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Continuous Learning at the Individual Level: a study in software development organizations

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ABSTRACT

This study aims to understand the occurrence of continuous learning at the individual level in Software Development Organizations – SDOs according to the framework proposed by Tannenbaum (1997). The objectives are to understand and describe the strategies and tools applied by developers during their learning process and if the studied SDOs offer a work environment conducive to continuous learning at the individual level. Thus, qualitative research was conducted with 12 Software Development Professionals in four SDOs applying semi-structured interviews. The subjects interviewed were involved in the software development process. The analyses were performed by the qualitative data analysis software Weft_QDA, which allowed the identification and analysis of speeches related to the theoretical concept of this study. The results show that SDOs offer an environment conducive to continuous learning at the individual level by allowing meaningful learning experiences, motivating constant participation in these experiences and, especially, engaging in complex projects whose results are influenced by the application of acquired knowledge.

KEYWORDS: Continuous Learning; Individual Learning; Software Development Organizations.

1 INTRODUCTION

The Brazilian market for software and services has increased considerably in the last few years. According to ABES - Brazilian Association of Software Companies (ABES, 2020), Brazil ranks ninth on the world stage, moving US$ 38,5 billion in the domestic market alone, which includes hardware, software, and services. Here, US$ 8,183 billion came from software and US$ 10,426 billion from services, which combined represent 48,8% of the market and consolidates the country as one of the economies with a higher degree of maturity in the world that focuses on the development of solutions and systems.

For Albertin (2000), today's economy denominated "economy of knowledge" is based on applying human knowledge to everything it produces and how it is produced. Knowledge is considered the most critical element in the processes related to products and services, from their development to their delivery and support in the application. It is human intelligence, rather than the physical effort of workers, that provides added value. Innovation, rather than resources or capital, becomes the critical factor. In this new economy, being able to enter and remain in the market is difficult when the products have a competitive life of no more than one year, one month, one week, or a couple of hours, as it happens to financial products (ELLIOTT; PEDLER, 2018).

It is essential for Software Development Organizations (SDOs) to create a work environment that supports learning to deal with the challenges of the new economy and remain competitive in the market. Furthermore, the level of quality of the final products is associated with the level of knowledge of its developer and how he has learned to apply it to turn a user requirement into a computational artifact (TONINI; CARVALHO; SPINOLA, 2008; YRJÖLÄ, 2018). Even though the literature has not presented a clear and accurate definition yet, continuous learning has been discussed at the individual, task and organization levels (TRACEY; TANNEBAUM; KAVANAGH, 1995). It is present in the work environment when all individuals continually seek to learn through conscious collaboration between the organization and employees. In a work environment conducive to learning, knowledge acquisition is facilitated and seen as a responsibility of each employee (ROSOW; ZAGER, 1988; VINK et al., 2019).

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Several analytical models are used to understand learning at the individual level. However, Tannenbaum (1997) proposes a framework for understanding the continuous learning at the individual level that is influenced by the work environment where the employee is placed, as certain characteristics of this environment can facilitate the learning process, such as: challenging tasks; task autonomy; peer support; leader incentive; organizational support. Thus, continuous organizational learning requires all employees to acknowledge its importance and a work environment conducive to learning once appropriate organizational environment leads to innovative behaviour, constant updates and better work performance (KOZLOWSKI; HULTS, 1987; LOLLI et al., 2016). Such model was mainly adopted because it values the experience in the continuous learning process impacted by particular characteristics in the work environment. Software experts participate in different projects, each presenting specific features, allowing them to constantly live new experiences. When there are favourable conditions for the developer to apply new methods and tools in his work environment, he experiences meaningful learning that enables him to 'reflect on the action' and, consequently, his performance. Then, the developer will question his assumptions and may reshape the way to perform tasks at work. When the experiences are not assessed, developers will act based on traditional theories, not exploring alternative and possibly superior theories in line with current market trends (MULHOLLAND; ZDRAHAL; DOMINGUE, 2004). Thus, learning is essential for Information Technology Sector, as it enables continuous innovation to meet the constantly changing costumer's needs.

Software experts oriented towards continuous learning are pro-active and present dynamic skills that, contrary to common skills, allow them to reset the organizational processes to deal with new technological paradigms and development methodologies and the demands of different clients (RAMASUBBU et al., 2008). As for the contributions of this study to the organizational learning field, the findings prove that guidelines and practices of Software Process Improvement Models and Agile Methodologies for the planning and management of projects are conducive to creating a favourable environment for continuous learning in SDOs and to enabling the development of quality software.

In this context, the main objective of this study is to understand the occurrence of continuous learning at the individual level in SDOs according to the framework proposed by Tannenbaum (1997). The specific objectives are to understand and describe (i) the strategies and tools applied by developers during their learning process; and (ii) if the SDOs studied offer a work environment conducive to continuous learning at the individual level.

2 CONTINUOUS LEARNING AT THE INDIVIDUAL LEVEL

The first study about continuous learning was published by Rosow and Zager (1988). The discussion of this topic continued in the following years, but in certain periods, no research was conducted. For instance, in the 1990s, studies were published by Willis and Dubin (1990), Tannenbaum (1997), London and Smither (1999). Later, other important pappers were also published, such as Maurer and Rafuse (2001); Flynn, Eddy and Tannenbaum (2006); Sessa and London (2008); Maurer and Weiss (2010); Harris (2013); Van Breda-Verduijn and Heijboer (2016); Devisch et al., (2021); Cegarra-Navarro et al. (2020). Although the literature has yet to

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present a clear and accurate definition, these authors have discussed continuous learning at the individual, task and organizational characteristics levels (TRACEY et al., 1995). In their studies, they listed the typical characteristics of an environment conducive to continuous learning. They are: as continuous learning as an individual responsibility to achieve competitive advantages for the organization; continuous learning as a means to establish innovations in products and services; employees encouraged to test new methods and tools at work; work environment tolerant to errors; the physical and technological structure of the work environment enabling the involvement in learning experiences; recognition and reward systems as motivations to learn; leader and peer support.

The main contribution of Tannenbaum (1997), when compared to the others, refers to the proposed model (cycle) to understand how individual learning occurs in environments with characteristics that are conducive to learning and how those characteristics contribute to its occurrence. The author highlights the specific characteristics in each element of the learning cycle. For instance: physical and technological structure (Learning Experience Element); physical and technological structure and the work environment tolerant to errors (Application Element); leaders and peers recognition, recognition and reward systems as motivations to learn (Recognition Element and Motivation to learn Element).

The motivation to learn can be affected by work environment characteristics that demonstrate the importance of learning for organizational results. A study by Baldwin and Magjuka (1991) in three companies identified that trainees were more eager to learn, transfer and apply their acquired knowledge when they received relevant information about the importance of learning before training, when they were responsible for their learning, and when their learning was considered mandatory. Continuous learning offers a new and challenging perspective on the changing nature of the economy and workplace. For to Rosow and Zager (1988), this approach strives for the evolution of traditional training in which the individual depends on someone else to learn. Individuals involved in continuous learning tend not to be obsolete, as they can innovate (London, 1996). For London and Smither (1999), those who comply with premises of continuous learning follow the progress in their profession and anticipate the changes in the external environment. The authors also justify the importance of continuous learning to the employees of contemporary organisations by mentioning, for instance, the software developers who constantly need to identify technological trends and learn how to introduce them in projects of new products (BERNINGHAUS et al., 2017; YRJÖLÄ, 2018). Companies focused on continuous learning are market-oriented and excel in performing in crises and noticing trends, and predicting how the environment will answer their actions to retain and attract customers or deal with competitors (DAY, 1994).

In the continuous learning at the individual level framework proposed by Tannenbaum (1997), the first element for the individual is to participate in a relevant learning experience – such as a workshop or a discussion with his co-workers. This learning experience leads him to develop new skills that can be applied at work. The individual who applies these skills is acknowledged and rewarded, enhancing his personal belief that it is possible to learn. When this belief is enhanced, there is greater motivation, making the individual more prone to search for new learning experiences. Figure 1 presents the continuous learning cycle at the individual level.

Figure 1 – Continuous Learning Cycle

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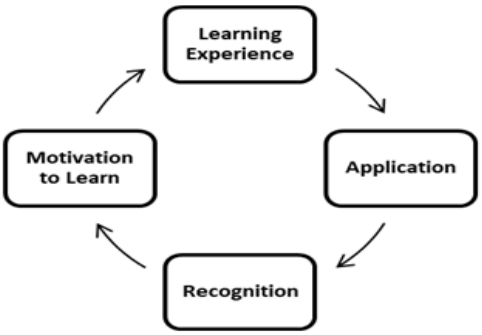

Source: Tannenbaum (1997).

For Tannenbaum (1997), the arrow from element 'application' towards the element' motivation to learn' shows that a successful application of new ideas and skills tends to generate intrinsic motivation, regardless of a company's recognition or rewards for it. However, without the organizational stimuli, the individual tends to get frustrated, not developing enough motivation to search for new learning experiences, and sometimes even choosing to quit his job for lack of recognition for his achievements. Thus, the element 'recognition' is required between those two elements. On the other hand, the arrow from element' learning experience' towards the element 'recognition' demonstrates that, in some companies, the individuals are rewarded just by participating in learning experiences to acquire new skills, regardless of those skills being immediately applied or not at work. This recognition usually happens through financial reward and is based on the assumption that the acquired skills can be applied in the future. Nevertheless, the author reinforces that this connection can be dysfunctional when the company rewards the individual for acquiring skills in learning experiences that are not related to the organization's needs. Thus, the element 'application' is required between them.

According to Tannenbaum (1997), continuous learning at the individual level is encouraged when all the elements in the learning cycle are properly connected to the work environment. Any disconnection caused by flaws – such as the inadequate combination of the learning experience, obstacles during the application of new skills, not enough incentives and recognition – can undermine it. Therefore, one can assume that the work environment can be conducive or detrimental to continuous learning at the individual level.

3 METHOD

This research was conducted applying a qualitative approach. The qualitative research seemed the most adequate considering the problem and objectives proposed in this paper. There are not enough explanations to the proposed problem, hence the need to adopt an exploratory and descriptive approach (GODOY, 1995). For Berg (2001), qualitative research allows the researcher to share in the understanding and perceptions of the individuals who live in those environments, such as interpret people's behaviours and the meanings they attribute to the situations experienced.

Thus, this research fits into what Merriam (1998) calls "basic qualitative study" due to its characteristics of qualitative methodology. However, it does not meet the requirements to be

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considered an intensive case study, aiming to investigate a clearly specified unit of analysis deeply. The main difference is that in a case study (single or multiple), the researcher focus on understanding a particular case. There are no elements in the text that show how these aspects are related to the phenomenon (continuous learning at the individual level).

The brief description in Table 1 is not enough for the reader to notice the relationship between specific contexts (one of the organisations) and the phenomenon. For those reasons, it is worth reflecting on the statement that this is a multiple case study.

In order to achieve the proposed objectives, data were collected in four software development organisations (SDO) because of the need to study several specific realities (environments) that maintain an essential correlation with each other to allow the understanding of a phenomenon as a whole, according to Yin (2006). Therefore, the unit of analysis is The Brazilian market for software and services.

Table 1, below, brings a brief description of the companies participating in this study, which have decided not to disclose their business names.

Table 1: Studied companies and their main characteristics

SDO	ACTIVITY DESCRIPTION	MAIN CHARACTERISTICS
A	Offers information technology solutions: customised project Development; financial market and public administration products; outsourcing.	Established in 1991, with 30 years of experience in the Software Industry and regional branches in the southeast, south and northeast Brazil and clients in over thirteen Brazilian states. Employs around 250 people.
B	Specialises in developing systems for academic management. Competitive advantage related to the professional management of educational institutions processes in a simple, but technological and efficient way.	Established in 1989, with 32 years of experience in the Software Industry and branches in the south and southeast Brazil and clients including public and private educational institutions. Employs around 150 people.
C	Its large portfolio includes a software factory in southeast Brazil. It is certified in the CMMI (SEI) Level 3 and ISO 9001-2000 (ABNT) standards to meet market demands.	Established in 1991, with 30 years of experience in the Software Industry, it has clients from the public and private sectors. Employs around 1.500 people, of whom 70 work in the software factory.
D	Provides services to the corporate and government market. Performs outsourcing projects in systems Development and maintenance all over Brazil, through its software factory or outsourcing.	Established in 1994, with 27 years of experience in the Software Industry and branches in southeast Brazil. Employs around 200 people.

Source: Authors (2022)

Note that the data collection method adopted was the semi-structured interview. This method was the only one applied because the participating companies did not allow observation nor documentary analysis due to their information security policy. These companies believe that their competitive advantages are explicit in the documents of standard procedures for software development, the activities resulting from these documents, and their organizational structure. However, it is important to emphasise the risks in choosing semi-structured interviews as the only data collection method. For a more in-depth understanding of the phenomenon investigated and to establish convincing and accurate conclusions, data must be collected from multiple sources, like interviews, observation and documental analysis, to be able to achieve a

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triangulation for the mutual validation of collection methods and results obtained in the research (WOODSIDE, 2010).

In order to obtain information from people with a consolidated perception of their work environment, only professionals involved in the software production process of the participant companies who had been hired for at least one year were interviewed. The developer interviewed with the least amount of time at an SDO had been working there for three years. The average interview time was 1h30. Table 2 presents the characterisation of the developers who participated in this study. Note that this paper is part of a much larger study resulting from a doctoral thesis. Although interviews were conducted in November 2011, data was sent back to the researched companies in February 2022 to be updated and revalidated. Thus, new information was aggregated, and others disregarded when compared to the original data.

Table 2: Characterisation of interviewees

Researched SDO	Interviewed Employee	Age	Job Description	Time with the company
A	Developer 1ª	39	Director of Operations	4
	Developer 2ª	28	Project Manager	3
	Developer 3ª	24	Requirement Analyst	3
B	Developer 1B	28	Customer Service Team Leader	7
	Developer 2B	32	Business Specialist	8
	Developer 3B	38	Analyst and Programmer	6
C	Developer 1C	41	SEPG Manager	12
	Developer 2C	26	Project Leader	13
	Developer 3C	30	Analyst and Designer	8
D	Developer 1D	43	Technology Manager	7
	Developer 2D	25	Analyst and Programmer	5
	Developer 3D	28	Analyst and Programmer	12

Source: Authors (2022)

There was a thorough reading of interview transcripts, through coding method, aiming to identify parts of the texts that described the occurrence of learning at the individual level in those organisations according to the framework proposed by Tannenbaum (1997).

Coding is the process in which the analysed data is defined. It involves identifying and registering one or more pieces of text or other data as parts of the general framework that somehow exemplify the same theoretical and descriptive idea. Usually, several passages are identified and then related to an idea. Thus, the text, among other elements that refer to or exemplify the same thing, is grouped and coded with the same name. Coding is a way to index or categorise the text to establish a structure of thematic ideas about it (GIBBS, 2009).

4 RESULTS AND DISCUSSION

4.1 Learning Experiences

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One of the objectives of this study was to establish whether developers complied with meaningful learning experiences in the work environment.

The results show that developers learn through internal training, which can be required by them or offered by the company to answer the need for specific training.

Furthermore, in the SDOs investigated, professional training is considered essential to achieve good performance in the projects, according to the guidelines of the Software Process Improvement Models adopted by these companies. These models offer a predetermined script for improving the production process of computational artifacts and establishing specific individual and team tasks, which will enable a significant improvement in the software produced. The models are conducive to learning, as developers need to understand the proposed guidelines to establish methods to meet them. Then, the SDO requires a work environment that supports the development, implementation, and evaluation of these methods, enabling better performance in developing their technological solutions. There are international models, like the CMMI - Capability Maturity Model Integration and the Brazilian model MPS-BR - *Melhoria de Processo do Software Brasileiro* (Brazilian Software Process Improvement), which was adopted by the SDOs investigated in this study. The MPS-BR aims to create and disseminate a standard model for software process improvement at an affordable cost and in less time than CMMI, specially designed for micro, small and medium-sized companies (RAMASUBBU et al., 2008; LEE; CHEN, 2019).

For instance, when the team identifies that its members need to learn specific knowledge, the team responsible is requested to promote professional training. For some developers: "Well, we have training courses" (Developer 1C). "In internal workshops, when there's an exchange of knowledge within the team" (Developer 2D).

Another meaningful learning experience evidenced refers to the reflections that occur during the discussions on formal meetings about projects. The knowledge generated in these meetings is expressed in a document shared between team members and other developers' teams: "So, in the meetings we have about the project, we check who is having problems. I mean, if someone makes a suggestion, if that is useful and can be applied to other projects too, then it is shared through the e-mail group of the project or the e-mail group of developers" (Developer 1A).

These meetings happen due to the *Scrum* methodology adopted by SDOs, which advocates for the team to have some formal meetings during the project.

Scrum is an adaptive and flexible methodology, indicated for contexts where requirements are constantly changing and results need to be delivered to customers quickly. Thus, the development process is divided into several cycle interactions called *sprints*. In the end, the software specialist delivers a validated version to the internal (organizational sector in which he works) or external client, which can be quickly implemented and that adds value to their business (CARVALHO; MELLO, 2009).

Meetings such as a *Product backlog,* identifying the software requirements and establishing the list of tasks to be performed, or even a *Daily Scrum,* a quick daily meeting between team members to define the daily tasks and check the results of the previous day.

A situation that promotes learning, mentioned by the interviewees, is the interaction with clients when collecting the requirements to develop the systems. The higher the complexity of

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the required feature is, the greater the learning, as atypical and complex situations motivate reflection and acquisition of new knowledge. According to some developers:" […] and I'm always talking to him. I say: '-Ah, let me ask you a question. Or they check it too. We have a lot of processes for review. So, I do and someone fixes it" (Developer 2C). Another learning situation identified refers to 'Peer Development', which occurs when a less experienced developer works and learns with a more experienced developer until he can also perform tasks following the standard practices required by the company. "And we also have peer development, a pre-program. We also use that. It's something we help with, programming together. Actually, I have used this method in both ways, as a student and as an instructor. Very useful" (Developer 2D).

SDOs adopt information and communication technologies to facilitate the interaction and sharing of knowledge and experience among developers according to the Software Process Improvement Model's guidelines. The software specialists learn when using discussion forums, *Wikis,* which are web pages that can be edited and where users can read or add content, interactions through text or voice chat tools, and interactions by e-mails.

Data repositories that stored the knowledge generated in the SDOs and applied according to the Software Process Improvement Model are also conducive to learning. An example is *Subversion*, a free/open-source version control system that manages files and directories and changes made over time. Its core is called 'repository', where data is stored to be shared. Individuals with access to this repository can read, write in these files and share the stored information through the company's intranet (SUSSMAN et al., 2007).

This repository stores, for instance, documents regarding the standard process for software which is, according to Couto (2007, p.116), "a basic process that guides the stablishment of a process for developing software which is common to all the projects". A developer says: "Well, everything that we see, I mean, that could be applied in another project, is stored in this repository" (Developer 1A).

Therefore, the primary learning experiences in SDOs occur during training promoted by the company, attending formal meetings to discuss projects, when interacting with clients, through peer development, and the interaction between developers promoted by the information and communication technologies integrated into the work environment in these organisations.

4.2 Knowledge Application

This study also sought to understand if the work environment in SDOs allows developers to apply the knowledge acquired through the learning experiences. Results show that these organisations present an environment that promotes the application of new work methods and is error-tolerant. Besides, these organisations consider mistakes as meaningful opportunities to learn. Developers learn when they assess their mistakes and, through their reflection, find new strategies to solve them. This situation is mainly promoted due to the improvement models in the software process, which specify that atypical situations, mistakes and their respective solutions must be recorded in a report called Lessons Learned. Thus, the best practices can be applied in future projects with similar characteristics: "I particularly like to write down the

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problems as soon as I have them and what is useful so that, in the end, I can put it all together. It is also a part of our lessons learned" (Developer 1D).

This environment, open to mistakes, allows SDOs to develop complex projects that require the application of the acquired knowledge and provide essential learning experiences. According to developers, complex projects are conducive to learning because of atypical situations that require new technological solutions and new ways to perform tasks: "I think the most difficult projects are the most special ones, the ones that require…something new, something you don't have experience with. Besides being challenging, there is also the great risk of not meeting the deadline, and running out of time makes you acquire new knowledge" (Developer 2B). In summary, the work environment in SDOs promotes the application of knowledge acquired in learning experiences because complex projects require not only the application of new working methods but also the development of features unknown to previous projects. Besides, the work environment motivates developers to apply new knowledge even when the first experience does not produce a satisfactory result. These organisations learn when they assess their mistakes and find strategies to solve them.

4.3 Recognition for Knowledge Application

This study sought to identify if developers receive recognition in the work environment for the application of knowledge and skills acquired in learning experiences and if it can positively impact the performance of projects. It was assessed that SDOs recognise the dedication, commitment and good results of their employees achieved by applying their knowledge and skills, which allows the development of systems.

SDOs adopt formal evaluations to measure employees' performance and recognise their achievements. These evaluations follow the model in which superiors evaluate subordinates or the model in which team members evaluate each other.

Job performance can be used as a factor in the career plan, including for salary increase: "[…] this feedback in the six-monthly evaluation is one of the criteria to assess if someone will get an increase in salary or not. It doesn't mean you get an increase every six months. But it is one of the factors observed" (Developer 2C).

Project leaders or managers also contribute to continuous learning when they provide positive and informative feedback in which they recognise the excellent result achieved in the job performance, rather than simple assessment reports or comparisons with other team member's performance: "We always get that positive feedback, praising them. Even if it's for their dedication. Sometimes, the result is not what we wanted, but the person was committed" (Developer 1A). For some developers, it is possible to learn with good or bad feedbacks. Thus, the project leader contributes to the occurrence of continuous learning in the work environment by evaluating his subordinates in order to eliminate deficiencies and motivate professional advancement: "During the performance of tasks, really, he can call you: 'Look, you didn't do it properly. You can do better'. Or: "See, congratulations. What a good job!'. It can be good or bad feedback. But you listen to and learn with it" (Developer 2B).

Team members also recognise the good performance of their peers through the application of knowledge, contributing to learning by providing feedback in which they suggest

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improvements that can be applied: "Well, for example, now I'm setting up a database, but it affects other modules of that project over there. So, sometimes, the other requirement analyst calls me on the phone or on the chat and says: 'Oh, look, this is wrong. Check it out.' Other times he says: 'Look! You did great! Well done." (Developer 2A).

Therefore, recognition for applying new knowledge occurs through the feedback provided by the project leader and team members and through performance evaluation, which even allows promotions and salary increases.

4.4 Motivation to Learn

This study also sought to understand if developers feel motivated to constantly participate in learning experiences due to the recognition achieved through applying new knowledge and skills, which cause a positive impact on the SDO performance or through other stimuli present in the work environment. The results demonstrated that SDOs seek to establish a continuous learning culture as a responsibility and an essential competitive advantage. A developer stated that: "Lately, here at the company, we have been motivated to do more research, study more, acquire new knowledge, not to be stagnated and think that what you know is enough" (Developer 1B).

The situation described above is mainly due to the previously mentioned guidelines of the Software Process Improvement Model, which emphasise the importance of regular professional training to improve software production processes continuously.

According to developers, there is healthy competition in the work environment between the team members in developing projects that motivates them to continuously seek new knowledge and professional advancement. They try to stand out by solving a problem or innovating: "Sometimes, you don't want to be in a rut. You want to do something new. That project has N tasks, and there's that new task that nobody knows. So, you want to be the first to go and solve it. Competition here is like that. Not the kind to take others down" (Developer 2B). For developers, this 'healthy competition' between team members must be continuous to handle extreme competition in the SDOs market. Those who do not possess this kind of behaviour are seen as 'settled'. Therefore, they are not willing to contribute to the company's competitive advantage: "I think there's competitiveness even in the soccer team. I believe that if there isn't, it's a sign that everybody is settled. And this competitive guy can help the company to innovate and have an advantage over other software providers" (Developer 1A).

Note that having a significant repository of knowledge acquired through continuous learning will not be enough if the developer is not willing to apply it and share it within the company: "I was asked a question last week: 'What do I have to do to become a senior employee here at the company? Do I need to get a degree? Do I have to…' And then, I answered: 'Man, here at the company you are not evaluated just by this kind of thing. There's no point in having a bag of certificates, be *the man* in theory, if you are not able to share it with other people, if you can't apply it in the company" (Developer 1B).

There are special rooms in the SDOs for formal and informal meetings that facilitate continuous learning by allowing discussions that lead to essential reflections on software development, which can be considered aspects of their organizational culture. Some of these

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rooms are designed to create a relaxed and informal atmosphere conducive to new ideas. An example is the 'Creativity Room' from Organization B, where employees can relax on mattresses and cushions, with video games, board games and books. Organisation D also provides a room for recreation with a similar atmosphere. The open layout adopted by SDOs, free of partitions and doors and where developers sit side by side, also facilitate discussions and knowledge sharing. Therefore, developers have the perception that the company, as a whole, promotes and supports continuous learning by providing the required conditions for their employees to learn, evidence that shows an organizational culture that strongly prioritises learning.

5 CONCLUSION

This research has achieved the main objective of this study: to understand the occurrence of continuous learning at the individual level in SDOs according to the framework proposed by Tannenbaum (1997). Regarding the 'learning experiences, the first element of this model, the results showed that developers have meaningful experiences in training provided by the SDOs to meet their training requirements.

They also learn through reflections that occur during formal meetings about task development in a particular software project. For Dixon (1997; 1999), individuals build personal meanings that can be accessed when shared with other team members through discussions considered learning facilitators, as while they occur, the team can assess the logic and reasoning of these personal meanings. Furthermore, when the personal meaning is rejected, the team rebuilds it to create better ideas and more efficient actions. After this group reflection happens during meetings' discussions, a new meaning is achieved, which is common to all team members. In SDOs, this meaning refers to the knowledge that establishes how to perform the work (BERNINGHAUS et al., 2017).

It is possible to learn with clients when they require new features that are not present in previous software. The higher the complexity of the feature, the greater the learning, as new contexts lead to the acquisition of new knowledge, experimentation and reflection on the results achieved (KOLB, 1984; VINK et al., 2019; RICE; HEINZ; VAN ZOONEN, 2019).

Thus, atypical and challenging situations allow developers to live meaningful experiences, which lead to the acquisition of new knowledge (O'ROURKE; BUNTING, 2018). Developers learn with team members, especially during the 'peer development' that happens when a less experienced developer works and learns with a more experienced one until he can perform his tasks alone, without any help. More experienced developers can also learn with less experienced ones during this mentoring process by accessing new knowledge and different experiences. They also learn through the interaction and sharing of knowledge facilitated by the information and communication technologies present in the work environment of SDOs. These technologies allow software experts to share their ideas and experiences, promoting the acquisition of new knowledge and methods applied in system development (DIXON, 1999; RICE; HEINZ; VAN ZOONEN, 2019). As for the element' knowledge application', the results demonstrated that the work environment in SDOs promotes the application of knowledge acquired in learning experiences, and it is not restrictive (LOLLI et al., 2016; SÁNCHEZ-POLO et al., 2019). The

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incentives to application occur mainly due to the tolerance to errors. Thus, SDOs tend to develop more complex projects with requirements unseen in previous projects.

Therefore, developers are motivated to present and apply ideas, and they are not punished when their contribution does not bring a satisfactory outcome. The lack of recognition for those efforts inhibits the employees' participation in decision-making processes, as they fear their suggestions may be rejected or they may be punished by expressing their opinion or attempting something new, which compromises the learning (TANNENBAUM, 1997; FLYNN; EDDY; TANNENBAUM, 2006). Regarding the element 'recognition for the application of knowledge', it was possible to establish that developers receive recognition by applying knowledge and skills that contribute to the success of projects through evaluations of performance, both formal and those assessed by the project team leader. It is important to observe that a successful application of new ideas tends to motivate the individual to keep learning, regardless of company rewards for this behaviour. However, if this situation persists for a long time, the employee may get frustrated, feeling demotivated to learn, and even consider quitting the company as his job is not recognised (TANNENBAUM, 1997; GIL; MATAVELI, 2016).

As for the element' motivation to learn', this study identified that SDOs offer a work environment that values and incentives continuous learning, which is considered a responsibility and an advantage (RICE; HEINZ; VAN ZOONEN, 2019).

The findings have also achieved the specific objectives of this paper: to understand and describe the strategies and tools applied by developers during their learning process and to understand and describe if the SDOs studied in this case offer a work environment conducive to continuous learning at the individual level. These findings give evidence of intentional strategies to learn through professional training and 'peer development', and unpredictable situations that lead to reflection and action, both regarded as meaningful learning experiences. For example, they demonstrate that these unpredictable situations arise during projects and require solutions that can be established through discussions in formal or informal and less structured meetings, in the Creativity Room or during work hours, are mainly due to the open layout that promotes interaction between developers. They also show the learning that occurs through discussions with clients to identify the user requirements necessary to develop a computational artifact. The results have also identified that information and communication technologies are essential tools for learning at the individual and group level by enabling the storage and sharing of information regarding the standard process for software development.

Moreover, the findings have also identified that the incentive and the presence of resources that support the acquisition of new skills contribute to continuous learning to be an element of the work context in those SDOs (ROSOW; ZAGER, 1988; KOZLOWSKY; HULTS, 1987; RICE; HEINZ; VAN ZOONEN, 2019). Regarding the contributions of this paper to the organizational learning field, the results show the role of the guidelines and practices of the Software Process Improvement Models and Agile Methodologies, such as *Scrum*, for the planning and management of projects in the establishment of environments conducive to continuous learning in the SDOs. In this study, all the organisations were certified by MPS-BR, the Brazilian Model for Software Process Improvement.

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The results also demonstrated that some practices implemented to follow this model facilitate learning and establish environments conducive to its occurrence. Such practices include regular professional training, lessons learned and the definition of an institutional and validated standard process for software development. Regarding *Scrum*, its relevance to organizational learning is demonstrated through meetings for project planning and management. They encourage significant discussions which enable developers to reflect on situations and determine solutions through sharing their personal knowledge, allowing the construction of a more accurate collective knowledge.

As for the limitations, this research was based on only one method for data collection - the semi-structured interview -, because the participating companies did not allow the observation or documentary analysis due to their information security policy. The lack of triangulation may have made it impossible to prove whether this "ideal scenario" identified through the interviews occurs in the workplace. There was no evidence of substantial organizational elements or characteristics that could hinder learning. Evidence was found in only one statement made by Developer 1B of possible implications to group learning when there is a reluctance to share their personal meanings. As for a future study, the authors suggest research to apply and evaluate if the guidelines and practices of the Software Process Improvement Models and Agile Methodologies can demonstrate meaningful results in organisations from other industries. They hope that these findings support other SDOs to establish environments conducive to continuous learning, favouring innovation and constant improvement of their products and services

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