together, a sort of electricity is generated from their closeness and that quickly launches them to an extraordinary height of exaltation... Probably because a collective emotion cannot be expressed collectively without some order that permits harmony and unison of movement, these gestures and cries tend to fall into rhythm and regularity".

In the context of technological interaction in events, the motivation derived from the interaction of large masses is one of the Collective Effervescence effects, especially when there is the possibility of interacting or transmitting their exaltation with the moment (Otsu et al., 2021), such as flash mobs or crowds in football stadiums cheering for their team.

In remote events such as live streams, this collective feeling is conveyed differently and can occur through comments on streaming platforms or other forms of interaction with the public. Therefore, in remote events, the collective experience is not the same as in events where the audience can physically interact (Otsu et al., 2021).

Collective sentiment affects emerging aspects influencing the crowd's experience, such as imitation and invention. Imitation is a contagious movement involving responses from the crowd to participate in collective behaviors, characterized by moments of emotion and arousal. In this context, invention is a phenomenon derived from imitation and refers to the emergence of new behaviors, such as creating new songs, dances, or rituals (Veerasawmy and McCarthy, 2014).

The literature brings different perceptions about behaviors and characteristics associated with Crowd Engagement. Therefore, it is noted that Crowd Engagement is a broad concept with varying points of view. However, it is necessary to understand how to design new forms of technological interaction to promote the crowd's experience, whether in face-to-face, virtual or hybrid spaces.

3.1.2 Audience

Mackellar (2013) defines an audience as a group of listeners or viewers waiting to engage with the event. This concept of audience is generic and includes crowds to individual viewers of an event. Thus, we consider Audience unit analyses as a grouping of viewers participating in an event. However, this unit analysis does not include audiences in large masses (crowds) as a target, but smaller audiences, such as audiences in theaters or lectures.

In the context of technological interaction, audience engagement is observed from emotional phenomena such as valence (positive and negative) and pleasure (Latulipe et al., 2011; Webb et al., 2016). Latulipe et al. (2011) emphasize that engagement can be used as a tool to understand how performance is perceived by the audience and can be an indication that the audience is engaged in different contexts. In traditional performances such as theater or opera, silence is an indicator of audience engagement (Webb et al., 2016).

Engagement is also considered from the perspective of performances in distributed spaces (Webb et al., 2016). In game live streamings, engagement can be observed from audience participation when using resources made available by the broadcast platform, such as chats (Chen et al., 2019; Friedlander, 2017), likes (Tang et al., 2017; Bründl and Hess, 2016), emoticons or stickers (Lu et al., 2021; Chen et al., 2019).

According to Latulipe et al. (2011), audience engagement is presented from an emotional perspective related to affection and how the audience expresses their emotions when interacting and participating in the performance. From this perspective, the affective states Arousal and Valencia stand out. Valence is associated with audience attention and interest and can be measured as positive and negative (Latulipe et al., 2011). On the other hand, Arousal is related to emotional intensity (sleepy - activated), and can be affected by the music or what the viewer observes around (Latulipe et al., 2011). Besides this, the concept of Arousal is used as a factor to evaluate audience reaction during a performance (Han et al., 2021).

3.1.3 Viewer

Engagement can be analyzed from the perspective of an individual following the technological interaction (Viewer engagement). The Viewer unit analysis represents the individual experience of a spectator who may participate in a Crowd or an Audience. The individual and collective experiences are distinct. Common examples occurred during the COVID-19 pandemic, where many live streams emerged as an alternative to promote events. In this context, a single viewer can be following a live music festival from home, however, collectively gathered with thousands of people through the broadcast platform chat or using social networks (Lessel et al., 2017).

Five dimensions affect viewer engagement: immersion, immediacy, interactivity, sociality (Haim-

son and Tang, 2017) and loneliness (McLaughlin and Wohn, 2021). These dimensions relate to what makes live streams engaging from the viewer's perspective and explore the limitations that arise from the interaction between viewer and content transmitter(streamer). Haimson and Tang (2017) and (McLaughlin and Wohn, 2021) refer to these dimensions in the context of live streams.

Haimson and Tang (2017) describe immersion as the feeling of being present as part of the experience, considering factors such as energy, excitement, and whether you can see and hear the crowd during the event. In addition, from the different modalities in which the event is held, the experience can become more immersive for the spectator and provide a sense of connectedness with both the performers and audience Geigel (2017). Unlike immersion, immediacy is represented by the unpredictable, associated with aspects in which viewers can perceive what happens in real-time, such as uncensored content, immediate responses, and the feeling of not knowing what might happen next. Interactivity explores behavioral aspects of the spectator, being concerned with active or passive states. While a passive viewer watches the stream, an active viewer uses resources (e.g., chat or stickers) to interact with the stream or other viewers (Haimson and Tang, 2017; Bründl et al., 2017; Striner et al., 2021). Sociality shares social aspects of participation and is perceived when friends or acquaintances watch the same broadcast and share the same experience. For instance, streamers who have friends watching the broadcast can invite them to be part of the show, thus promoting engagement (Haimson and Tang, 2017). Contrary to Sociality, Loneliness is considered the state of isolation of the viewer, which happens when one lacks appropriate social partners to share desired social activities (McLaughlin and Wohn, 2021).

3.2 Participation

Event and audience studies have become prominent in areas such as tourism (Getz, 2007, 2008), where audience participation as part of the performance has become a popular topic. In this sense, audience participation is conceptualized from active and passive behaviors (Mackellar, 2013). Active participation involves energy, enthusiasm, skills, and commitment to audience resources. Passive participation doesn't require many skills and is related to just watching and following the event (Mackellar, 2013). The representation of this concept is presented in Figure 3.

Considering events with technological interaction, Audience participation is a way to engage audiences, and reinforce the liveness of the experience (Robinson et al., 2022). In the literature, audience participation is synthesized from active/passive behaviors (Cerratto-Pargman et al., 2014; Li et al., 2019). Other works highlight qualities(Cerratto-Pargman et al., 2014) and motivations(Martins et al., 2021) that influence audience's experience through technological interaction. Participation is constantly used as an alternative to making events engaging and interactive, as an essential part of interactive performances (Cerratto-Pargman et al., 2014). Through this participation, elements like emotional expressiveness and interactions between artists and audience members can emerge from audience participation (Tholander et al., 2021). In remote events, audience participation can be performed through features such as chat and voting (Li et al., 2019). Such interactive features for audience participation may influence the content of the broadcast and the content to be broadcast in the future (Lessel et al., 2017). Consequently, immersion content, the immediacy of audience action, and the sociality of the experience can be affected (Striner et al., 2021).

From literature, audience participation by technological interaction can be analyzed from four perspectives: concerning the time or moment in which it occurs, the environment in which this participation takes place, the audience's motivation to participate in the event, and the qualities of this participation. A representation of this perspective can be seen in Figure 3.

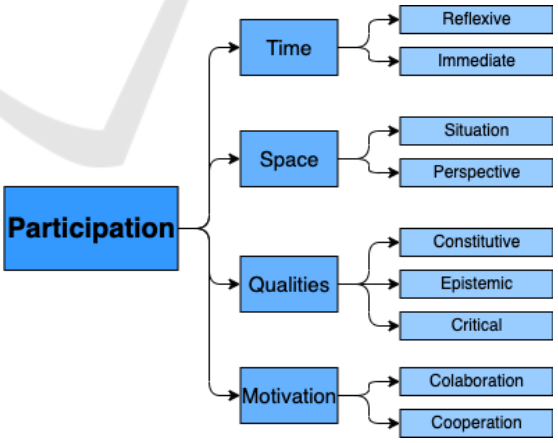

Figure 3: Representation of concepts associated with Participation.

3.2.1 Time Related Participation

Regarding time as an aspect, participation is characterized by two facets: reflexive and immediate (Cerratto-Pargman et al., 2014). The reflective facet reflects the personal participatory experience after the

performance. The immediate facet describes emerging qualities during the show. The authors add that sensory, emotional, and intellectual stimuli associated with engagement are awakened from technological interaction.

From an immediate facet, two concepts were identified which affect participation with technological interaction during the event: technology-mediated audience (Hödl et al., 2020) and Co-performance (Li et al., 2019).

Moreover, we related the immediate facet with Co-performance concept. Li et al. (2019) refer Co-Performance as a collaboration between performance, audiences, and streamers to present performances in live streaming. In this sense, the authors emphasize that Co-performance is concerned with how the streamer and audience interaction occurs and how it can improve such interaction.

3.2.2 Space Related Participation

Participation integrates elements that affect the experience, including the space in which the audience is distributed (Webb et al., 2016).

One concept regarding audience participation is Perspective. Geigel (2017) refers 'Perspective' as the experience of participation related to the venue of the performance, considering where the audience view and interact with the performance. Besides this, audience view is related audience's position in the environment, such as the seat of the viewer during the performance. Still, from Perspective, we associated another concept, Intervenability. The concept of Intervenability refers first-person perspective, specifically the sense of being involved in the relationship with a member (Yakura, 2021). This concept cares about how members can control the mode of interaction is conducted.

3.2.3 Participation Qualities

Studies emphasize the need to understand the experience through audience participation in interactive performances (Williamson et al., 2014; Martins et al., 2021; Lu, 2021; Striner et al., 2021). Cerratto-Pargman et al. (2014) explore audience participation from three emerging qualities: constitutive, epistemic and critical.

The Constitutive quality seeks to understand participation from the cultural and social perspective of the participants concerning the performance, especially how they establish themselves to interact or accompany the performance (Cerratto-Pargman et al., 2014). In live stream context, communities can be considered as members of grups around themes such as culture and pride. The members has roles and specific identities where a network of thematic relationships and emotional connection (Striner et al., 2021; Hilvert-Bruce et al., 2018).

In Epistemic quality, the values of participation are associated with the experience of knowing more about oneself, and about others around them during the performance (Cerratto-Pargman et al., 2014). On the other hand, Critical quality seeks to understand the emergence of emerging social issues and critical thinking about participation (Cerratto-Pargman et al., 2014). Social aspects can emerge from messages with a socio-political charge, such as themes related to minorities, wars or social movements (Cerratto-Pargman et al., 2014). As an example of Critical quality, we can mention the live streams where performers encourage the public to express themselves about various topics. The incentive reflects in audience participation through text comments in chat and the rise of hashtags associated with the theme.

3.2.4 Motivation

When designing interactive technologies at events, it is necessary to observe motivation as a fundamental factor. Each type of audience may have different intentions to participate (Gomes et al., 2020). Hödl et al. (2017) note that the audience wants unique and special experiences and feels part of an audience. Wu et al. (2017) suggest that the motivation to participate is influenced by the desire to be an active spectator and point out some characteristics that affect audience motivation, such as imitation, competitiveness, contributing to the performance, or directing/leading the performance.

The motivation is the intention to interact and experience new experiences. Motivation can be associated with two main activities presented by Martins et al. (2021), Collaboration and Competition. Collaboration is described as the "process by which people act together for a common goal, being a collective, synchronous activity that results from a sustained effort to build and maintain a shared understanding of an issue or task" (Martins et al., 2021). Therefore, motivation is the desire to participate in collective activities with common goals. Otherwise, Competition reflects the intention to participate in competitive activities, and motivation is affected by the feeling of challenge (Martins et al., 2021). Typical examples are seen at sporting events where audiences are influenced to cheer for a team.

Therefore, exploring possibilities for participation can be a challenge where it is necessary to think about how to design new experiences and study the context of the event.

3.3 Liveness

Liveness represents the connection of people following and watching the event in real-time and living the spontaneity of the experience(Mueser and Vlachos, 2018).

In the context of technological interaction, Webb et al. (2016) describes the concept of Liveness as: ”experiencing an event in real-time with the potential for shared social realities among participants”. Hook et al. (2012) suggests that Liveness is conceived from aspects of location and presence, as well as attributes such as space and time (Webb et al., 2016). Besides this, Liveness is considered a key aspect to capturing the energy of a live performance (Robinson et al., 2022), related to connection between viewers watching the same event and the naturalness of the live experience (Mueser and Vlachos, 2018; Jacobs, 2018). Therefore, *Liveness* is associated with the experience of being there (Hook et al., 2012), and accompanying the audience by participating in the event (Mueser and Vlachos, 2018). Liveness is usually used to differentiate live events from recorded events concerning possibilities of interaction and engagement (Geigel, 2017; Benford et al., 2021; Striner et al., 2021). A representation of this perspective can be seen in Figure 4. We use the term Liveness to represent the whole atmosphere that affects the experience of the audience, as well as sensations and emotions. In this sense, two concepts are associated with Liveness: Flow and Presence.

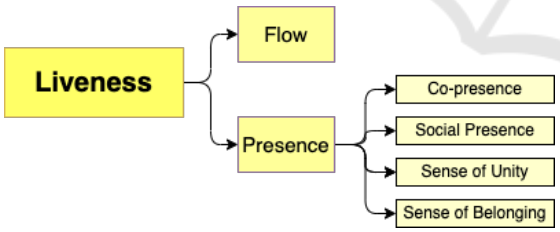

Figure 4: Representation of concepts associated with Liveness.

3.3.1 Flow

The Flow represents the phenomenon of being absorbed and entwined by something (Csikszentmihalyi and Csikzentmihaly, 1990). In the context of technological interaction, Mueser and Vlachos (2018) highlight examples that provoke the state of Flow, such as engagement and concentration, learning and challenge, energy and tension, shared experience and atmosphere, and personal and connection.

3.3.2 Presence

Unlike Flow, which represents the perception of being absorbed, Presence is a paradigm concerned with redesigning Liveness, considering the degree to which spectators pay attention to the event and intensity of engagement (Kim, 2017). For instance, in virtual reality events, Presence is used to evaluate the quality of experience, concerned with the emotional response of ”being there” (Yakura and Goto, 2020). Presence can be associated with two concepts: Co-presence and Social Presence.

Haimson and Tang (2017) present the concept of Co-presence as a ”shared sense of space and time that bridges the gap between event participants and audience”. This concept represents how audiences can be established at the event to interact or follow the performances. For example, in environments with physical Co-presence, participants can socially interact with (Webb et al., 2016; Geigel, 2017) audience members. In remote or virtual spaces, this concept is important to engage remote audiences and promote liveness (Otsu et al., 2021), and can be associated with audiences chatting in a shared chat(Webb et al., 2016).

Social Presence is related to the degree of awareness of others in an interaction (Geigel, 2017), concerning how people present in the same space coexist and react with other viewers (Li et al., 2020). Geigel (2017) points to factors between audience members, such as their verbal and non-verbal communication and the feeling of shared simultaneous experience in the same environment.

Sharing the same environment and reactions with audiences can awaken new feelings. In virtual and remote environments, there’s the Sense of Unity. This concept is described as a consequence of the synergic effect among audience excitement, such as cheering or shouting reactions (Yakura and Goto, 2020). Sense of Unity is also described as unique interaction between the audiences and the performers (Abe et al., 2022). Additionally, the Sense of Belonging is one of the reasons viewers interact during remote events. This concept is related to community relationships, considering emotional dependence on the group and how users interact in these communities (Li and Guo, 2021).

4 DISCUSSION

In this literature review, we sought answers to the following research question: *How researches in HCI and CSCW areas are approaching technological in-*

teraction in events? Therefore, the concepts derived from the literature were organized into a taxonomy structured around three major concepts, here considered lenses of analysis: engagement, participation and liveness.

Regarding HCI, the review frequently addresses issues associated with live streaming. Researchers are concerned with how to increase audience interaction and engagement with the streamer of the content (Tang et al., 2016; Fraser et al., 2019), which makes experiences in live streaming engaging (Haimson and Tang, 2017). Interaction happens in many ways, such as chat, likes, polls, or other interactive features (Striner et al., 2021; Miller et al., 2017). Another concept related to live streaming is associated with liveness since the consumption of content after the live broadcast makes the experience different from when performed live (Benford et al., 2021). Viewers appreciate raw content, and value real-time interaction (Lu et al., 2018). For instance, lives that occurred during the pandemic, although it has already happened, the recording is available to be watched on video-sharing platforms.

It's important to consider keeping viewers motivated and engaged in live streaming. Viewers interact with each other or with the broadcaster. This interaction has the potential to change the content during the live. Therefore, it is necessary to explore opportunities from the viewers' perspective, provide alternatives to remain engaged, identify how they can change the broadcast, and generate new interactive resources.

Outside the context of live streaming, there were studies related to concepts of collective effervescence in live music performances (Otsu et al., 2021) and audience participation by music creation (Hödl et al., 2020).

In CSCW, studies address how liveness experiences are transformed by technology into distributed performances (Webb et al., 2016), how participants are collaborating in virtual spaces (Wallace et al., 2020; Araújo et al., 2022) and different forms of interaction and participation in live streamings (Lu et al., 2021; Li et al., 2019; Tang et al., 2017). For the CSCW community, it is interesting to explore audience participation in *live streams*, as, in many live streams, the audience is encouraged to work together for common goals, such as raising funds for a campaign and collaborating to solve challenges in games, for instance.

From these works, there is a growing demand for research with interest in understanding audiences' experience in live broadcasts. Therefore, promoting alternatives to increase interaction and participation in live broadcasts are trending topics in these areas.

The taxonomy proposed is based on three main lenses (Engagement, Participation and Liveness). When analyzing aspects of engagement, it is natural to observe aspects of audience participation and liveness, in the same way, when investigating liveness, aspects of engagement and participation emerge since such concepts have an intrinsic relationship with each other. For example, an audience may attend a remote event and engage actively with the provided technology interaction. Consequently, when designing forms of technological interaction, it is important to consider the experience as a whole without losing focus on the individual experience that participates in the interaction.

Considering engagement as an emotional, cognitive, and behavioral phenomenon (Doherty and Doherty, 2018), participation as a result of technological interaction can arouse different levels of engagement, that is, feelings that represent the experience. Such feelings are presented in different ways, as presented in the Subsection 2.1. This experience is affected by the feeling of being there experiencing the experience and the immediacy represented by the concept of Liveness.

Studies already propose alternatives to measure audience engagement during events(Wang et al., 2014; Latulipe et al., 2011). However, it needs attention since, while they seek to measure engagement, they can also affect the audience's experience as a technology user. Interactive features in live streaming can also affect the remote event experience. Text messages can be useful when interacting with audiences or small crowds. However, when the audience grows exponentially, it becomes difficult to manage the flow of messages (Miller et al., 2017; Haimson and Tang, 2017). Therefore, there is a need to think about how to explore these concepts in order to minimize difficulties faced when providing experiences derived from technological interaction in events, as Haimson and Tang (2017) suggest message flow groupings in chat.

In this sense, the HCI area can contribute by observing how to promote and improve interactive experiences based on new resources and technologies. However, it is necessary to explore different modalities, events, and audiences considering different contexts. Such concepts help assess how the experience expected by technological interaction is affected by the performance and how audience interaction is affected. In this context, this is a topic to be explored, as event producers seek to provide unique experiences to the public, improving their involvement and engagement. As a result, opportunities can be explored to contribute to the experience, in particular, improve the UX of technologies or study how can apply In-

teraction Design to design products aimed at public participation and engagement.

The CSCW area, on the other hand, can contribute to exploring how audiences collaborate to achieve common goals. It is noted that several aspects are to be explored, such as remote, face-to-face, or hybrid audiences. Therefore, how the audience and show collaborate is essential to transform experiences lived during the event and audience motivations to collaborate.

This research contributes to the taxonomy of concepts related to technological interaction in events found in the literature. Those concepts have the potential to introduce novel perspectives for engagement across varying contexts and modes of occurrence, including frameworks or models that serve as a foundation for comprehending and interpreting the technology-mediated phenomenon or process. This, in turn, may facilitate the advancement of technologies pertaining to said phenomenon or process. However, they need to be explored carefully since, in the same way that experiences provide positive feelings about the interaction, negative perceptions must also be considered.

5 CONCLUSION

This paper presented a taxonomy of concepts associated with technological interaction in events with the potential to provide new audience experiences. The organization of concepts was derived from an exploratory literature review using backward and forward snowballing techniques. As a result, three main concepts were identified: Engagement, Participation and Liveness.

These concepts were associated with a unit analysis that helps to characterize ways of promoting technological interaction. As a result, we verified how engagement could be observed from different perspectives. In addition, we highlight how the audience can be motivated to participate and the importance of their real-time experience.

Understanding the concepts presented can change the experience mediated by technological interaction, considering different modalities of the event. This representation aims to obtain an overview of concepts that affect the experience. In future work, we aim to validate this taxonomy through a study with specialists and investigate how to design technologies considering the association of all concepts.

ACKNOWLEDGMENT

We thank USES Research Group members for their support. The present work is the result of the Research and Development (R&D) project 001/2020, signed with Federal University of Amazonas and FAEPI, Brazil, which has funding from Samsung, using resources from the Informatics Law for the Western Amazon (Federal Law nº 8.387/1991), and its disclosure is in accordance with article 39 of Decree No. 10.521/2020. Also supported by CAPES - Financing Code 001, CNPq process 314174/2020-6, FAPEAM process 062.00150/2020, and grant 2020/05191-2 Sao Paulo Research Foundation (FAPESP).

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