

# Trajectory and traits of devigners: a qualitative study about transdisciplinarity in a software studio

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## ABSTRACT

Contemporary software engineering requires multidisciplinary teams, organized in different roles to collaborate. Among the roles, two are consolidating as complementary opposites: the developer and the designer. These roles require different backgrounds and skills, which makes the developer-designer collaboration quite difficult sometimes. Intending to bridge the gap between these two roles, some students are pursuing a double background in design and development, trying to become what has been called a *devigner*. This research presents a qualitative study on the common trajectory and traits of students who fit the devigner profile in a particular place. The study was conducted in a software studio program focused on mobile app development in Brazil, following a combination of oral history and grounded theory methods. The findings are useful to identify devigners already acting in multidisciplinary teams, as well as in the construction or improvement of undergraduate courses aiming at supporting transdisciplinary professionals.

## KEYWORDS

Devigner, devigner trajectory, devigner traits, transdisciplinary profile, software studio, software engineering.

## 1. Introduction

Software engineering is a discipline that constantly interacts with others since software development is a complex, collaborative, and creative activity [1]. Effectiveness in this activity depends a lot on the collaboration between the different roles played by team members [2]. Among the roles growing in this activity, two are consolidating as complementary opposites: the developer and the designer. Grossly speaking, the developer is responsible for software function, while the designer is responsible for software form. Since software requires a fine integration between form and function to perform well, the collaboration between these two roles is essential [1],[3].

Previous research has shown that this collaboration is not straightforward. To deal with the specificities of each role, developers and designers have different backgrounds and skills, as expected by the multidisciplinary premise of software development. They look at the same problem with a different perspective, helping to generate robust solutions [4]. However, to implement these solutions, they need to understand each other, which is rarely the case. Difficulties in developer-designer collaboration range from a lack of a shared vocabulary to harsh epistemological conflicts [3], [5], [6], [7], [8], [9]. These difficulties are increasingly under scrutiny since software teams are also under higher pressure from markets and users, in particular, in mobile ecosystems, which have streamlined distribution and fast time-to-market. Mobile apps must compete in saturated marketplaces, where user experience is essential for differentiation. Nevertheless, software robustness is still important and even taken for granted, eventually generating conflicts between usability and efficiency. This pressure has caused profound changes in the software development process [10], requiring even more collaboration between developers and designers. A term commonly used in the industry to address this scenario is “full stack developer”, a professional capable of working with technologies that involve developer and designer roles. However, this professional is characterized mainly as someone with technical skills.

A rare but growing tactic to deal with this challenge is hiring, training, or becoming a hybrid practitioner who can productively work with both design and development issues, the so-called *devigner* [11]. This practitioner is supposed to better collaborate with other developers and other designers since she understands both perspectives [11]. She can also help with both designer’s and developer’s tasks, effectively acting as a bridge between the two roles. In the case of software startups, the devigner typically works alone, creating a competitive advantage of having development and design integrated right from the beginning.

Despite these possibilities, there is not yet a clear role for designers in software teams.

Software engineering has been mostly characterized as a multidisciplinary endeavor. The case of designers introduces the question of transdisciplinarity, an approach to learning and development that recognizes the existence of knowledge beyond and across academic disciplines [12]. Transdisciplinarity cultivates knowledge that does not have its discipline yet and, due to that, is often ignored by multidisciplinary. Long journeys characterize the transdisciplinary learning and development into the realms of unknown, uncharted fields. The practitioners who go through these journeys become hybrid profiles that are difficult to fit within clear boundaries, but that can deal with overlooked issues.

Transdisciplinarity poses a challenge for software engineering education. Educators have worked hard in the last decades to define clearly the discipline and to build up a coherent curriculum for it, yet there is still room for improvement. Research on software engineering education points towards the need for more practical learning in the curriculum [13], such as the one provided by software studio programs. These programs put students in situations where they have to develop real applications for real clients and users [14]. The studio environment reinforces external criticism and encourages students to personally reflect on their activities, methods and solutions presented. This environment develops artistic talent [15]. Students who follow a transdisciplinary trajectory may fit well within these programs since they require learning skills in both design and development.

The available research on the designer profile is scarce, and there is no research on the educational needs of this transdisciplinary profile. The goal of this research is to characterize the designer profile through finding common patterns in the trajectories and traits of a group of students that meet the definition of the designer.

The students who participated in this study were selected from a software studio program called Apple Developer Academy (ADA) located in Curitiba/PR, which admits three types of students: (1) Developer: students who are interested in developing technologies and who have strong logical reasoning and high absorption capacity; (2) Designer: students who are interested in designing graphic user interfaces and who have strong dialectical reasoning and are capable of creating original visual identities and navigation structures; (3) Devigners: students who are capable of dealing with both modes of reasoning and are interested in developing both kinds of skills. Students may come from any background, but they must fit within one of these roles. The selection and admission of these students involved a formal test, a formal interview, and a hackathon. The test evaluated their technical competence in development and design; the interviews helped to understand their interests and the hackathon aimed at observing less objective competencies such as collaboration,

leadership, proactivity, creativity, and autonomy. The program runs alongside undergraduate or graduate studies for two years, serving as complimentary education. The pedagogy is based on Challenge Based Learning (CBL) [16], an approach that requires students to set their own learning goals to meet software development challenges. The challenges are centered around building mobile applications for the Apple ecosystem.

The next section of this paper describes the research method, which will be followed by the results and findings.

## 2. Research method

A qualitative research method has been crafted to study the trajectory and traits of the designer profile in the software studio program mentioned above. The trajectories were gathered through interviews with the students, following the oral history approach [17]. The trajectories were reconstructed and analyzed by following some steps of the grounded theory method [18].

### 2.1. Oral History

Oral history strives for representing the diversity of life's experiences and the different views of the world [17]. Its main challenge is to reconstruct the past from the experiences of the individuals who experienced it directly [19]. As a qualitative research method, oral history is characterized by taking testimonies as the central focus of studies [22]. Asking for personal testimonies means necessarily entering an intimate and unstable field of memory, which is not questioned by the method [21]. The epistemological choice of accepting subjective narratives also implies that there are multiple, different, and equally valid experiences of the world. Under this view, the oral history interview follows an open and inductive protocol [22], in which the interviewer gently guides the interviewee to tell her history. The main task of the interviewer is to keep the conversation alive, generating a collaborative exchange between interviewer and interviewee [22]. To allow the interviewee to tell the story from their point of view, the interviewer asks as few open questions as possible.

In this study, the questions centered around the trajectory that brought the interviewee where she is now, i.e., in the designer role. The interviewee was free to tell her story in any likely order, including any experience that would be connected to the trajectory, including personal and childhood experiences [22]. The interviewee had the freedom to speak as long as she wanted. While conducting the interview, the interviewer took notes of what was not understood at first, which were used for clarification by the end of the interview. A total of 16 students (13 men and 3 women) from the 2017-2018 cohort were interviewed. Twelve of them were admitted as designers, and 4 developed an additional role within the program, for example, a designer who learned development. The interviews were previously scheduled and conducted in the software studio premises, which offered a natural environment for the interviewee, as well as good acoustics

and privacy. The interviews lasted between 30 and 90 minutes. The audio conversation was recorded and transcribed, amounting to 235 text pages. These pages were tagged with an anonymous code for each interviewee (E1-E16). In addition to the audio recording, the interviewer took notes during and after the interviews, which served as memos in the grounded theory method, which will be explained next.

## 2.2. Grounded Theory

Grounded theory (GT) is another qualitative research method that, differently from oral history, adopts systematic procedures of data collection and analysis to generate, elaborate, and validate emergent theories about social phenomena [23]. In this research, GT is used to find common patterns among the narratives collected with the oral history method. This is necessary to meet the researchers' goal of characterizing the designer profile in this particular setting.

To transcribing and reading the interviews, as typically done in oral history research, these were coded and analyzed in the Atlas.ti software, as done in most recent GT research. The coding procedure was implemented in three stages: (1) Data organization and initial readings: all the interview transcriptions were first imported in a hermeneutic unit in the Atlas.ti software and later read for reassuring the transcription fidelity; (2) Open coding: the conversational turns from the interviews were coded for common incidents and traits described by the interviewees. The codes tried to explain why such incidents happened to these people and how their traits were developed. Through constant comparison, these codes were eventually revised, merged, and deleted; (3) Axial coding: common patterns in the trajectories and common traits were found by using code incidence search, as well as by making visual code networks. This step also included the revision of the codes and the organization of quotes for writing this paper.

The open coding stage performed a detailed, line-by-line, analysis which gave rise to codes based on the interviewees' own words. These codes mainly reflected personal preferences and interests, such as: "likes to play Lego," "likes to think in the future," "interests in technology," "study on your own," "likes to play video-game," and "concern about people (user)." Eventually, these codes reflected professional activities such as "worked as a translator," "worked as a teacher", "worked as a vendor", "worked with marketing", and "worked with design". In total, 362 codes emerged at this stage. After the line-by-line analysis, the codes were grouped into larger codes, which worked as categories for dealing with the data from a broader perspective. Constant comparisons were made between codes and categories, which prompted modifications on both sides. Each category was labeled based on an interpretation of the aggregated codes. For example, the category "Creative" aggregates situations and experiences that suggest the trait of a creative person. The categories ended up revealing two aspects of the designer profile: their common traits and their common trajectories. Although the group of interviewed is small, it was possible to achieve data saturation from the codes

collected. This saturation is observable in the results of this study and the projected trajectory.

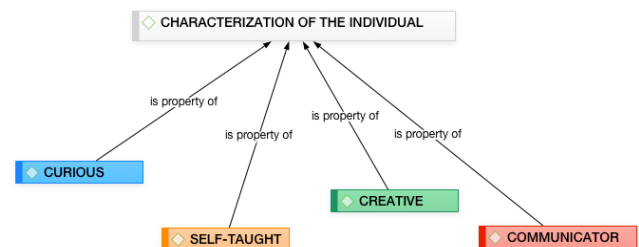
The axial coding was performed in these two aspects separately. In the case of the traits, axial coding did not find any common relationship between the categories since each person presented very different traits. It was possible to find a common path between trajectories, according to an abstracted chronology of events. For example, the category "Interests" represent some activity that interviewees had during childhood, which is connected with "Know the unknown" because small activities and experiences worked as incentives for more discoveries. These connections were mapped with the code network feature of Atlas.ti. The results of this analysis will be presented in the next section.

## 3. Results and Discussion

In this section, the characteristics of the designer transdisciplinary profile will be presented.

### 3.1. The Designer Traits

Fourteen codes were identified through the statements of the interviewees who, when grouped into four categories, represented common personal traits: curious, self-taught, creative, and communicative. A code network was created to support and confirm the axial coding (Figure 1). No connection was made between the categories, as it was noticed that they are independent but complementary to the characterization of the individual. In this sense, they are linked through the "is property of" connector as a representation of personal traits. These traits will be described together with some interview quotes that were used to construct the evidence of these traits in the designer profile.



**Figure 1: Characterization of the individual with the transdisciplinary profile.**

#### A. CURIOUS

Being curious is one of the main characteristics of the transdisciplinary profile, which is already manifested and recognized. Many interviewees reported having an interest in how electronic toys such as cars and dolls worked. These experiences were labeled with codes such as "curiosity to know how things works", "like to play games", and "like to assemble and disassemble things". As an example, E14 reported: "[...] when I

was a very young child, I liked to take my toys apart to know how they worked. I also liked to make my toys [...].”

During the adolescent phase, the interviewees had new contacts and new experiences that resulted in other curiosities and more discoveries. Many of these experiences were generally related to computing and, in some cases, to electronics. Besides, there was a desire to understand how software (including games) worked, and this curiosity led them to study such disciplines as programming and design. As an example, note the speech of the E8: “[...] I was also very curious to know how the games worked, because for me, standard software and such, it was something that I thought was very cool, I really wanted to do, but the time I looked at games seemed more magical [...]”. Interest in games was mainly because many respondents used to play electronic games. It is observed in the report of E4 this context: “[...], and then I found it interesting to see how I played a lot, I wanted to understand what was going on behind that game, how I got up that interacted so many hours in my day [...]”.

It was also noted that as adults, the curiosity remained very present in this profile; however, in a different context from that seen during childhood. The fact of being curious encouraged the conduction of different researches about new subjects that generated interest in several areas and, consequently, knowledge about different disciplines. Knowledge in different areas is perceived as something very positive, capable of generating different feelings ranging from satisfaction in understanding a topic to a possible debate until it is considered an advantage, which can be used as a tool to facilitate the work. E2's speech represents this scenario: “[...] I do not need to be the reference for a subject, but I do not like to feel that I do not understand. So, I always try to find out enough so that I can understand what the other person is talking about [...]”.

Concerning the professional environment, curiosity makes it possible to understand why a given task needs to be performed. As the transdisciplinary profile knows several areas, there is an interest in understanding the whole process and not just part of it, as noted in the excerpt from E08: “[...] I was very fond of understanding the process, so I think what I sometimes try to learn today is to understand the process. Sometimes you see the result, but I am very curious to know how it is done behind the scenes, right [...]”.

## B. SELF-TAUGHT

Another characteristic very present in the transdisciplinary profile of this study is the ability to study by itself without the help of a teacher or instructor. The codes that better represent this scenario are: “motivation for learning” and “study on your own”. As it is a curious profile that has an interest in many areas, respondents seek to learn about various subjects that seem appealing to them, and in many cases, the study is conducted without the help of a mentor. With the advancement of technology, the internet has become the main source of research and knowledge acquisition. While they conduct these searches for

the content of interest, they also practice what is being learned. This movement of research and practice without the presence of a tutor is repeated until satisfaction with the acquired knowledge occurs, as a fragment of E11: “[...] when I wanted to do something I had to go after, research, see as I did and do it myself. I had no other alternative. I also had no one to turn to teach me in person because I did not know anyone who had that knowledge. So, what I had to do was search the internet, find out how to do it and do it [...]”.

From adolescence and adulthood, there is a search for knowledge in a deeper and more consolidated way as something that represents the professional future. This process is represented by graduation.

With the beginning of a higher education course, respondents begin to study very specific subjects; however, it is possible to observe that even having a very exclusive focus of studies, there is also an interest in several other subjects. Once again, we noticed the interest in multiple subjects and the ability to study alone without the need for a teacher or instructor. However, graduation is not always a guarantee of learning satisfaction, mainly because there may not be certain about the future professional. Respondents report that when this uncertainty occurs, they seek to align what has been learned in undergraduate learning with what has already been learned by their own study. From this combination of knowledge, they can choose another undergraduate as a new attempt to define their professional future.

Based on their undergraduate experiences, they perceive the existence of multiple disciplines that can be complementary to each other and which, through their joint study, can provide solutions to different problems and provide new ways of viewing the same situation. On the other hand, it is possible to perceive in some scenarios that respondents consider some professional experiences more valuable than taking a higher education course. In these cases, they cast doubt on the continuity of the undergraduate degree concerning the study of subjects of their interest that is, in their view, fundamental to the continuity of their professional career.

## C. CREATIVE

Being creative is another attribute very present in the profile of respondents. This feature is observed countless times during the different situations experienced in all phases of life. The codes “flexibility and fluency”, “originality”, and “hybridity within projects” are some representatives of this characteristic.

Creativity was seen as a form of intelligence to behave differently concerning events, occurrences, or situations. Since they have a transdisciplinary profile, interest in different disciplines is common in their life trajectories and results in an extremely broad knowledge base that fosters creative ability. As an example, we can see the speech of E6: “[...], so today I see that starting with engineering and then moving to an advertising

course gave me a good hybrid knowledge within projects because I can connect the dots. So, I can make the designer talk to the programmer in a way that both can optimize their time and achieve a better result [...].”

Creativity also helps in adapting new situations that arise during the different moments of the trajectory. This differentiated look helps in solving complex problems, providing the search for creative resolutions, or the discovery of alternatives. An example of this scenario is observed in the speech of E9: “[...] I worked out a solution, sometimes I took spreadsheets, more technical, more detailed information and worked out these solutions for them and presented them. Furthermore, they always liked, always approved, they ended up leaving us to solve their problem, their system. So, at that time, I think the company saw that it was not even worth leaving me programming, (because) if I worked out the interface, I worked out the client solution better [...]”.

These details present an original way of being able to create combinations and possibilities that can result in events and solutions different from the usual ones. An example is in the speech of E9: “[...] so I think my greatest difficulty now is this, but I think creativity has helped, I have achieved quite a lot with solutions that are often as simple [...]”. This scenario can also be noticed in the speech of E3: “[...] I wanted to learn from creative people to become a more creative person because I saw that this was an important thing, that would help me and always helped me [...]”.

#### D. COMMUNICATOR

The ability of respondents to express themselves is another important feature that can be observed. In general, they know how to make themselves understood, and this attribute goes beyond sympathy or extroversion. It also can convey ideas clearly and objectively in a way that other people can capture what is being said. During the analysis, the codes “sociable”, “self-confidence”, and “connecting people” were used to register this characteristic.

This situation is experienced in the studio, because the teams are formed by different professionals, with different backgrounds and who have their vocabularies. Being a communicator, in this context, allows the communication to be fluid with the different components of the teams, as an example in E1’s speech about his activities in the studio: “[...] because the worst thing is that you develop, a code or do a screen and then realize that it does not even matter so much or maybe at the end of the project it does not even exist anymore. I think it is a matter of mediation, maybe, exactly, is bridging the two, a balance. They are different people, but if you have a person who speaks their language, they understand each other. I think that is right; it is an interpreter [...]”. However, it is noted that the ability to communicate with different types of professionals brings a sense of responsibility for managing the workplace in which they find themselves. As an example, it can be observed in the speech of E7: “[...] but sometimes the facilitation work or the work of ... understanding

these two worlds of design and development brings not only bonuses but also burdens, which is when you realize that your co-worker is earning less than he should, simply because he does not want to do it or because he is not excited about the project. So, there is the annoying part that you have to come up with and tell the person that you understand what is going on. You are not being deceived [...]”.

An important feature is knowing how to listen to others and managing their speech. This situation is directly linked to teamwork, as there is often the involvement of people with different knowledge, backgrounds, and opinions. This context can be seen in the speech of E3: “[...] sometimes (it is necessary) to make concessions. Intentionally giving up things that I know will be good for people to have a feeling that they are contributing [...]”.

In the studio, the developer and designer are put in contact with each other in various situations. In this scenario, the interviewees act as mediators between the two professionals, managing egos, visions, opinions, and adapting their points of view to what is discussed.

### 3.2. The Devigner Trajectory

Through the interviewees’ statements, several codes that represent patterns in the trajectory of the transdisciplinary profile were identified. These codes are grouped into nine categories that form a timeline in the career path, as shown in Figure 2.

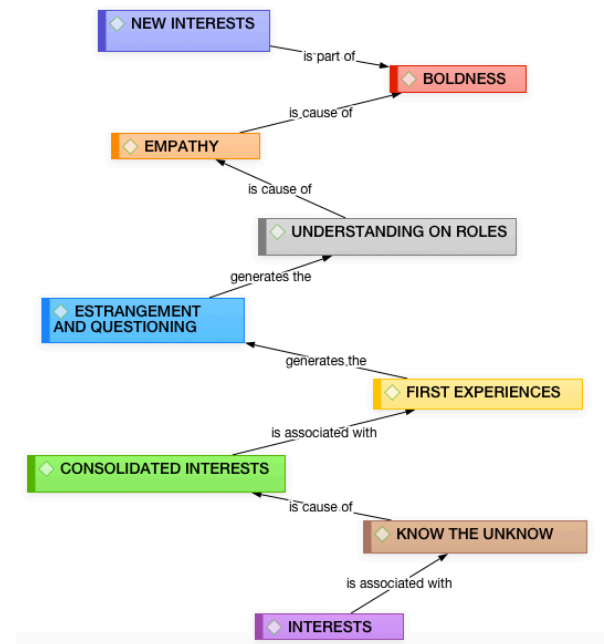


Figure 2 - Common trajectory of the individual with a transdisciplinary profile in the software studio.

This sequence does not represent a chronological order of events; instead, it represents the common patterns found in the trajectories of the interviewees. Each code encapsulates a major shift in the trajectory of the designer. These shifts will be described together with the leading evidence in the next lines.

#### A. INTERESTS

This category represents some situations that occurred during the childhood and adolescence phases and attracted the attention of the interviewees. Codes as “interest on design”, “interest on developer games”, “interest on programming”, and “interest on science” show some interest reported by interviewees. An example is the speech of E6: “[...] and my other sister always took guitar lessons. And then I started watching her guitar lessons as I passed in the living room [...]”.

As the interviewees were in a phase of a lot of learning and news regarding the professional trajectory, the interests were related to the most diverse areas, and there was no commitment, in the sense of engagement, to know or understand more deeply what was being experienced. The attention-grabbing situations involved the most diverse subjects like programming, design, game development, music, photography, science, and hardware.

It was observed that most of the time, there was a pattern for this type of event: the interviewee witnessed a situation that attracted attention, and from this experience, an interest in a particular subject arose. However, at this stage of their life, they still could not realize what the real importance of any subject was. This scenario was repeated countless times during the interviewees' childhood and adolescence. It turns out that some interests remained alive in memory to the point of evolving into something deeper like the pursuit of more solid knowledge.

#### B. KNOW THE UNKNOWN

The interviewees reported that the feeling of curiosity is something constant in their lives and appears as a natural consequence of an experience that was lived from an interest. When something becomes relevant, there is a desire to look for more information on that subject. This creates the relationship between interest (first contact) and curiosity (vertical knowledge). The kind of codes that represent this category are related to acquiring knowledge on something like “learn programming”, “learn music,” and “learn photography”.

It was observed that during childhood, the main experiences involved toys and, in some exceptional cases, products that had some technology. In this sense, E14 highlighted this situation during childhood: “[...] as I was very young, I liked to take my toys apart to know how they worked, and I also liked to put together my toys [...]”.

During adolescence, respondents began to have new types of contacts that generated new experiences. The use of the computer was one of the main experiences, due to the interest related to

both the hardware and the software. It turned out that the computer, compared to simple toys, presented itself as something much more complex. In this way, the search for information started to be done in another way and no longer through the assembly and disassembly of computers. The knowledge was directed to the understanding of the functioning of the software/websites and was obtained through videos, tutorials, books, etc., without formal and organized learning; that is, there was no presence of a tutor or teacher. For example, E2 mentions that “[...] I always studied alone, I was looking on YouTube, on the internet and such, but I do not remember if I ever did any course [...]”. From these excerpts, it is possible to notice that the interviewees have the ability to study alone. This competence was observed at various times during the interviews, especially when it comes to learning involving programming or design. It is also possible to find other topics of interest, such as music, geography, history, math, etc., which have been studied independently. However, the biggest occurrences of this scenario were in the area of computing and design.

With the knowledge gained through these studies, respondents began to apply what was learned, whether in sporadic freelance work or in developing software and websites as their personal projects. As a consequence, these subjects or areas were studied in more depth and became interests.

#### C. CONSOLIDATED INTERESTS

Consolidated interests are the results of the most compelling experiences that were experienced during adolescence, represented by areas in which respondents felt comfortable performing or studying. It occurred that throughout other phases of life, these activities continued to generate some satisfaction to respondents, regardless of whether these interests are related to the choice of graduation, the choice to enter the job market, or leisure time. Activities that involved programming, electronic games, photography, and electronics study were some of the subjects that attracted attention and interest during the interviewees' adolescence. Some consolidated interests can be seen on codes labeled as “like to study electronic”, “like to play games”, “like to draw”, and “like to practice sports”.

This continuing interest in an activity or area of study can be seen in the speech of E5: “[...] I had a hobby since high school, which I liked very much was Graphic Design [...]”. Still, E8 also highlights this consolidated interest: “[...] I liked electronics as a child, ah, I started to like computers, but I did not drop electronics, I still liked to study and practice [...]”.

It was noted that some of the mentioned interests demanded more theoretical knowledge, such as the arts and literature. On the other hand, tastes involving the area of software development, photography, or drawing directed the interviewees to the practice.

In many cases, the first experiences in the labor market were in areas that were directly related to these consolidated interests. However, not all experiences with the labor market were

satisfactory. Interviewee E10 reports a reflection on his occupation: “[...] people programmed better than me, and I thought “I do not think it is for myself, I am very...”, and I also think that there was a reinforcement of people saying to me “no, because you look like you are from the humanities area, you are very much from the humanities” you know? It seems that people were reinforcing that it was not my place to program [...]”.

Regarding the choice of the undergraduate course, it was observed that in 40% of the interviews, this selection had no connection with the consolidated interests. The option for a college degree occurred in a very diverse way involving several factors such as family pressure, aptitude tests, among others.

#### D. EXPERIENCES

The experiences reported by the interviewees involved the beginning of the academic career at graduation and the initial contact with the job market. Here the codes show mainly the experiences during the professional trajectory. Some codes were labeled as “worked with design”, “worked with 3D”, “worked as a vendor”, and “worked with marketing”.

As far as labor market experiences are concerned, they emerged as a result of the search for a source of income and were based on choices that did not involve areas of preference. These early experiences generated feelings of both satisfaction and dissatisfaction. Satisfaction occurred whenever there was learning, either in a new activity or in a new area. Dissatisfaction was reported whenever there was a feeling of stagnation.

Concerning academic experiences, all respondents were studying undergraduate, either in an intermediate or final phase of the course. In some interviews, it was observed that there is a continuity link between the consolidated interests and the choice of the course. In these cases, there is a sequence of interests that have been consolidated in such a way that the participant has chosen to pursue a career based on these preferences. Interviewee E2 mentions this context justifying the choice of the degree: “[...] but really, seeing these two subjects in the course grid was like the validation I needed, you know? Because I wanted to be a designer who also programmed and they were telling me, “You can be a designer who programs [...]”.

In other interviews, it was observed that the choice of graduation was due to different factors such as family preference and pressure, vocational tests, course curriculum, among others. Interviewee E9 reports that: “[...] I started, my first college was Cartographic Engineering. I did Cartographic Engineering because I already knew how to work with topography, which was the profession of my father, my grandfather, my brother, all of my family followed this profession of topography [...]”.

Regardless of how they entered the undergraduate and what were their professional experiences, it was observed that these different experiences were relevant to the professional career to the point of generating a personal reflection to evaluate what has

already been experienced, think about what was learned and what was not yet fully understood.

#### E. ESTRANGEMENT AND QUESTIONING

With the beginning of their experiences in the professional and academic fields, respondents began to have new perspectives on undergraduate and the job market. What happens at a certain moment is the emergence of a feeling of discomfort and lack of accomplishment with the disciplines (academic) or with the activities (professional). Codes like “demotivation in graduation”, “frustration in graduation”, “abandonment in graduation”, and “personal reflection” show this moment of the trajectory.

This phenomenon arises from the interviewees' reflection about the moment that was being experienced, and, from this analysis, there is an identification that they are not inserted in the context that most satisfies them. Disinterest in graduation can be observed in three different scenarios.

The first scenario refers to the choice of graduation based on consolidated interests, and there is an understanding that this choice will represent their professional future. However, when the practical activities begin, respondents are frustrated because they realize that context does not meet their initial expectations. For some respondents, this frustration resulted in dropping out of the course. Another scenario observed in the interviews showed that the choice of graduation occurred without much doubt; however, the life experiences that happened during the course ended up influencing the decision to look for another course that would meet their new expectations. The last scenario represents the choice of the degree that was directed by the family, especially so that there could be continuity in a family business. In these cases, the interviewees understand what the purpose of the chosen course is, but they are aware that their real desire for vocational training is linked to another course, with other subjects. E9's report portrays this scenario: “[...] it was that thing “one day I will be back to study this”, but it was eight years later [...]”.

In addition to frustration and demotivation with the completion of a higher education course, respondents made several criticisms of graduation. Comments are directed at the way universities conduct disciplines and prepare students for some real situations that happen in the job market. It was also noted that not all respondents had any demotivation or frustration. For them, the choice of graduation occurred in a planned, assertive, and directed to the professional future they desired.

#### F. UNDERSTANDING ON ROLES

From the different experiences, including professionals and academics, the interviewees gained a greater understanding of the various roles that play in software development, especially the developer and designer. Stereotypes have been created for both, each with their unique characteristics that make them so

important in development teams. The codes “designer’s role”, “developer’s role”, “interaction between developer and designer”, and “characteristics of engineering professional” show the formation of stereotypes reported by interviewees by your points-of-view.

In the case of the developer, the understanding is that of a very technical professional, with an eye toward logical thinking, such as the efficiency of an algorithm or a compiler, as reported by E2: “[...] the problems are only for who likes programming a lot. One does everything based on the compiler. If it is good if it is going [...]”. For having this more technical profile, the developer generally has a natural shortcoming concerning usability care and user concern for software. On the other hand, the designer has more humanized characteristics, which makes both roles complementary. For the interviewees, the designer is a professional who is mainly concerned with the user experience through the interface that should be able to transform the functional into something intuitive.

The definitions of developer and designer stereotypes, as well as understanding each of these roles, allow respondents to realize that while they are complementary, there is a gap between their thinking. E4’s statement represents this context: “[...] a programmer does not always understand what a designer is trying to propose as a solution or a designer cannot understand that the product he is going to generate has to be tied to the effective capabilities that a programmer has to build. It is no use to you within a team profile; you have an amazing designer and a not so efficient programmer [...]”.

From the developer and designer stereotypes, respondents are beginning to realize that they have characteristics that combine the two stereotypes and can fit into one of these roles and thus bridge the gap between them. An ecosystem-oriented look enables students to understand the different perspectives that software provides, whether from the developer, designer, client, or even the market side.

#### G. EMPATHY

The affinity that respondents feel with different perspectives favors collaboration at many stages of software development by being able to perform various types of tasks, whether related to programming, design, testing etc. This affinity can be seen on codes “concern about people”, “concern about presentation”, and “concern about professional future”.

The transdisciplinary profile favors empathy for different roles but requires an understanding of the responsibilities that each role has. One of these concerns is related to the presentation, especially in the visual aspect, as reported by E1: “[...] I liked to make things more beautiful because even in the presentation it was nicer, when it came to the presentation, people they would look and say “yes, this one is much prettier than the others” [...]”.

As software is perceived as an ecosystem that involves the logical (developer), visual (designer), and (user) interaction, it is important to consider numerous perspectives, including those of use. To do this, one need to put himself in the user position and understand how something can be improved to meet the needs of those who will use the software, as pointed out by E1: “[...] you sometimes find that it is the way she holds the phone, her finger is on the button, for example. Then the button is hidden, and she never finds the button. So, some things you could hardly see just creating, just thinking [...]”.

As they see the software development process from different perspectives, interacting with different roles and at different stages, respondents reported that they have an affinity for participating in projects from the early stages and actively working in the process of creating these projects. E4 pointed out that: “[...] When you take a project that is already under development or join a group that already has something directed, you get it, you come in, you understand where you are, from the moment you entered and the continuation, but you do not participate in that until the moment you entered, you just accept. So, you do not like it much anymore [...]”. However, respondents realize the need for development and design to come together and see it as an opportunity for professional fulfillment. Thus, a concern for the future professional arises for a profile with such particular characteristics and such unique interests.

#### H. BOLDNESS

From the uncertainty about the professional future and the discovery of stereotypes in software development, it is observed difficulty in identifying what will be the real function of the professional with this transdisciplinary profile in the job market, especially in the software development process. In this sense, some movements occur in an attempt to understand how this profile can be allocated in the professional environment and what role it can assume. Some examples of these movements were coded as “dedication to the business itself”, “combination between design and programming”.

The first path concerns the professional who wants to work in companies as a differentiated professional, acting in multiple areas and on different roles in the software development process. In this scenario, the interviewees are characterized as people who interact with different areas, mediate the various roles and act in the project as a whole, contributing at all stages, regardless of the technical requirement.

A concern that permeates the interviewees is that the market may not be able to absorb this professional because there is a preference for an expert profile. Besides, respondents have no interest in working in a specific area. They prefer the freedom to perform tasks. The consequence of these thoughts, coupled with the characteristics of the transdisciplinary profile, directs respondents to the second path in choosing the future: becoming an entrepreneur. As an example, interviewee E6 mentions that: “[...] I really wanted to be all three at the same time and I cannot



find that. Furthermore, the way I found it for myself is what, I am very determined to start a business of my own [...]”. Moreover, the expectation of running a business of its own offers the opportunity to have experiences that a company, with all its rooted bureaucracy and systematization, would not be able to offer.

Entrepreneurship also emerges as an alternative for the application of knowledge that is being acquired along the personal and professional life trajectory. However, entrepreneurship is a complex task and requires more skills than are required to play a role within a company or organization. That is, it cannot be summed up to a few responsibilities or concerns. As respondents begin to have a greater interest in entrepreneurship, their curiosity about different issues related to entrepreneurship activities increases.

#### I. NEW INTERESTS

During the career path, respondents reported seeing the software as an ecosystem, and this perception basically involved the roles that are played by the developer and devigner. From the desire to start in the business of entrepreneurship, there is a rereading of this scenario. The ecosystem seen by respondents goes beyond codes, interfaces, and users. The part that complements the vision of software as an ecosystem is its interest in the business. Some codes were labeled as “attraction of executing all stages of projects”, “attraction of business”, “attraction of global vision of work”, and “thinking on business model”.

Thinking about project planning as something marketable highlights the focus for entrepreneurship. In previous moments the interviewees also showed interest in the participation of the various project stages; however, they were based on the execution of tasks such as programming and prototyping, leaving aside the involvement with the strategic part that has issues such as sales and marketing.

This change of perspective is observed in the speech of E9: “[...] I always say that after you publish, you are not even halfway through what is a project, because there is everything that comes after it. So, it is how you will disclose, how you will monetize, what your business is, so these are all other skills that have nothing to do with programming, nothing to do with design. You are already entering the area of marketing, business [...]”.

According to the interviewees, this type of (more strategic) management mainly favors creative freedom, as all project steps are performed without the bureaucratic structure of an organization. The interviewee himself is the one who defines the next steps, based on his experiences, and what actions must be taken for the project or tasks to be successful.

The freedom to think and execute one's ideas, coupled with free will for decision-making, further sharpens interest in entrepreneurship. On the other hand, acting in roles in different

areas also generates new interests, either as a consequence of market need or the involvement of respondents in new areas.

## 4. Conclusions and Future Works

In this work, it was possible to identify four main characteristics in the individual with a transdisciplinary profile in a software studio: curious, self-taught, creative, and communicator. These characteristics become intertwined when looking at software development as a problem-solving activity involving the human element, and that requires another interpersonal skill like analytical thinking, communication, and logical reasoning [24]. The curiosity makes the devigner a discoverer. As a self-taught learner, the devigner goes beyond what tutors or professors guide them through. As a transdisciplinary thinker, frequently, the devigner questions the knowledge that comes from disciplines. With sheer creativity, they look for mixing different kinds of knowledge and skills. As a practitioner, the devigner often works as a broker between developers and designers, bringing both roles together.

This work also found patterns in the trajectory of the individual with a transdisciplinary profile who works in a software studio. The mapping of the characteristics of the individual with a transdisciplinary profile can be used as a model for forming software development teams or even to identify possible transdisciplinary profiles that are already acting in multidisciplinary teams. Besides, the discovery of patterns in the training path that characterize the individual with a transdisciplinary profile can be used in the construction or improvement of undergraduate courses to train transdisciplinary professionals, which is currently not considered in discussions about software engineering education.

Based on the interviewees' statements, the data collected and the reflections made in this study, it is possible to state that the researched studio is capable of contributing to the participants' personal and professional development, besides offering similar experiences to those that occur in real projects in the job market. It was also possible to identify that the studio provides a different view from that perceived in the traditional academic environment, mainly by the activities performed and the roles involved in the projects that are performed in the studio.

This research presents a qualitative study conducted in a particular setting with limited scope for generalization. Despite the work on generalizing the devigner traits and trajectories from the individual narratives, more work needs to be done to characterize this hybrid role. Future research could replicate this study in other software studios to compare, modify, and consolidate the found categories. It is also possible, and necessary, to study devigners in professional software development environments. It is possible to use other methods for data collection and comparison, which may allow larger scopes. With the initial categories presented here, future research can proceed to a much more ambitious goal of analyzing and comparing

software engineering curricula to verify and improve their suitability to accommodate transdisciplinary profiles.

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