



Rethinking Strategies of Hackathons to Increase Team's Creativity: Findings of a Qualitative Research

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Keywords: Knowledge Management, Knowledge Application, Solving Conflict, Individual Learning, Emotions.

Abstract: Hackathons are events that have become increasingly common around the world. This kind of event, described as a programming marathon, is based on problem-solving that can go beyond the technological boundary. This paper presents the findings of an international hackathon to aid its organizers to rethink their strategies to improve the development of the team's creativity to solve the challenge proposed. The paper summarizes qualitative research based on interviews and observations which point out that the organizers should consider strategies to improve *knowledge application*, *resolving conflicts*, *individual learning*, and *experienced emotions*, during pre-hackathon as well as post-hackathon events. Our findings could leverage the innovation, creativity, and knowledge sharing and creation within hackathons.

1 INTRODUCTION


One of the means to stimulate innovation, creativity, and to further knowledge creation and sharing is to host a hackathon. Hackathons are events that became common around the world. This kind of activity can be described as a programming marathon which aims to solve a challenge that can go beyond the technological world (Vivanco-Galván, Castillomalla, and Jiménez-Gaona, 2018). Flores et al. (2018) point out that a hackathon is a competition where participants work in teams for a short time, in which they need to idealize, design, prototype, test and launch their solutions to a given challenge. Those events encourage both individual and organizational learning through innovative ways (Briscoe and Mulligan, 2014). Knowledge, then, is considered one of the most valuable corporate assets. In this way, the


organization that manages its knowledge benefits from a hackathon and other activities has a higher possibility to create innovative products and services, remaining sustainable in the market in which it operates (Nonaka, Toyama and Konno, 2000). Knowledge Management (KM) is indispensable for stimulating innovation in the organizations. KM is a collection of processes that govern the creation and dissemination of knowledge to achieve organizational team goals (Dalkir, 2011).


Therefore, this paper aims to help hackathon organizers to rethink strategies to increase the team's creativity during the event considering four categories such as *knowledge application*, *solving conflicts*, *individual learning*, and *experienced emotions*, once those can directly impact in the solutions proposed during the event.


Therefore, creativity is a trigger to increase *knowledge application* (e.g., lecture, mentoring,


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workshops) which might improve problem-solving. Our lessons learned with *resolving conflicts*, for instance, help the organizers to gather information about team member's conflicts during the hackathon once it aids the groups to find ways for supporting in the next event. *Individual learning* means that it is an experience each participant has throughout the hackathon and can be gained through interaction with other activities, teams, or in specific situations. Finally, *emotions experienced*, basically tiredness, lead us to rethink the duration of hackathons, as well as to promote such events during the daylight. Thus, although the participants experienced different positive situations at the event, tiredness was highlighted as a challenge faced.

To show our findings, we organized this article into six sections. Following this introduction, the second section presents the concepts and related works regarding KM, emotions, conflicts, and individual learning. Next, the section presents our research method followed by the empirical settings, data collection, and data analysis. The chapter after that summarizes the results and discussions followed by our conclusions and the references.

2 LITERATURE REVIEW

2.1 Knowledge Management

Organizations have to manage their knowledge to get business sustainability in a competitive market. In this sense, Knowledge Management (KM) can be useful as a resource for (managing) organizational knowledge. According to Dalkir (2011), KM is the deliberate and systemic coordination of people, technologies, processes, and organizational structure to add corporate value through knowledge reuse and innovation. So, the organizations which manage their knowledge to create innovative products and services, remain sustainable in the market which they act (Nonaka et al., 2008). In this sense, KM arises through the process of knowledge creation, in which it requires a physical environment to create new knowledge. Regarding this, it's necessary to highlight two types of knowledge: implicit and explicit. For Davenport and Prusak (2012), implicit knowledge is complex, developed, and internalized by people over a while, compounded by lifelong learning. Explicit knowledge is easily communicated, either through product specifications, scientific formulas, or computer programs (Nonaka et al., 2000).

So, Nonaka and Takeuchi (1991) emphasize that knowledge creation could start with socialization and

passes through the four modes of knowledge conversions. The first of the methods is socialization, which is presented as the sharing and creation of implicit knowledge through direct experiences. The authors identify the second method as outsourcing that aims to articulate tacit knowledge through dialogue. The third one is the combination; which suggests both implicit and explicit knowledge application. Finally, the fourth method is the internalization, which suggests the needs to acquire and learn new tacit knowledge in practice.

In this way, once the individual has the knowledge internalized, it is necessary to apply this experience so that the organization obtains sustainable competitive advantage and profit.

Therefore, organizations which use the knowledge appropriately may achieve competitive advantages, reaching a notorious place in a competitive market.

2.2 Emotions

The emotions are a legacy left by evolution that gives the person impulses for immediate action. The sentiment is the personal evaluation result of the meaning of an event in the creation of its well-being (Lazarus, 1991). Thus, emotions refer to feelings and reasoning, psychological and biological states, and the range of propensities for action. So, there are hundreds of emotions, including their combinations, variations, mutations, and shadows (Goleman, 2005).

Emotion is a complex reaction triggered by a stimulus or thought with personal sensations, an answer involving different components which it is a notable reaction, a physiological excitation, a cognitive interpretation, and subjective experience. Moreover, it is a mental state of readiness that arises from cognitive evaluations of events or thoughts, and that can be perceived by gestures, postures and facial features (Bagozzi, Gopinath, and Nyer, 1999). Therefore, emotion is a natural way of evaluating the environment that surrounds us and reacts adaptively (Fredrickson, 1998).

Emotions are characterized as negative or positive. One of the theories explaining negative and positive emotions is so-called the 'theory of control over behavior' considering that the view of behavior can show the nature of emotions. The theory suggests how feelings can arise and function in human behavior (Carver and Scheier, 1990). Positive emotions allow an individual to know what is being done toward a desirable goal. In this context, there is compelling evidence that positive emotions are not just the result of well-being, but can also drive

success and prosperity (Hazelton, 2014). Inversely, negative emotions are the way of realizing that no behavior, progress, or action is being taken toward goals (Carver and Scheier, 1990). Negative emotions occur when we perceive a negative meaning in personal situation changes or related ones (Ben-Ze'ev 2000). These emotions represent a general dimension of subjective suffering and unpleasant engagement that includes a variety of aversive mood states, including: anger, contempt, repulsion, guilt, fear, and nervousness (Watson, Clark, and Tellegen, 1988); frustrated, angry, depressed, harassed, hostile, worried and unmotivated (Kahneman, 2004); anxious, sad and angry (Fredrickson, 2001).

However, positive emotions work as effective antidotes to the persistent effects of negative emotions, correcting or undo the subsequent effects of the negative emotions (Fredrickson, 2001). In this sense, some positive emotions can be highlighted: Joy, interest, contentment, love (Fredrickson, 2001); Satisfaction, joy, pleasure, pride, relief, affection, love, hope (Bagozzi, Gopinath and Nyer, 1999).

2.3 Conflicts

Conflicts may occur in a wide range of settings involving people in a work process. Those conflicts are social and psychological phenomena in which they have different sources, processes, and results. So, various disciplines, such as sociology, economics, philosophy, and management, try to explain the conflicts in different ways (Wu, 2017).

Thomas (1974) points out that conflict is a process that begins when one party realizes that the other had frustrated or was about to disappoint some of their concerns. In this way, conflict can be described as a state, in which disharmonious phenomena trigger hostile actions, under a state of confrontation or emotion. However, conflicts are widespread in today's world due to the competition and the growing expectations of all business stakeholders (Wang, Fink and Cai, 2012), the conflict is used as an indicator of a lack of reliability of some sources. Thus, adopting appropriate conduct it's for such situations (Pichon, Jousseme, and Ben Abdallah, 2019).

According to Rao (2017), conflicts can occur for a variety of reasons, *e.g.*, personality clashes, ego clashes, differences of opinion or culture, perceptions, lack of communication, lack of information, ambiguity in roles and responsibilities, stress and lack of resources. Regarding this scenario, conflicts arise when there is a gap between expectations and realities, being possible, then two types of conflicts: interpersonal - those that occur

within the individuals, and the conflict between several groups - known as 'group conflicts.'

However, if the conflicts are not well resolved, they can have detrimental effects on the progress of an organization, team, or project (Chen, Zhang, and Zhang, 2014). It could also reduce the creative process (Reiter-Palmon and Murugavel, 2018) once this confrontational relationship makes it difficult to reach a project, team or organization goal, resulting in excessive expenses of time and costs (Hwang, Zhao, and Ng, 2013). Therefore, more attention should be given to finding out the critical factors of projects conflicts and related mechanisms. Thus, dealing with conflict means effectively resolving, a possible disagreement could happen between one another and others, in which it occurs because no two equal persons perform and think the same task in the same way (Rao, 2017).

Thus, conflicts can exist in an organization, team, or project, and the expertise to deal with such disputes is essential. The lack of conflict's experience causes the loss of time and resources of poorly resolved conflicts; those could be strategically applied in an organization, team, or project.

2.4 Individual Learning

The concept of individual learning as an object of study is still uncommon in the literature since it is relatively new and, as of that moment, not much is known about its conceptualization and empirical basis (Poell and der Krogt, 2010).

However, individual learning can be described as a lifelong process in which it is possible to learn and develop cognitive skills (Cornford, 2007). Also, Sanchez (2003) emphasizes that the learning is the personal experience throughout the life which occurs individually, through the person's interaction with groups of people, or in situations lived in its work environment (Sanchez, 2003). In this sense, all the interactions of the individuals are incorporated into the person's lifelong learning. This learning later becomes knowledge that will be shared with other individuals (Melo and Araújo, 2007).

A unique learning project is one that has a specific time, and that seeks to teach some relevant subjects to the individual (Roberson and Merriam, 2005). One of the reasons for using an individual learning project refers to the fact that individuals need other ones to learn. This context can come from friends, co-workers, or anyone who contributes to the personal learning process by providing models and constructive feedback (Hara et al., 1996). Thus, a unique learning project is in a constructivist

approach, in that it can be adherent to diverse contexts, *e.g.*, personal or work, for the individual (Voinea and Purcaru, 2015). Therefore, collaboration for individual learning can be a way out once the help of one's specific knowledge can be learned in practice (Zambrano et al., 2019).

Therefore, interactions with other people may help in to acquire individual learning. So, this learning can become a solid knowledge use when required.

3 HACKATHONS AND KM

Hackathons are events in which they use different cultures and expertise regarding that each participant applies their vision to solve a specific challenge (Seravalli and Simeone, 2016). To solve a hackathon challenge, the participants have an opportunity to communicate with each other, providing insights into the creation of the content (Serrano-Laguna et al., 2015). Thus, hackathons provide means to share and create knowledge by seeking solutions to everyday problems posed as challenges by resorting to the production of innovative software for the benefit of society.

According to Zukin and Papadantonakis (2017), hackathons promote the opportunity for participants to learn new skills, *e.g.*, computer code creation, application creation, and mockups, as well as providing face-to-face networking. In this way, hackathons stimulate the creativity of participants, who have the opportunity to deal with technology (Richterich, 2017). However, hackathons are applicable in a variety of settings, as they seek innovative solutions for a real challenge (Calco and Veeck, 2015).

In this context, Briscoe and Mulligan (2014) emphasize that hackathons have been stimulated in different areas such as music, fashion, and fitness. Thus, the authors further underline that the hackathons are encouraging of experimentations and creativity, being able, then, to aim different challenges. Hackathons, therefore, aim to stimulate innovation as individuals share ideas and seek solutions to the problems presented (Lourenço et al., 2018).

From the perspective of the KM, hackathon becomes a tool for creating and sharing knowledge in a group. It makes sense once this type of event encourages its participants to work in teams, sharing information for generating experience on the challenges. The dynamism of creation can be seen through Nonaka's theory (1994), which suggests that

knowledge can be created through socialization (tacit to tacit), externalization (tacit to explicit), internalization (explicit to implicit), and combination (explicit to explicit). It is in the explication and union of these two elements that the creation of knowledge intervenes. So, some organizations formally encourage and support practices once they consider the event benefits the creation and sharing of knowledge regarding innovation. They do that sponsoring and supporting internal or external hackathons around the world.

However, hackathons provide participants an environment that helps to learn new skills as well as interaction with other participants and networking. Thus, hackathons stimulate the participants' creativity to solve a real challenge.

4 METHOD

To present the findings of an international hackathon to aid its organizers to rethink their improvement strategies of team's development creativity to solve the challenges of the hackathon; we used the qualitative methodology suggested by Creswell and Creswell (2017), and empirical evidence based on a case study. The same approach was used through interviews and observations during the event. The hackathon took place between 19 and 21 of October of 2018. The inspections were performed during the first two days of the event, aiming to identify how team members create and share knowledge among the other members. On the third and last day, we performed face to face interviews, conducted with the participants, through a semi-structured interview protocol. This strategy was adopted so that the interviewees could consider all the elements involved in the course of the event. The findings showed in this article are based on this empirical material, which was recorded, transcribed, analyzed, and, finally, discussed based on theoretical reference.

4.1 Empirical Settings

Hackathons are public marathons that involve participants for hours, days or weeks to discuss ideas and develop software or hardware projects that can create or disseminate productions and especially digital innovations (Topi, 2014, Leckart, 2012). Usually, such events are sponsored by entities (public or private), which presents a challenge to the participants, being related to the most diverse areas of knowledge. They are divided into teams that must propose solutions for the proposed trial. Hackathon

event is the scenario behind NASA Space Apps, a NASA-sponsored hackathon. The event was held between October 19, 2018, until October 21 of the same year and involved professionals and students from different fields of knowledge. The Space Apps event took place simultaneously in 75 countries, with more than eighteen thousand participants (Space Apps Challenge, 2018). The event was taking place by a University in the city of Maringá, Brazil. During the three days of the event, several activities took place. On Saturday morning (the first day of the challenge) mini-courses, workshops and mentoring were held. The participants randomly segregated into teams, had twenty-four hours to develop projects on one of six themes set by NASA: freestyle, better earth, natural impact, big rocks, the *kryos*, and space mindfulness. At the end of these twenty-four hours, the teams were previously submitted to an examining board, composed by the mentors of the event, who evaluated the solutions presented in each project and selected the ten best ones, which were presented to the other teams and the appraisers invited to the event in the afternoon. After the introductions, the appraisers chose the best works. In this way, the research was carried out in five phases, as shown in Figure 1.

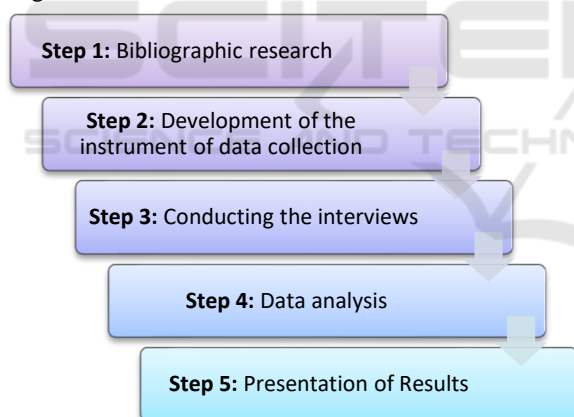


Figure 1: Research steps.

The first step consisted in searching for publications related to the subject of this research, carried out in the databases: Science Direct, Emerald Insight, ACM Digital Library, and Capes Research Website. The following keywords were used in Portuguese and English: knowledge management, individual knowledge, conflicts, and hackathons. These keywords were chosen because they seek to support the theme proposed here. The second step, the development of a semi-structured interview protocol consisted of ten questions, which aims to understand how the interaction between the participants

happened. In the third step, the interviews were conducted face to face with the participants during the days of the event. The duration of each interview had an 8 minutes average. In the third step, the interviews were analyzed based on content analysis. Finally, the presentation and discussion of the research results were discussed looking at the literature and relating it to the findings.

4.2 Data Collection

Data was gathered through the interview's observation conducted with the hackathon's participants through an interview protocol, as suggested by Creswell and Creswell (2017). The inspection and the interviews occurred only with the participants in the city of Maringá, Brazil. All the material was recorded with the interviewee's permission. During the first two days of the hackathon, the observations were focused on interaction among the team members. We did our views for twenty-five hours from 21st to 22nd of October 2018. On the last day (22nd of October), after the pits, we conducted interviews with participants from eight different teams. Such a method was used in the data collection so that the interviewees could report their experiences during the whole event. The interviewees were selected by intentional sampling. This type of sampling provides in-depth data on what is being researched (Creswell, Creswell, 2017). The interview protocol contained ten open questions where the participants reported their experiences before the event and skills gained during the current hackathon, as well as their perceptions regarding the interaction between all the participants (team level or not). The interviews were carried out in a room at the same place as the hackathon.

4.3 Data Analysis

Data analysis is the essence of qualitative research, which consists the data interpretation and, identifying means that was refined by researchers (Creswell and Creswell 2017). Among the many methods used to analyze interviews, we used the content analysis (CA), suggested by Bardin (1977). This method aims to obtain, through a set of indicator techniques that allow the "inference of knowledge regarding the conditions of production/reception" of the analyzed content, *i.e.*, analyses what was said by the participants in the interviews (Bardin, 1977).

For the interviews to perform the data collection, the ones were transcribed word by word. Afterward, interview transcripts were analyzed to understand

how the knowledge was internalized among the participants, highlighting important perceptions and experiences regarding their participation.

5 RESULT AND DISCUSSION

The interviews came out with interesting findings, showed in four categories as follows: *knowledge application*, *solving conflicts*, *individual learning*, and *experienced emotions*. Those categories mean that:

Knowledge Application: Participants bring their experience to combine with a newly acquired knowledge providing a sustainable and competitive advantage for the problem solve in the hackathon. In this context, the 'Interviewee IV' quoted his/her previous experience, which aids him/her.

"Even being my first year at the university, I have already applied some of my knowledge which I have brought from my personal experiences [to the hackathon]." (Interviewee IV, 21/10/2018).

In this way, we observed that the interviewee was able to apply the knowledge acquired during his/her first University year in an appropriated solution into the hackathon. Considering this, the 'Interviewee VII' reported to us that s[he] worked in the software development area and applied his/her knowledge to design their solution of the hackathon's challenge.

"I already work in the area, and I was able to apply my knowledge of design and to prototype a good solution for my team. I hope to help with them promptly." (Interviewee VII, 21/10/2018).

Looking at those quotes carefully, we observe that knowledge application occurs when the actual use of knowledge has been captured or created and put into the KM cycle (Dalkir, 2011). Hackathons follow a KM cycle, *i.e.*, Nonaka (1994) SECI model. Once the team members perform socialization which provides knowledge creation through their interaction (tacit to tacit); externalization since they're designing and discussing the solution of the challenge (implicit to explicit); internalization whereas team members understand the answer (explicit to implicit); and, finally, combination in which team members can use previous experience with new acquire knowledge to propose solutions to hackathon's challenge (explicit to explicit). So, in hackathons, the individual's tacit knowledge is the leading way to solve the problems once the essence of problem-solving, innovative suggestions, creativity, design, analysis, and project management is based on more implicit, rather than explicit knowledge. In this sense, the hackathon organizers must rethink the ways to potentialize *knowledge application* to stimulate creativity and,

consequently, knowledge creation, problem-solving, and innovation. They must offer pre-events such as workshops, coaching, training, mentoring, and so on. The NASA hackathon suggests a pre-event, namely *boot camp*. The boot camp intends to 'equalize' team members knowledge to figure out the challenge with innovative solutions. We have observed different kinds of hackathons in our region; however, the hackathons which do not provide pre-events end up less innovative products than those which does. Therefore, we observed that pre-events have shown essential to promote *knowledge application*.

Solving Conflicts: Through the interviews emerged concerns regarding frequent disagreements within the team during the hackathon. Those conflicts comprise different proposals to solve the challenges presented by the hackathon organizers. When the conflict raised, the participants act differently to resolve such dispute. The 'Interviewee VIII' reported to us his/her strategy to solve conflicts during the hackathon.

"There were many different opinions to define the project, so we decided to take place a 'vote system' to support our decision." (Interviewee VIII, 21/10/2018).

Thus, voting was conduct used as a criterion for a fair decision among the participants. This voting took place in an open manner in which the project to be voted on was presented to all, and from that, the participants expressed their opinion by one vote. We also observed some people stressful or discouraged at the beginning of the hackathon once the team did not accept their ideas and even criticized those hardly. Those kinds of conflicts, referred to the divergence of opinion, use to occur during the solution design, *i.e.*, when the team is discussing the challenge and the ways to figure it out. While the 'Interviewee VIII' reported us a voting system as a strategy to choose an idea and mitigate the conflict, the 'Interviewee IV' was discouraged from presenting his/her ideas since no one agreed with it and further wanted that their ideas were accepted, as show the quote below.

"I had several ideas, but each one wanted different things with different ideas, [...] that conflict discouraged me." (Interviewee IV, 21/10/2018).

More important than ideas are the way to solve the conflicts and, further not discourage the team members. However, even with the conflicts that permeated the 'Interviewed IV' team reported that a solution could be found through final consensus. Thereby, 'Interviewee II' reported us the absence of conflict inside his/her team, as shown quote below.

"There was no disagreement in our team, each one of us arrived with three proposals, and we were tapering them considering positive and negative

points. We discussed each one of those proposals, and we ranked those that would be most interesting until we reached an agreement of the team members. So, I cannot say that there was a conflict.” (Interviewee II, 21/10/2018).

Like this, ‘Interviewee II’ describes no conflicts into his team and an excellent strategy to figure the conflicts out once the groups suffered from team disagreements, mainly during the creative process. This kind of disputes results in lowered creativity (Reiter-Palmon and Murugavel, 2018). Understanding more about the conflicts is relevant to hackathon’s organizers once it could improve the quality of the solutions. So, the organizers should collect information regarding conflicts occurred within team members during the challenge. It concerns to learn more about discussions and organize means to support teams to figure their conflict out in the next event. One possibility to avoid team conflict is offering lectures to the participants regarding interpersonal relationship within the pre-event. Those lectures could be conducted by inviting psychology students to give those lectures presenting techniques to solve the conflicts.

Individual Learning: This category refers to a lifelong process that an individual learns and develop his cognitive skills. We know that each hackathon provides means to individuals to learn about the challenge, solution, interpersonal relationship, technology, and so on. The ‘Interviewee III’ reported what his/her learning in the hackathon, as quoted below.

“In this hackathon, I learned how to work within a team and also learned from my team different point of views of the problem we were working on” (Interviewee III, 21/10/2018).

Thus, we observed clearly that the participant learned some new within the hackathon. Another participant reported to us about his/her skill to interact with other people has been evolved.

“I felt that my skill to interact with other people evolved in this hackathon” (Interviewee IV, 21/10/2018).

Thus, we observed that the participant has been able to improve his interactions with the hackathon, reinforcing the idea that the learning can occur with the interactions. And such communications promote socialization among participants, which can facilitate the creation of ideas and insights about the project undertaken. Finally, the quote below shows the ‘Interviewee V’ talking about

“I have learned useful things in this hackathon to be practiced out of here and in my life, such as

interpersonal relationship, technology skills, and the spirit of competition” (Interviewee V, 21/10/2018).

Thus, it is possible to observe that all respondents reported that a hackathon is an event in which it facilitates learning practically and interactively. This solid form refers to the fact that such projects are elaborated and executed during the same period of the event. And the interactive way can be related to the socialization that the event provides among the participants. Once hackathons are events of challenges based on basic functionalities due to the short time of the event, Roberson and Merriam (2005) highlight that the *individual learning* project is one that has a specific time, seeking to teach something relevant from the project and interaction with the team. Working on a project, the individuals might learn in practice, internalizing their knowledge (Dalkir, 2011, Takeuchi, 1994). Thus, hackathons bring a constructivist approach in which aligned to different personal or work contexts (Voinea and Purcaru, 2015). Thus, the hackathon organizers should stimulate individual learning in hackathons offering online courses, mentoring, and materials before the hackathon beginning to afford ideas and creativity to the participants.

I experienced emotions. The ‘Interviewee VIII’ revealed some perceptions regarding his/her feelings during the hackathon.

“I’m feeling pleased here [in the hackathon]; however, I’m feeling tired because I’m in the event since it started [twelve-hours]” (Interviewee VIII, 21/10/2018).

Thus, we observed that even though of the participant happiness during the event, the participant reported tiredness due to its long-time duration. The ‘Interviewee I’ highlighted his/her fatigue even having fun in the hackathon and having an environment in which provided such joy and engagement.

“The hackathon was a lot of fun and a motivating environment, but after a while, it gets very tiring” (Interviewee I, 21/10/2018).

In the same sense, another interviewee commented:

“There were disagreements over tiredness, but everything was decided in the vote” (Interviewee VII, 21/10/2018).

The participants experienced different emotions, some of them positive (*i.e.*, happiness and fun) in contrast with tiredness. According to Fredrickson (1998), the effects of positive emotions share the capacity to enlarge people's momentary repertoires and create their enduring personal resources, from physical and intellectual resources to social and

psychological resources. Positive emotions occur when positive related changes are perceived, significantly improving a situation (Ben-Ze’ev, 2000). The positive ones reflect how much a person feels enthusiastic, active, and alert, being a state of high energy, total concentration, and pleasurable engagement (Watson, Clark, and Tellegen, 1988). Also, the other participant highlighted the happiness of attending the event.

However, looking inside the hackathons, if on the one hand, we observed the motivation and engagement by the participants; on the other hand, we found tiredness and discouragement. Despite an environment all prepared and conducive to creativity, we noted some team members are giving up their participating in the hackathon. Unfortunately, we have not interviewed the members who gave up of the event, but we interviewed some of their team members in which reported us some motivations of the withdrawal of its members namely tiredness, discouraged, and afraid to be ashamed of the proposed solution during the pits.

Based on this kind of behavior, we should rethink hackathon’s design trying to avoid those negative emotions (*i.e.*, tiredness, discouraged, and afraid). Firstly, hackathons’ organizers should reduce twenty-four hours to twelve-hours proposing short challenges in a format of mini-hackathons like mini-marathons. Secondly, take place the hackathons during daylight, *e.g.*, three days of eight-hours-day. Finally, allow some members, particularly those whose feel more tiring, might participate virtually.

Therefore, our findings pointed out that hackathon’s organizers should rethink the design of the hackathons considering four categories. The first category, *knowledge application*, shows that hackathon takes place a KM cycle which converts knowledge tacit to explicit and vice-versa, providing knowledge sharing and creation. The second category, *solving conflicts*, show a fragility of the team members to handle with the clash of ideas and how this is detrimental to the team's creativity and coexistence during the event most of the times discourage the team members from continuing the challenges. The third category brought to us how *individual learning* is essential to and should be stimulated before the event to improve the solutions to afford ideas and creativity to the participants. Finally, the fourth category, namely *experienced emotions*, show how relevant is the feelings of the individuals during the event and how the tiredness can be unfavorable to solve the challenges given in the hackathon. Table 1 summarizes our findings.

Table 1: Findings summarized.

Finding	Strategy
Knowledge application	Potentialize: <ul style="list-style-type: none"> • problem-solving, • innovation, • the creativity of the participants Offering pre-events such <ul style="list-style-type: none"> • workshops • coaching • training • mentoring
Solving conflicts	Collection <ul style="list-style-type: none"> • information regarding conflicts occurred within team members Try to avoid conflicts offering <ul style="list-style-type: none"> • pre-hackathon interpersonal relationship training
Individual learning	Stimulate individual learning in hackathons <ul style="list-style-type: none"> • online courses • mentoring • materials before the hackathon beginning
Experienced emotions	Avoid negative emotions <ul style="list-style-type: none"> • tiredness • discouraged • afraid Reduce twenty-four hours to twelve-hours short challenges (mini-hackathon) Take place the hackathons during daylight (<i>e.g.</i> , three days of eight-hours-day) Allow members who feel tiring, to participate virtually

6 CONCLUSION

This article aims to present the findings of an international hackathon to help its organizers rethink their strategies for improving creativity and innovative ideas to solve the proposed challenge. To this end, qualitative research was conducted, which used observation and interviews with the participants of the event. The results pointed out that organizers should consider strategies for improving knowledge application, conflict resolution, individual learning, and emotions experienced during pre-hackathon and post-hackathon. This is because, through these

strategies, new opportunities are possible in such events. In this way, these discoveries could leverage innovation, creativity, and knowledge created within hackathons. Thus, the main contribution of this article is the presentation of strategies to make this world-class hackathon more productive for participants and organizers. As future work, we intend to test our findings in a real marathon and analyze the results.

ACKNOWLEDGEMENTS

Our special thanks to Instituto Cesumar de Ciência, Tecnologia e Inovação (ICETI) Maringá, Paraná Brasil. We also thanks to Programa de Suporte a Pós-Graduação de Instituições de Ensino Particulares (PROSUP) da CAPES (Coordenação de Aperfeiçoamento de Pessoal de Nível Superior).

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