All For One and One For All: investigating how Global Game Jam participants get and offer help

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***Abstract*—*Background*: Time-bounded collaborative events are events that bring together different participants to address a problem through the creation of a computational artifact over a short period of time. Examples of these events include hackathons, game jams, and ideathons. Despite previous research on these events, little is understood about how people seek and get help during these events. *Aims*: Our goal is to understand how event participants seek and get help during time-bounded collaborative events to design better strategies supporting search behaviour. This is necessary because participants learn and improve different skills important for working in the industry during these events. *Method*: We conducted a mixed-methods study where we collected data through a large-scale survey with participants of a global-scale game jam. Our primary method was quantitative, but we had a qualitative dataset that we used to augment aspects of our quantitative results. *Results*: Our findings suggest that professional and independent developers are the ones who provide help most often, while students interact more with mentors. In addition, the frequency that participants getting help from mentors decreases with increased experience in game development and the number of participations in game jams. Participants also point to mentors as an essential part of the jams: they are expert facilitators, so much so that the perception of the mentors' absence or distance was reported as a disappointment. *Conclusions*: Understanding how participants in time-bounded collaborative events seek and get help is important to design more effective events and improving the participants' overall experience. We translate our findings into suggestions for event organizers.**

***Index Terms*—Time-bounded collaborative events; Game Jams; Game development; Information-seeking; Help-seeking.**

I. Introduction

Time-bounded collaborative events bring participants together to solve a problem by creating a software solution over a short period of time. Such events are becoming increasingly popular among various organizations [1,2] and bring together people with different skills to create prototypes usually over the period of one to three days [3]. Participants typically organize themselves into teams and work intensively on a specific problem or theme. In face-to-face events, they share the same physical space throughout the event [1,2]. Such intensive and collaborative events usually do not take place in the participants' workplaces and usually involve participants who do not know each other before the event.

Time-bounded collaborative events are important because they provide an informal learning environment [4,5], improve students' performance [6], offer teamwork experience [7,8] and networking opportunities [9,10], among other advantages. This led researchers to study these events. For instance, previous studies have explored the collaboration among participants [11], the role of mentors [12], the continuity of the prototypes [13], and their impact on startups [14]–[16].

Due to the limited duration of these events, participants need to effectively conclude their tasks, which means solving the different problems they encounter. To do that, participants might need information that is not available to them during the event. However, the participants' information-seeking behaviour during these events has not been explored in previous research. Understanding how participants search for information is important prior to design strategies to support those who participate in time-bounded collaborative events. This way, strategies to support search behaviour can be more holistically understood and provided. Furthermore, information seeking is an important metacognitive skill that includes "knowledge about when and how to use particular strategies for learning or for problem-solving" [17].

This paper addresses this gap in the literature by studying information seeking in the context of a game jam. Game jams are examples of time-bounded collaborative events where the participants, the *jammers*, develop games [1,2]. Game development is a special case of software development that requires multiple disciplines including programming, sound, art, game design, artificial intelligence, and human factors [18]. In this context, this paper addresses the following research question: *How do jammers seek and offer help during a game jam*?

We answer this question in the context of the Global Game Jam (GGJ), the biggest face-to-face game jam. The event has become increasingly popular, bringing together thousands of participants every year [19]. Due to the multidisciplinary nature of digital games, the GGJ tends to attract participants with different interests and profiles [20].

Our study adopted a mixed methods approach [21]. Specifically, we first used a quantitative method with an approach

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based on descriptive and analytical statistics. Then, a qualitative database was analyzed to describe and exemplify aspects of the quantitative results. Our results illustrate, for instance, that professional and independent developers, hereon called simply *indie*, are the ones who provide help most often and that students are the ones with the most intense interaction with mentors. In addition, the frequency with which jammers receive help from mentors decreases as experience in game development and participation in game jams increases. Finally, our results indicate the need for more intense collaboration, from both mentors and jammers, with more experienced professionals during the events, as this can improve the overall experience in the event.

II. Related Work

A. Time-bounded Collaborative Events

Time-bounded collaborative events are usually large-scale events that bring together participants from different backgrounds to address a problem through the creation of a computational artifact over a short period of time (a day or two) [22]. In these events, participants engage in a focused effort that is both resource-limited and goal-oriented. Typical resource limitations include time and expertise. Meanwhile, goals are often prescribed, but the prescription may be as general as thematic notions or concepts [23].

These events may share a physical space that encourages participants to jointly brainstorm about problems of shared interest in a collaborative environment, as well as providing an opportunity for new participants to get involved in collaborative projects [24]. Such events may be competitive or non-competitive. They may also differ on whether participants collaborate by interacting face-to-face or remotely [1]. These events assume that participants have sufficient expertise to work on projects on their own [12]. They normally provide periodic assistance from subject matter experts who act as mentors and assist with scoping and executing the projects.

B. Game Jams

Game jams are examples of time-bounded collaborative events [1,2]. They usually last 48 hours and end with drawings and functional prototypes of games. Their participants are called jammers. In contrast to hackathons, game jams are not exclusively focused on coding activities and their participants are typically unaware of the event's theme until it commences, ensuring that the creative ideation process occurs solely during the event [25]. In addition, they are usually non-competitive and jam organizers are motivated by their desire to grow the local community and by a sense of belonging [26].

Previous studies [10,27] indicate that game jams allow jammers to gain important experience for working in the industry by providing social and informal learning opportunities [3,5,7]–[9,28]. In other words, game jams are an important part of the larger ecosystem of game development.

The GGJ can be considered *"the world's largest game development activity (game jam)"* [29]. It takes place in physical locations simultaneously all over the world [29], and it has been taking place since 2009 annually. All jammers develop games within the same time frame and on the same topic [29]. At the end of the event, all games are submitted and published as open source on the GGJ website [28].

The GGJ attracts participants with different interests and profiles varying from students, professional game developers, hobbyists, and independent developers (indies) [20]. Indies are usually either self-employed or work for small development units (see section III-C).

C. Information Seeking

Information seeking is construed as the activities involved in realizing a need for information, exploring this need, identifying possible information sources, consulting selected sources, adapting the acquired information to the problem at hand, as well as coming across information without actively looking for it [30]. Note that finding information is followed by analyzing this information to ensure it is useful in the original context in which one decided to seek information.

Many authors use information seeking *behaviour* to discuss the activities performed by those seeking information, information *needs* to indicate the types of information these people look for, and information *sources* to indicate the origin of the information. We will use this same terminology.

More than 20 years ago, Case [31] estimated there were more than 10,000 publications about information-seeking since this area is at the intersection of psychology, management, communications, and information science. Therefore, it is not a surprise that the concepts of information-seeking behaviour and information needs have been studied in different contexts including elementary school [32], university [33], and workplaces [34], just to mention a few examples.

D. Information Seeking in Software Engineering

In the context of software engineering, researchers have studied different aspects of information-seeking behaviour including developers' information needs [35], the queries performed by software developers [36], the usage of Q&A sites [37], code search engines [38] and recommendation tools that suggest code [39].

Li et al. [17] was one of the first authors to focus on developers' information-seeking behaviour. They studied the information sources and behaviour of students performing software development tasks. Their results indicate that medium-experienced developers use more diverse information sources followed by less experienced and more experienced developers. According to Li: *"A plausible explanation could be* [that more experienced] *developers already possess the necessary knowledge, while* [less experienced] *developers do not know of as many types of information sources as* [those] *developers"* [with medium experience].

We follow an approach similar to Li's [17] focusing on the overall information seeking *behaviour* during time-bounded collaborative events, and especially the event participants as *sources* of information. We use *help*-seeking in our survey (instead of information-seeking) since it is easier to understand.

E. Information Seeking in Time-bounded Events

To the best of our knowledge, there are no previous studies focusing on information seeking in the context of time-bounded collaborative events. The closest work to ours is Karch's [40] who studied members of a game design community. She collected data by (i) conducting 10 interviews with beginners, hobbyists, and professional game designers from a game design organization and (ii) observing a 32-participant one-day game jam hosted by the same organization. It is worth mentioning that her results were obtained using data solely from the interviews, not from the game jam itself.

According to Karch, the interviewed participants sought help by asking other people. Indeed, seven out of ten participants asked *another person* for information. Furthermore, the community members were mentioned as the main source of information. These members were mentors, experts in particular areas (e.g., marketing), developers, and other professionals.

F. Game Development Software Engineering (GDSE)

Game development has a multidisciplinary nature involving the integration of sound, art, game design, control systems, programming, artificial intelligence, and human factors, which sets it apart from conventional software development [18, 28,41,42]. Some examples of these differences include [18]: (1) functional requirements are better suited for traditional software engineering than games one; (2) in game development, testing procedures typically involve high-level approaches, rather than relying on automated, low-level testing commonly employed in traditional development practices; and (3) game development requires a more diverse team. Other authors [41,43] also argue there are differences in the development processes of games and traditional software applications.

III. Research Methods

This research presents an exploratory and descriptive study that aims to investigate how jammers seek and receive help during an instance of the GGJ. To do this, we used an approach with mixed methods, which involved collecting quantitative and qualitative data simultaneously to better understand the research problems, i.e., a nested concomitant strategy [21]. This research strategy is characterized by having a primary method that guides the research and a set of secondary data that complements and seeks information at levels different from the primary method [21]. In our case, we used a questionnaire with closed-ended and open questions to collect data. The main method we used was quantitative (the close-ended items in the survey), and the secondary was a qualitative database (the open-ended questions in the survey)i.e., we used qualitative data to better describe some aspects of the quantitative results.

A. Context of the Research

We conducted a survey with participants of the GGJ 2020, a global-scale event (see section II-A) that took place over a weekend. This event produced 9,601 games, according to the organizers. All of this happened simultaneously at 934 different locations in 118 countries around the world during 48 hours. At each of these venues, the event started after a presentation with some guidelines on game development and then the "secret" theme of the event was announced.

In order to get familiar with the dynamics and better understand the context of the GGJ 2020, the first author participated in the GGJ in the city of Natal, Rio Grande do Norte, Brazil. The local gaming community was responsible for the organization of the event in the mentioned city. This participation enabled his contact with this type of event, which made it possible to observe the behaviour of the participants and the particularities of the event. Furthermore, this *in-situ* contact guided and provided context to the development of the questions and their answer items used in the survey. The next topic presents the details of the research instrument used.

B. The Survey

Our questionnaire was divided into four major sections. However, the responses considered in this paper refer to only two of these sections since the other sections were unrelated to the topic of this paper. In the first section, we asked questions about the personal information of the participants and their professional and academic experience. This survey section included the following variables: Gender, Age (Open with a numeric - integer - field), Highest school level or degree completed, Prior involvement with game development, Experience (in years) with game development, and Number of previous participation in game jams. The response items associated with each variable are available in Table I.

In the second section of the survey, we asked how the participants sought and provided help during the event. To do so, three questions were introduced to better understand the exchange of information between participants and mentors. It is important to notice that in some GGJ venues, there may not be an explicit role of "mentor". In this case, the organizers also assume this responsibility. Because of that, this question assumed mentors and organizers have the same role. Therefore, whenever we mention "mentors" in this study, we refer to both event organizers and mentors.

In the first question, we asked the survey respondents to choose the relative frequency with which they sought and provided help during the event. Answers were given on a five-point Likert scale. The details (options and scale) for this question are presented in Figure 1.

The second question was an open and optional question where we asked participants to explain the answer they provided in the previous question about how often they sought and provided help.

In the final question, respondents were asked where or with whom they got help in addition to their teammates. Details about this question are presented in Figure 2.

C. The Data Collection

We surveyed participants of the GGJ 2020. We collected information from 29,384 participants worldwide through the email information made available on the event website.

We initially conducted a pilot study with 2,000 randomly selected event participants. This pilot study received 243

responses (12.2% response rate). Based on these responses, two corrections were made. First, in the question "Have you ever been involved with game development before the Global Game Jam 2020?" the response items "Yes, professionally" and "Yes, as an indie developer" were replaced by "Yes, professionally (employed)" and "Yes, as an indie developer (Independent/Self-employed, small commercial or other small development units)". After that, we distributed the online survey to our full sample of participants. We received a total of 3,197 answers (10,9% response rate). The pilot survey responses are not included in our final sample.

D. The Quantitative Analysis

The analysis of our survey used descriptive statistics to present the demographic characteristics and the average behaviour of the jammers. Section IV-A describes the absolute and relative frequency distribution of background information from the sample.

Correlation and regression analyzes were applied to verify possible associations and antecedents of the seeking/offering help variables by the jammers. In a complementary way, correspondence analysis, analysis of variance, t-test and the Chi-Square test were used to verify possible differences in behaviour between groups defined by the type of involvement with game development and also groups formed by the gender of the participants about (i) their frequency of seeking/offering help, and (ii) the sources of help manifested by the jammers.

E. The Qualitative Analysis

Our qualitative analysis was applied to the open-ended question about how the jammers sought and provided help during the event. These questions were of the survey analyzed using coding techniques [44]. Coding consists of labelling data segments that summarize a core concept. In our first step, *open* coding, our data from the open-ended question were analyzed line-by-line to identify initial categories. The first author coded the open-ended answers, and the fourth reviewed those codes. This initial coding resulted in unique codes that characterize the survey responses. After that, we used *axial* coding to organize the categories hierarchically and link them to subcategories and categories among themselves. As a result, we reorganized the data segments we coded. Finally, during the *selective* coding, we organized the categories around four core categories we identified.

In our analysis, we tried to separate the qualitative data according to the type of involvement and demographics. However, as in most surveys, the answers to the open answers were concise with an average size of 138 characters including spaces. Therefore, when we divided the answers by these groups, we were not able to find meaningful results per group. This means the results of our qualitative analysis are based on *all* open answers. By doing so, we offer a macro-level perspective on the help-seeking and offer behaviors of jammers. This allows for a more comprehensive understanding of the different types of help offered, the reasons behind their decisions, and specific examples of situations where jammers and mentors seek or offer help.

IV. Results

A. Descriptive Statistics

Table I summarizes the demographic information of our respondents. It is possible to notice that the majority of the survey participants (52.3%) reported having an undergraduate or graduate degrees. Meanwhile, 27.3% of the participants were professional (12.8%) or indie (14.5%) developers. In addition, 42.2% were participating in the event for the first time, and 28.1% had no experience (12.6%) or less than one year of experience (15.5%) with game development. These data indicate that GGJ attracts *new* participants, i.e., the event contributes to the growth of the gaming community.

TABLE I: Demographic data

	Groups	Number	%
Gender	1. Male	2404	75,2
	2. Female	652	20,4
	3. Others	141	4,4
Educational Level	1. Less than a high-school diploma	91	2,8
	2. High-school or equivalent (e.g. GED)	642	20,1
	3. Some college, no degree	790	24,7
	4. Bachelor's degree (e.g. BA, BS)	1178	36,8
	5. Professional degree (e.g. MD, DDS, DVM)	115	3,6
	6. Master's Degree (e.g. MA, MS, MEd)	355	11,1
	7. Doctoral Degree (e.g. PhD, EdD)	26	0,8
Level of Experience	4. No experience in game development	402	12,6
	5. Less than 1 year	494	15,5
	6. One year	409	12,8
	7. Two years	511	16
	8. Three years	400	12,5
	9. Four years	284	8,9
	10. Five years	183	5,7
	11. More than five years	514	16,1
Number of previous game jams	1. No, this was my first game jam	1349	42,2
	2. One game jam	559	17,5
	3. Two game jams	322	10,1
	4. Three game jams	242	7,6
	5. Four game jams	188	5,9
	6. Five game jams	105	3,3
	7. More than five game jams	432	13,5
Type of involvement	No involvement (None)	485	15,2
	Professionally (employed)	408	12,8
	Indie developer (Independent/Self-employed, small commercial or other small development units)	462	14,5
	Hobbyist	669	20,9
	Student	1067	33,4
	Others or None	106	3,3

It was also possible to identify, in 1,716 open responses, the country in which the survey respondent attended the event. In this case, 101 different countries were mentioned. The five most mentioned were: United States (398), Brazil (122), United Kingdom (105), France (81), and Canada (69).

Figure 1 presents an overview of the dynamics involved in seeking and providing help during the event indicated by the jammers. In general, it is possible to notice that most of our informants answered they "Occasionally" or "Rarely" helped or got help from other jammers. They also answered that "Never" or "Rarely" got help from mentors. We dive into these results in section IV-B, where we discuss these data considering participants' profiles and demographics. Later on, we present qualitative evidence that can explain these results.

Figure 2 shows the main sources of help, i.e., with whom jammers interacted to get help, besides their teammates. Note that the majority of respondents indicated they mostly get help from other jammers in the same location (47%). These results are interesting because they show that most sources of help by

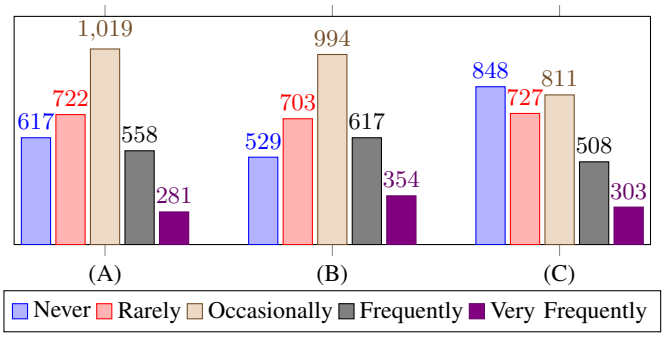


Fig. 1: Exchanged help during the event indicated by the jammers: **(A)** - I got help from other GGJ jammers; **(B)** - I helped other jammers in GGJ; **(C)** - I got help from GGJ mentors/organizers.

the jammers are different from the "expected" sources of help, such as mentors/organizers (20%) or online sources (25%). This result reinforces the fact that the GGJ is an event that favours informal interaction and collaboration.

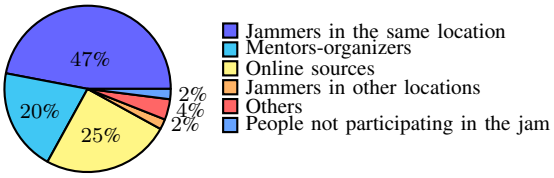


Fig. 2: The most frequent source of help.

B. Quantitative Results

1) Who asks and provides help: At first, we compared the overall averages of each type of help (request/offer) and applied two paired t-tests between help asked from jammers and help provided to jammers and between help from jammers and help from mentors. In the interaction between jammers, there was a significant difference between the averages ($p < 0.01$), with the average of help offers (2.86) being higher than the help requests (2.74). This means that participants are more likely *to help* their peers than to actually *seek their help*. In addition, in relation to the source of help, a significant difference was found ($p < 0.01$), with the average number of help requests for jammers (2.74) being higher than for mentors (2.59). In short, when jammers ask for help, they ask for it more from their peers than from the event mentors.

2) Age and Experience of the Jammers who ask and provide help: Table II presents the results of Pearson's correlation analysis between the investigated variables. It is important to note that the variables that are most closely correlated with types of help are the level of experience and the number of participations in jams. In particular, the level of experience of the jammer is positively and significantly associated with the frequency of help provided from jammer to jammer ($\rho = 0.100; p < 0.01$), as is the number of participations in jams ($\rho = 0.128; p < 0.01$). In other words, the greater the experience or the number of previous participation in jams, the greater the help provided.

Conversely, the higher the jammer's level of experience, the smaller the likelihood of the jammer seek help from mentors (ρ = -0.161; $p < 0.01$). The same happens in relation to the number of previous participations in jams, i.e., the greater the number of previous participations, the smaller the likelihood of this jammer seek help (ρ = -0.159; $p < 0.01$). Finally, the jammer's experience also level reduces their search for help with other jammers (ρ = -0.097; $p < 0.01$). There are still some other significant associations in Table II, but with less important magnitude.

Linear regression analysis shows a similar pattern of behaviour. In this case, we performed three regression analyses, one for each type of help requested/offered (see Table III). Unlike correlation analysis, this linear regression analysis included in the test all of the independent variables simultaneously. According to this assessment, the request for help from peers decreases as the jammers have a higher level of gaming experience (ρ = -0.096; $p < 0.01$). On the other hand, the intensity of assistance offered to peers by a jammer increases as a result of their greater number of previous participation in game jams (ρ = 0.097; $p < 0.01$). Finally, the greater the experience in events and the number of participations in game jams, the lesser their search for help from mentors (respectively: ρ = -0.103; $p < 0.01$; ρ = -0.104; $p < 0.01$).

TABLE II: Correlation Analysis

	Help from jammers	(1)	(2)	(3)	(4)	(5)
(1) Help to jammers	,545**					
(2) Help from mentors	,541**	,388**				
(3) Age	-0,01	,062**	-,061**			
(4) Educational Level	-0,025	,051**	-,058**	,473**		
(5) Experience Level	-,097**	,100**	-,161**	,323**	,213**	
Number of jams	-,072**	,128**	-,159**	,272**	,224**	,624**

**p<0,01

TABLE III: Linear regression analysis

	Help from jammers	Help to jammers	Help from mentors
Age	0,033	0,021	0,01
Educational level	-0,013	0,012	-0,015
Experience level	-,096**	0,023	-,103**
Number of jams	-0,024	,097**	-,104**

** p <0,01

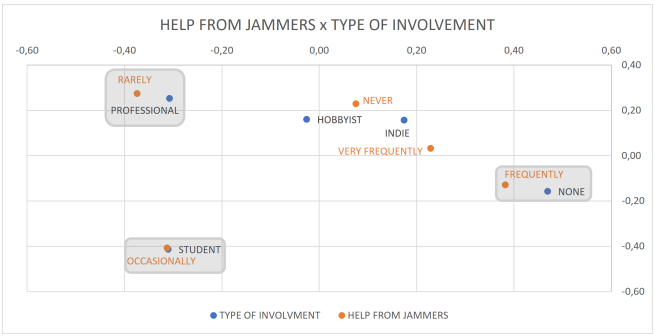
3) Type of Involvement of the Jammers who ask and provide help: A second analytical approach compared the ways in which the jammers sought and offered help, considering the jammers' type of involvement in the event. To perform this analysis, correspondence tests were applied involving each of the variables describing the help requested and/or offered (help *from* jammers, help *to* jammers, and help *from mentors*) in relation to each of the group formation variables, in this case, type of involvement in the event.

As for *the request for help*, in Figure 3a, it is possible to notice that two types are clearly associated with the extremes of the scale. The so-called Professional jammers tend to "Rarely" ask for help from other jammers, while those participants who place themselves in the group without a clear definition of the type of involvement (Others or None) show a propensity for "Frequently" request help from other

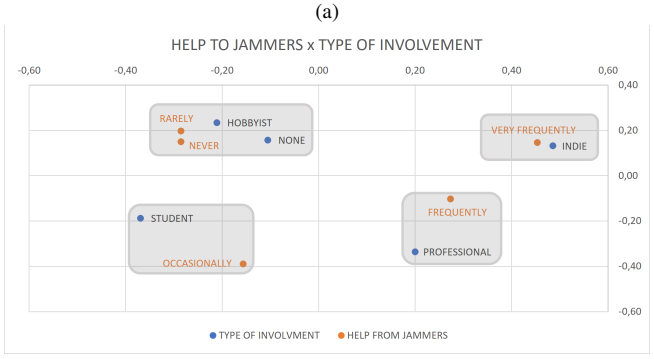
jammers. Note that the groups of Hobbyists and Indies do not have a clearly defined position, being simultaneously inclined to opposite positions on the jammers help scale (Never and Very Frequently). Finally, jammers who are Students reported requesting help from other jammers "Occasionally".

As for *providing help*, Figure 3b shows that the so-called Indie jammers declare doing it "Very Frequently" while Professionals jammers tend to provide help "Frequently." Respondents who declared themselves as Hobbyist jammers or did not include themselves in any of the categories indicated (None) "Rarely" or "Never" provide help to other jammers.

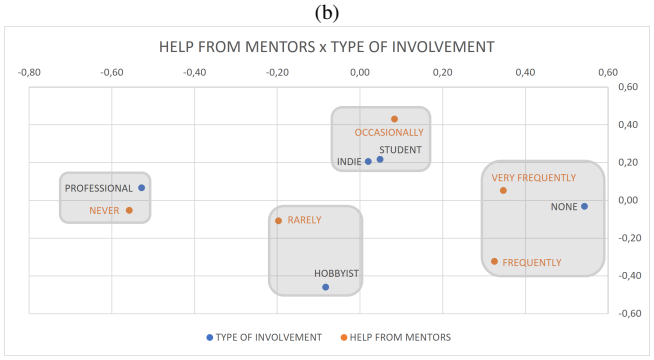
Professionals, in turn, tend to "Never" ask for help *from mentors*, while those with no declared game development involvement (None) tend to do so either "Frequently" or "Very Frequently". Indie and Student jammers seek help from mentors "Occasionally," while Hobbyists "Rarely" do it as shown in Figure 3c.



(a)



(b)



(c)

Fig. 3: Correspondence analysis of the types of involvement with game development and the ways of requesting and providing help during the event.

In addition to the correspondence analysis, the second analytical approach verified the difference between the averages of the types of help requests or offers by jammers in relation to the aforementioned grouping variables. For groups according to the type of involvement of the jammers, an ANOVA test was applied, using Tamhane's T2 test to verify differences between groups (see Table IV). Note that the expressions of behaviour of the groups already reported in the examination of the correspondence analyzes are statistically strengthened by the results verified in the ANOVA. Basically, jammers without a declared type (None) have significantly ($p < 0.05$) higher average *seeking help from other jammers* (2.91) when compared to Professionals (2.58). When *offering help* to jammers, Indie and Professional jammers (3.12; 3.00) are significantly ($p < 0.05$) more active than the other groups (Students = 2.78; Hobbyists = 2.77; and None = 2.77). Regarding the search for *help with mentors*, Professionals are the ones who express the lowest frequency (2,23).

TABLE IV: ANOVA – Comparison of means between groups by type of involvement in game development

	N	Help from jammers	Help to jammers	Help from mentors
Total	3091	2,74 (1,205)	2,86 (1,220)	2,59 (1,290)
None (N)	485	2,91 (1,269)	2,77 (1,234)	2,92 (1,327)
Professional (P)	408	2,58 (1,158)	3,00 (1,196)	2,23 (1,173)
Indie (I)	462	2,72 (1,260)	3,12 (1,272)	2,62 (1,308)
Hobbyist (H)	669	2,74 (1,202)	2,77 (1,216)	2,56 (1,291)
Student (S)	1067	2,74 (1,163)	2,78 (1,184)	2,60 (1,269)
ANOVA	F	4,228**	8,994**	17,519**
	Tamhane's Test	N>P	[I, P] >[S,H,N]	N>[I,S,H] >P

Note: The symbol ">" means that the average of the type of help (in the column) of a specific group by type of involvement to the left of the symbol is statistically higher($p<0.05$) than the average of the type of help(in the same column) of the groups by type of involvement to the right of the symbol. Obs: The type of involvement labelled as "others" is not shown in the table because it was not statistically representative (106 cases).

** p <0,01

In the last statistical analysis, the main types of search for information performed by the jammers were explored, observing possible differences between the groups formed by the type of involvement in game development (Table V). A cross-table frequency analysis was used, with a chi-square test and verification of z-tests to compare column/row proportions, adjusted by the Bonferroni method. It is possible to notice that three forms of interaction are more frequent among participants, regardless of the type of involvement; namely, with mentors, with others jammers and with online sources.

The comparison of frequencies for the crossing of groups defined by interaction sources and types of involvement (Table V) showed a significant difference (Pearson's chi-square = 60.287, df = 20, $p < 0.01$). The level of interaction with mentors is significantly higher than expected among participants with no defined involvement (None), even though Students are the group with the most intense interaction with mentors. The interaction of Hobbyists and Students with online sources is also noteworthy, which is significantly higher than expected, particularly when compared to the group None.

C. Qualitative Results

The statistical analysis presented in the previous section provided descriptive results on how jammers seek and provide help during the studied game jam according to their type of

TABLE V: Cross-Table by types of interaction and involvement.

	None	Professional	Indie	Hobbyist	Student	Total
Mentors/organizers	$135^{a,A}$ 96,2	$59^{b,A}$ 80,9	$88^{b,A,B}$ 91,6	$123^{b,A}$ 132,7	$208^{b,A}$ 211,6	613
Other jammers in the same location	$211^{a,B}$ 229,2	$201^{a,A}$ 192,8	$237^{a,A,B}$ 218,4	$302^{a,A}$ 316,2	$510^{a,A}$ 504,3	1461
People not participating in the jam	$16^{a,A,B}$ 12,2	$16^{a,A}$ 10,3	$8^{a,A,B}$ 11,7	$18^{a,A}$ 16,9	$20^{a,a}$ 26,9	78
People not participating in the jam in other locations	$10^{a,A,B}$ 7,8	$8^{a,A}$ 6,6	$9^{a,A,B}$ 7,5	$8^{a,A}$ 10,8	$15^{a,a}$ 17,3	50
Other sources (websites, online documentation etc.)	$95^{a,B}$ 120,7	$104^{a,b,c,A}$ 101,5	$93^{a,c,B}$ 114,9	$193^{b,A}$ 166,4	$284^{b,c,A}$ 265,5	769
Other	$18^{a,b,A,B}$ 18,8	$20^{a,b,A}$ 15,8	$27^{b,A}$ 17,9	$25^{a,b,A}$ 26,0	$30^{a,A}$ 41,4	120
Total	485	408	462	669	1067	3091

Note: Each lowercase letter denotes a subset of the type of interaction (row) whose proportions between groups by type of involvement (columns) do not differ significantly (p <0.01). Each UPPERCASE letter denotes a subset of participants in the group by type of involvement (column) whose proportions between types of interaction (rows) do not differ significantly (p <0.01). Numeric values express the observed frequencies (expected – in italics) in each cell.

involvement in game development as well as the participants' demographics. As mentioned in section III-E, we did *not* separate the qualitative data according to type of involvement or demographics, i.e., this section illustrates how seeking and providing help among jammers take place in general.

The codes from our qualitative analysis were organized into four main categories, namely: (i) aspects facilitated by the environment, (ii) exchange of help between jammers, (iii) interactions with mentors/organizers, and (iv) aspects that cause dissatisfaction. To illustrate different aspects of each category, we included significant excerpts from the jammers' answers. Each snippet is referenced as [S#], anonymously mentioning the respondent according to the order of their response in the survey. Figure 4 illustrates these categories in a hierarchy that is explained in the following subsections.

1) Seeking and providing help is facilitated by the local environment: A common dynamic among jammers is to move within the local environment to get an overview of the work being conducted by other teams. For instance, Informant S1379 reported:"*I tried to get up and mingle with the other groups at least once every few hours. Usually that led to discussions about their games or ours, and often that involved brainstorming or problem solving*." This **movement of the jammers** also happens during the official event breaks.

Jammers also indicated positive aspects about the socialization and ideation at the beginning of each event. Such **collaborative dynamics** broke initial barriers and provided a pleasant experience: "*As part of the welcome event, we split off into random groups 3 times and shared ideas based off of the theme we were given. Also, the leaders at the game site went around giving advice*" (S663). Along with this, **the physical proximity of the teams** encouraged interactions between jammers: "*Our team shared a space with another team, every so often we would test ideas on each other*"(S2005).

It was common to find reports indicating that GGJ was **organized in an educational institution** and, because of that, **there were teachers available at the event**. For instance, according to informant S1702: "*It was in my school and our programming teacher was there, so we could ask him things*".

In general, jammers reported feeling in a **friendly and collaborative atmosphere** in which favorable conditions are provided for the jammers to interact: "*You feel empowered to approach everyone and discuss ideas and difficulties. Everyone there seems to love seeing all the projects come to life and so freely share their knowledge and experience, or call out for help when they're stuck*" (S2738).

2) Seeking and providing Help among Jammers: As shown in Figure 4, help-seeking and offering can occur within the same team (intra-team) or between different teams.

Several reports from jammers indicated that help seeking and offering is limited to **intra-team**. Three characteristics explain this. First, **teams with a large number of members** tend to maintain the interaction within the team: "*We had a very large team of 8 people so the conversation was pretty limited to our group and when we needed help we would consult each other*" (S148). Second, **self-confident teams** or **teams with very experienced members** do not feel the need to seek help from other teams. According to S710: "*My team was mostly self-contained and had a good spread of technical knowledge. We mostly were able to answer our own questions for each other*". Third, jammers with an interest in **gaining teamwork experience** also tend to focus on interactions within their team: "*We help each other to do our best and because we wanted to act as a teamwork's company do*" (S2855). In summary, this results in positive experiences (e.g., socialization) for the jammers: "*I was lucky enough to have a pretty well-balanced team. We were all able to help and ask questions of each other when we got stuck. As a result, most of our problem solving was internal to my team*" (S1034).

As for jammers' interactions **between different teams**, the participants' reports indicate that both providing and receiving help do take place. For instance, S2911 exemplifies a typical situation in which **feedback from other jammers** is essential to decide and refine the game idea proposed at the event: "*We were unsure which idea so we gave some people information about some potential ideas to see which one would work better and what people would like to see*". Similarly, S397 reports having often helped other jammers with the **refinement of the scope of the game**: "*I tend to help people in cutting scope and focusing on a playable game*".

The exchange of feedback through game testing was something that jammers talked about abundantly. In fact, it is noted that the dynamics of **game testing** during the jam are recognized and valued by the participants: "*We always collectively help each other play test our games*" (S2377).

Several reports indicated that jammers **like to provide**

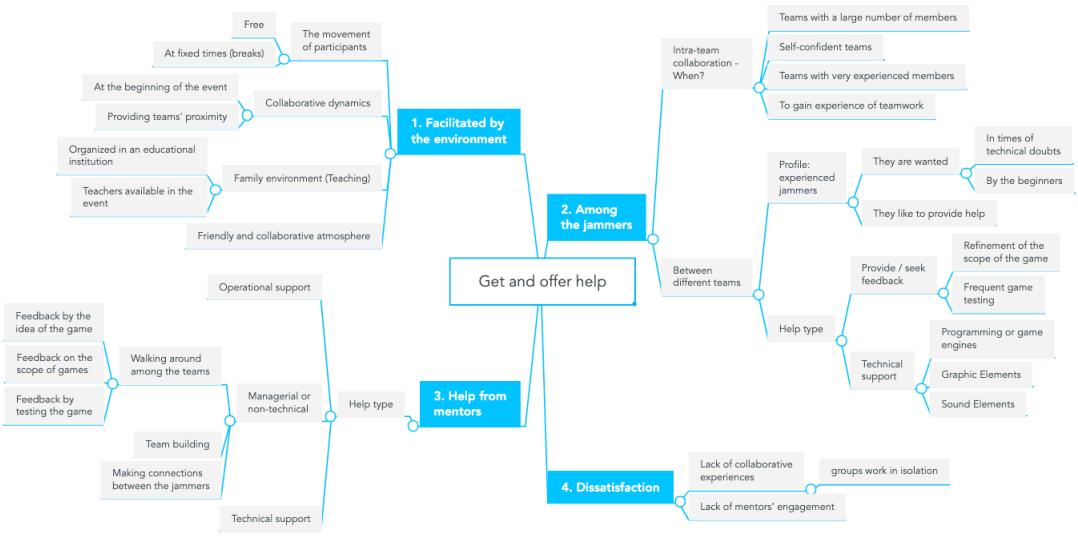


Fig. 4: Hierarchy of analysis codes of qualitative data

help during the event, as exemplified by S244: "*I always try to share my knowledge and experience to help everyone solve problems. I enjoy helping others learn and develop their skills*". In this sense, some participants who identify themselves as **experienced jammers** assume the role of providing help during the event: "*Since I was an experienced jammer, I volunteered to help people out*" (S38) and "*I've been making games for over 8 years, so I end up helping other people a lot*" (S3356). In a similar way, other respondents (**begginners**) reported that, in moments of doubt, they seek help from **experienced jammers**: "*We did not know how to use the Unreal engine, so we asked many groups for help who were experienced with that engine*" (S537).

Regarding technical support between jammers, several examples were provided related to providing and receiving help to solve **technical issues** regarding **programming and game engines** or **graphics elements**. Basically, programmers and graphic artists from different teams exchanged knowledge to address technical issues that arose during the event: "*I would ask people from other groups help on solving a coding problem. I did this maybe 4 or 5 times* (S2340).

As for seeking and providing help about **sound elements**, it could be noted in several reports that musicians normally worked in many teams due to the low number of participants in this area: "*I helped multiple (4, I think) teams as a sound designer and composer because there weren't many so I did a lot of things*" (S1062).

3) Seeking Help from mentors: Concerning seeking help from the mentors, the jammers provided reports regarding mentors' **technical support**, for instance: "*The GGJ mentors helped me with the use of Photoshop to create the game design*" (S2710). However, the importance of mentors as support for **managerial and non-technical** topics stands out in the jammers' reports. For example, the jammers emphasized the fact that mentors periodically monitored the teams, i.e., the mentors were always seen **walking around among the teams** to help them out: "*The local organizers/mentors roamed around the site to provide small pieces of advice which are helpful*" (S428). In other words, the mentors' movement creates opportunities for jammers to request their help. It is noted that it is expected, on such occasions, for mentors to offer feedback to teams about the game, whether related to **the idea**, **the scope**, or even **testing the games** and providing advice for their improvement. The following quote is an example of this situation: "*When I explained my plans to one of the organizers, he recommended me to keep it simple*" (S588).

As mentioned earlier, in the collaborative activities at the beginning of the event, the mentors play an essential role in the **team building** process, as well as **making connections between the jammers**: "*The site organizers are also very helpful, if you ask them anything they usually know everyone so they direct you to the best person to help you with that question*" (S3159). Finally, as expected, the mentors/organizers are also important in providing all **operational support** during the event: "*The organizers provided us with the necessary equipment, e.g., cables we missed*" (S2887).

4) Dissatisfaction: Some jammers took advantage of the open-ended question in our survey to report dissatisfaction with their participation in the event. Note that dissatisfaction is related to the **lack of opportunities and collaborative experiences** during the event. For example, S1955 emphatically expressed this: "*Unfortunately, it was a more insulated experience this time around. We rarely spoke to other teams, and it was only really near the end when we had stuff to show*". In addition, S3140 exemplify the disappointment with the lack of encouragement and communication between jammers: "*I was a bit disappointed on this side of the event at* [Location], *because the way it was organized didn't encourage communication between the teams*".

Additionally, the jammers also pointed out that, when **groups worked in isolation**, this makes socialization among participants difficult and can result in negative experiences: "*We rarely had contact with other teams, because we were separated from them. We had to sit in our own small classroom. Really it was a shame, we are probably not attending this location next year*" (S2046). As expressed by this last

jammer, it is essential to mention that these points are often associated with particular locations.

Finally, when the jammers do not notice the mentors' engagement (**lack of mentors' engagement**), they express dissatisfaction with the event, as reported by S493: "*In this case, as I said, what I am most disappointed with is with the mentors. They didn't really help us in any way, they were extremely biased and most of the time they were absent*". S2872 emphasizes that even when jammers get help from other jammers during the event, the lack of interaction with mentors is reported: "*Other jammers were helpful but the organizers were not very helpful*" (S2872).

V. Discussion

A. Information Seeking in Game Development and Jams

As mentioned in section II-B, game jams are an important part of the larger ecosystem of game development because they allow jammers to gain experience that is useful in the industry [3,5,7]–[9,28]. Furthermore, developing a game is different from developing another software application. This difference is reflected in several codes we identified. For instance, testing in game development typically involves manual playthroughs by human testers, or script-based simulations that mimic human actions, rather than relying on automated, low-level testing commonly employed in traditional software engineering practices [18]. This aspect was often reported, and valued, by participants and reflected in a code called *game testing* in which both jammers and mentors got involved. Another example is related to the code *provide/seek feedback about the scope* of the game which reflects the fact that developing a game also requires a variety of skills and the ability to communicate with non-engineers [18]. In summary, our results complement previous studies on software engineering for game development.

Our results extend previous studies about game jams by illustrating how the advantages of these events come into being, i.e., GGJ organizers strive to create favourable conditions to allow this social and informal learning to happen: jammers can move freely in the environment, collaborative dynamics are used to integrate the jammers, the event might be organized in a familiar location (e.g., an university) with familiar faces (e.g., programming faculty), there is a collaborative atmosphere that allows jammers to both seek and offer help, mentors periodically monitor the teams facilitating the exchange of knowledge, etc. However, as we found out in the reports associated with the *Dissatisfaction* code, there also were negative aspects when (i) the collaboration between jammers is limited, or inexistent, or (ii) the mentors are *not* engaged, i.e., they do not provide useful feedback to the jammers. In fact, the opposite – when mentors interact periodically with teams – is perceived and valued by the jammers.

As mentioned before, Li and colleagues [17] authored one of the first studies on information-seeking *behaviour* in software development. In their experimental results, subjects did *not* appear as significant information sources. The ones who were reported as information sources were *experts*, in contrast to sites (q&a, code examples sites, etc) and documentation (manuals, API specs, etc). However, these experts were only the 7^{th} most requested information source. In our results, other jammers in the same location were the most common source of information, followed by online sources (including q&a sites, documentation sites, etc), and mentors. A possible explanation for the difference in these results is that we focused on an event that places strong emphasis in *collaboration*.

Karch [40] is the closest work to ours, i.e., that focus on information seeking in the context of a game community. (see section II-E). Even though her study was qualitative and ours adopted a mixed-methods approach, our results are aligned with hers by showing that in close-knit communities (like gaming), people are important sources of information.

B. Game Jams and Communities of Practice (CoP)

Taken together, our results suggest that game jams are events that support the creation of a community of practice (CoP) [45] focused on game development. A CoP is a group of people who "share a concern or a passion for something they do and learn how to do it better as they interact regularly" [45]. In the following paragraphs, we will discuss how game jams illustrate key aspects of CoPs.

First of all, our results indicate that more experienced jammers demonstrate a higher frequency of involvement in helping others. Conversely, the greater the participants' level of experience, the lesser they seek for help from mentors or other jammers. Furthermore, when feeling stuck or blocked, jammers tended to seek help from more experienced peers. Finally, experienced jammers reported feeling at ease helping others and sharing their knowledge both within and outside their teams. This set of behaviors is consistent with the concept of "legitimate peripheral participation (LPP)" [45] when discussing CoPs. Specifically, LPP proposes learning as a process of participation in CoPs, i.e., participation in the community is initially peripheral and may eventually evolve to be more central. It evolves from small contributions to a more sustained collaboration. Although peripheric, this collaboration helps to keep the community thriving because is legitimized by more experienced members of the community Through peripheral activities, novices become familiar with the community's tasks, vocabulary, and organizing principles. This is exactly what happens with jammers during the events.

Second, experienced jammers play a crucial role in supporting and sharing their knowledge with younger jammers, despite not being as interested in learning as the latter. This willingness to help less experienced members associated with opportunities for informal communication are key aspects of a community of practice [45]. They show how easy and welcoming the community is, but they also indicate how often people get help and from whom.

Another key aspect of CoPs is that they promote a learn-by-doing approach based on informal communication that allows them to meet and solve problems in groups while having the help of experienced and knowledgeable participants. Game jams promote such a learn-by-doing approach with jammers

focused in building a game collaboratively and doing that by freely moving around the event location. Meanwhile, mentors walk around among the teams to offer feedback.

Fourth, mentors are not as much sought after by experienced jammers. This can be observed in our quantitative and qualitative data, as the reports indicate that jammers prefer, first, to ask other jammers for help. At the same time, jammers recognize that mentors walk around among the teams and facilitate interactions among their members, i.e., mentors work as expert facilitators [46] helping with problem-solving and decision-making. They not only stand out for providing operational or technical support but also discuss important features about team building, the idea and scope of the games, provide feedback by testing the games and make teams reconsider implicit assumptions about game design [46]. In addition, mentors play an important role in connecting people with common interests, but different skills, whether to form teams or to promote networking among the jammers. In other words, mentors help jammers find other participants who have the expertise to solve their problems. As such, mentors act as brokers by connecting people and linking elements of one practice to another [47]. Brokers are a role typically found in CoPs.

Finally, when discussing CoPs, Lave and Wenger [47] acknowledge the concept of *boundary objects* [48], i.e., artifacts that facilitate the coordination of community members with different backgrounds. In the context of game jams, the games being developed are these artifacts that allow jammers with different areas of expertise (e.g., programming, graphics, design, sound) to collaborate.

C. Recommendations and Opportunities

This section presents recommendations for those interested in organizing game jams and other time-bounded collaborative events. First of all, our results show that, although most respondents are participating in GGJ for the first time, knowledge sharing is guided by the participation of more experienced people, i.e., professional and indie developers are the ones who often provide help. Thus, event organizers should create mechanisms to attract these *experienced* jammers into the event to allow inexperient members to get help when needed. This will likely improve the experience of the event for the other jammers while contributing to the creation of a sustainable community of practice around game development.

Second, a dissatisfaction reported by the event participants was the lack of collaborative activities. Strategies to facilitate this social and collaborative process, include (1) group games/activities at the beginning of the event to facilitate team formation and ideation processes; (2) breaks and encouragement to people circulate in the environment; (3) organization of the site to allow teams to be physically close to each other; and (4) if the event seeks to attract the participation of students, encourage the presence of faculty members among mentors to provide a more familiar experience for these participants.

Finally, it is important to note the role of mentors in the game jams. Our results indicate that they are more useful for jammers when they make themselves available for the jammers, i.e., jammers do not even need to approach them. Furthermore, mentors act as brokers who connect people with different skills, which is particularly important in the multidisciplinary context of game development [18].

VI. Threats to Validity

We believe our work has a low threat to internal validity because the research instrument in this study was developed based on a review of the literature and our experience with game jams [25,49]. We also conducted a pilot study - with 243 answers - to ensure the validity of our survey questions. As for *conclusion* validity, we used appropriate statistical techniques and often more than one approach (e.g., Pearson's correlation and linear regression) to double-check our results.

As for the *construct* validity, one of our questions used the word "interact with", which might have biased the respondents toward selecting other people as main sources of information. In addition, our survey assumed that mentors and organizers exercised the same role, as it was verified that events may not have mentors and, in these cases, the organizers act as so. Despite this possible limitation, no complaints or doubts were found in relation to this in the open answers we analyzed.

Finally, regarding *external* validity, we decided to collect information from a non-competitive international game jam that takes place simultaneously in several venues around the world. This means that survey responses were collected from a heterogeneous set of people of different nationalities and cultures. However, it is important to note that although such an event was held in multiple locations simultaneously, it has the same organizational aspects, guidelines, marketing, and objectives. Thus, we argue the results of this study are valid for game jams or events with characteristics similar to the GGJ, but can not be generalized to other development-focused events like hackathons. As mentioned before, game development attracts people from different disciplines, which is not necessarily true in traditional software development.

VII. Conclusions

This study investigated how GGJ participants seek and offer help during the event. We carried out a large-scale mixed-methods study using a survey. Our study provides insights into help seeking and offering during game jams by different groups of participants and the influence that group characteristics (e.g., demographics) have on the intensity of help offers and requests as well as the role of mentors in these events. These results can be used by event organizers to propose strategies that make help seeking, and collaboration in general, more pervasive and effective in such events.

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