Usability Testing for Teachers' Lesson Planning Services

Leandro Marques Queiros
Informatics Center (CIn)
Federal University of Pernambuco
Recife, Pernambuco, Brazil
email: lmq@cin.ufpe.br

Nicolau Calado Jofilsan
Informatics Center (CIn)
Federal University of Pernambuco
Recife, Pernambuco, Brazil
email: *ncj@cin.ufpe.br*

Amadeu S. Campos Filho
Telehealth Center
Federal University of Pernambuco
Recife, Pernambuco, Brazil
email: amadeu.campos@nutes.ufpe.br

Alex Sandro Gomes
Informatics Center (CIn)
Federal University of Pernambuco
Recife, Pernambuco, Brazil
email: asg@cin.ufpe.br

Francisco Kelsen de Oliveira
IF Sertão Pernambucano (IF Sertão-PE)
Salgueiro, Pernambuco, Brazil
email: francisco.oliveira@ifsertao-pe.edu.br

Carlos José Pereira da Silva
Informatics Center (CIn)
Federal University of Pernambuco
Recife, Pernambuco, Brazil
email: cjps@cin.ufpe.br

***Abstract* — The purpose of this paper is to present and discuss the results from the usability and attractiveness analysis of an information system for sharing lesson plans with open educational resources (OER). For this, Human-Centered Design practices were adopted to better understand the needs related to the act of planning lessons and the meaning given to this planning. As a complement, studies have been carried out on the professional activities involved in the execution of lesson planning. With this set of information, programmers and designers have used the Brainsketching collaborative creativity technique to materialize the team's ideas into low-fidelity prototypes. Then, the prototype was scanned and received interaction features. A task analysis was performed for each of the main tasks in order to understand how actions with representative users would take place. After this step, a usability test was applied to a group of 18 high school teachers from public schools in the city of Recife, Brazil, in the first semester of 2017. The results point to problems of satisfaction and use of the application's high-fidelity version which has been tested. These issues were related to users' critical tasks and aspirations. Although it presents usability and satisfaction problems, the application is recognized by the target group as important and with potential for evolving.**

Keywords—learning design, usability, lesson planning, teacher practice.

I. INTRODUCTION

The literature on the teacher-student relationship in the teaching-learning process reveals that the learning phenomenon begins even before the teacher has a direct contact with the students [1]. Recent studies point to the importance of lesson planning activities as a crucial step to increase the impact on the students' performance [1][2][3]. In contrast, few information systems are specifically designed to support this stage from the teaching practice [4][5].

The planning activity present in the teaching practice is one among several tasks that are assigned to the teacher in their role as a teacher. Activities such as orientation and follow-up with students, participation in the preparation and execution of the political-pedagogical project from the educational institution, evaluation of students, homework and pedagogical activities are also present in the hard work performed by this professional [6].

This paper's motivation is due to the observation of the complexity and relevance of the planning stages from the teaching practice. Studies with the target group have been carried out with the intention of designing an application that facilitates the fulfillment of the tasks that constitute the teaching practices' planning. The purpose of this paper is to test the usability and measure the satisfaction of high school's educational users from public schools when using the Inovaula platform, which is currently a high-fidelity prototype. The paper is structured as follows: In section II, it presents information systems to support teaching practices for material planning and reuse; In section III, the method and procedures are presented; Section IV presents the Results. Finally, section V presents the discussion on the achieved results.

II. INFORMATION SYSTEMS TO SUPPORT THE TEACHING PRACTICES FOR PLANNING AND REUSE OF ARTIFACTS

The authors Gomes & Silva (2016) [7] indicates that there are many benefits in adopting design techniques for elaborating new learning experiences. The didactics with the use of appropriate technologies and techniques can have a complexity level as high as the classroom lessons. Even though, it is possible to plan experiences with the ICTs inside or outside the classroom, in a transparent and integrated way to the most varied digital devices, allowing the reuse of these materials.

Among the efforts that promote positive effects, there is the reuse of educational materials and how they are planned, developed, distributed, and evaluated [8][9]. According to John, P. D. [10], there are several attempts to train teachers to

978-1-5386-1174-6/18/$31.00 ©2018 IEEE

develop lesson planning skills. Such educational training initiatives aim to provide new paradigms that engage students through the use of digital technologies in the classroom. This need for innovation in teaching practices and the incorporation of new materials have imposed challenges on teachers [11].

The teaching planning with the mobilization of educational materials is considered important to promote innovations in the teaching practice. These materials are commonly embraced, however, due to factors that still need to be investigated, their use is improvised. Some teachers simply copy and replicate the planning used in the previous year to fulfill a requirement before the school [12]. Professionals seem to ignore the potential of the technological resources available in their planning [13]. In the Brazilian context, only one-third (⅓) of the teacher's total workload is allocated to studying, researching and preparing the lessons [6]. Fusari [12] defines the teaching planning as a "radical", "rigorous" collaborative process, and the teacher must see it as an educator's critical activity for working as a teacher.

In the literature, some studies indicate negative aspects of the adoption of learning design tools in the teaching practice. The challenges include trouble in adapting the content, incompatibility between systems, lack of knowledge on the technologies or languages required in the tools, obstacles of usability in the tools, and lack of space to share ideas, needs or solutions for problems [5].

III. METHOD AND PROCEDURES

We have adopted Human-Centered Design practices to guide the design process and decisions.

A. Participants

The study was conducted within two groups of individuals who work in public schools located in the *(blind review)*. The first group was composed of ten (10) teachers who have participated in the context analysis stage.

The second group has participated in the usability testing stage for the created prototypes, with the participation of eighteen (18) teachers. The research, comprised of the context analysis, interviews, prototyping, and testing stages, took place from March 2014 to October 2017. The criteria for being included in the research's target groups consisted of working as a high school teacher in the *(blind review)*. The criteria for being excluded consisted of not meeting the inclusion criteria.

B. Data collection and analysis

At first, an immersion was performed in the context of the teaching practice to understand the activities' structure in the stages that precede the lessons [14]. In the immersion stage, literature review techniques and narrative interviews have been used [15][16].

The researchers have visited the schools to conduct the narrative interviews, asking the teachers how they used to plan their academic activities and what functionalities would be important in an application that would aid them in fulfilling those tasks. These functionalities were classified and prioritized in the form of requirements. By using the interviews and observations, it was possible to collect the main requirements needed for developing the application.

An unsystematic qualitative observation technique was used to understand, explore, describe the phenomena, and identify possible problems in the chosen environment through an immersive way, which means the researcher was able to integrate into the studied group. This technique has been chosen because it is a semi-structured interview. The researcher's inference is required to capture the phenomenon of interest.

C. Prototyping

From the collected qualitative data and results obtained in the context analysis stage, it was possible to start the prototyping stage [14]. From the results of the context analysis, brainstorming and idea selection exercises were performed. The team held a Brainsketching session, a collaborative brainstorming technique aimed at generating sketches through drawings. Thus, it was possible to obtain the visual representation of functionalities that would be used as a starting point for the generation of low-fidelity prototypes.

Subsequently, the interfaces were scanned by using a vector graphics software program. Once completed, the interfaces were converted into images and loaded into a specific program for the creation of interactive prototypes.

D. Usability testing

In this study, we have used the criteria of Bastien and Scapin [17] to identify the ergonomic problems of the studied interfaces. From the observation of the prototype use and its interpretation through the transcriptions of opinions and thoughts aloud, it was possible to identify a series of problems in the ergonomics of the tested interfaces. These problems were analyzed and classified according to the ergonomic criteria of [17]. The relationships between interface problems and ergonomic criteria have been described in the course of this paper.

The usability testing has been carried out with the voluntary participation of 18 high school teachers. To evaluate high-fidelity prototypes, the Think-Aloud protocol was used, in which participants are invited to speak aloud during the fulfillment of a task in order to express their thoughts, problem-solving, and/or learning acquired in it [18].

The usability testing was divided into three steps. First, the teacher was asked to use the high-fidelity prototype's interface by expressing their feelings and opinions through the think-aloud protocol. This protocol allowed us to identify the cognitive and metacognitive processes produced by performing tasks proposed to the participants [19]. During the usability testing, participants would have to perform four tasks:

- Task 01 – obtaining a lesson plan;
- Task 02 - creating a lesson plan with digital media;
- Task 03 - scheduling a lesson plan;

- Task 04 - finding a teacher with the best reputation.

In the second step, the participants completed the Attrakdiff standardized satisfaction test to identify usability issues, analyze the user experience, and determine the satisfaction through Inovaula. In the second step, the participants were also asked to complete a demographic survey for better identifying the researched group.

In the third and last step, the participating teacher was asked to report their reviews, suggestions for modifying the interface and opinions that they would consider relevant. The instrument for recording the use of the interfaces was performed through screen capturing and recorded vocal contributions for further analysis.

According to this user experience model, through the satisfaction analysis proposed by Hassenzahl [20], each user assigns specific characteristics to the product/system when they are used. This experience/satisfaction is formed as a consequence of these characteristics, and it depends on the context and/or situation in which this product/system will be used.

AttrakDiff is an instrument used to measure the attractiveness of interactive products with a focus on the user experience. This instrument uses a semantic differential scale composed of pairs of opposing adjectives. Through this scale, the user can express their perception of the product. These adjectives are grouped into four evaluative dimensions, as described below:

- Pragmatic Quality - PQ: Describes the usability of a product and indicates how users achieve their goals when using the product;
- Hedonic quality stimulation - HQ-S: This dimension explores the evolution potential of the product. It indicates to what extent the product can support user needs regarding innovation, interest and stimulating functions, content, interaction and presentation styles;
- Hedonic quality identity - HQ-I: This dimension indicates the extent to which the product allows the user to identify themselves with it;
- Attractiveness - ATT: Represents, through a global value, the quality of the product perceived by the user.

It is important to emphasize that hedonic and pragmatic qualities are independent dimensions, but both contribute to measuring the attractiveness.

IV. Results

In the following sections, we present the main results from the prototyping and usability testing stages.

A. Prototype's Evolution

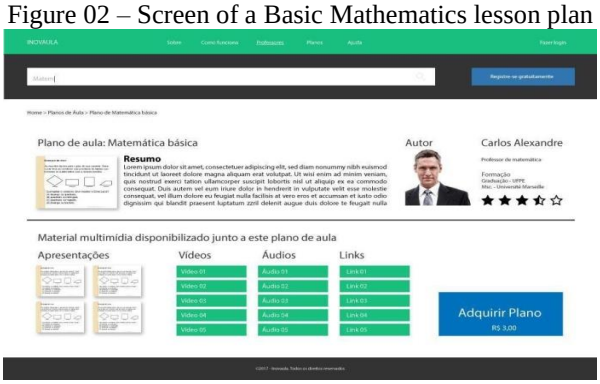
The team of designers and programmers had the challenge of designing and making a useful application available to the teacher working in high schools, in which they could find features such as searching and acquisition of lesson plans, creation and provision of lesson plans, well-evaluated authors, and the ability to use and link digital media with their lesson plans. For that, a series of documentary, bibliographical, field, and user-focused research has been carried out.

The version used for the usability analysis, present in figures 01, 02, 03, is a high-fidelity prototype and has the functionalities and visual features which are most like the version that will be implemented.

Figure 01 - Inovaula home screen

The interaction with the application was designed in a similar way to the use of an e-commerce website. It is possible to search, obtain and consult the lesson plans already obtained (Figure 02).

Figure 02 – Screen of a Basic Mathematics lesson plan



By using the application, the teacher not only can consult their lesson plans but also organize them into a weekly schedule (Figure 03).

Figure 03 - Screen of lesson plan scheduling

The management of plans was aimed to meet the need of connecting the dates and times of the lessons to contents in a digital media format, and using the lesson plan as a link between them.

In the following sections, we present the results from the effectiveness, satisfaction, and ergonomics testing performed with the high-fidelity final version.

B. Usability testing

The analysis of results has shown that most users were able to perform task 01 – obtaining a lesson plan – and task 04 – finding a teacher with the best reputation. The task 03 – scheduling a lesson plan – had a lower completion rate and task 02 – creating a lesson plan – was the one with less completion rate.

Table 01 - Results of the tasks by groups of participants

	Task 01	**Task 02**	**Task 03**	**Task 04**
Total	SP:14 PP:00 PI:04 NP:00	SP:02 PP:07 PI:04 NP:05	SP:09 PP:00 PI:09 NP:00	SP:15 PP:00 PI:03 NP:00

Caption: SD- Successfully Performed; PP- Partially Performed; PD- Performed with Issues; NR- Not Performed.

Considering the population of 18 teachers surveyed, task 01 had 14 successful performances and 4 performances with issues. The common issue among the 4 participants was to find the link to the lesson plan acquisition area on the homepage. Task 02 presented 2 successful performances, 7 partial performances, 4 performances with issues and 5 unsuccessful performances.

In partial performances, some users had issues while trying to perform task 02 and could not attach media to the lesson plan. In addition to having issues to find the link to create the lesson plan, the user could not identify the area for inserting the digital media that would be attached to this plan. In this case, the plans were created without the resources of digital media. The 4 participants who performed task 02 with issues had as the main limitation the difficulty in finding the link to create the lesson plan, which could be found on the My Plans page. It has been suggested that there should be a button or link on the homepage that would take them to the lesson plan creation area without the need of accessing more in-depth pages.

From the 5 participants who could not perform task 02, two of them could not find the 'Create lesson plan' link, even though the other three could find the link with issues, they did not complete the lesson plan. These last participants mainly complained about the lack of clarity in the steps of creating the lesson plan. Although they were able to read the recommendations for creating a lesson plan, which were present on the first page from the lesson plan creation, they have argued that these recommendations do not provide the necessary instructions for creating a plan. Thus, it was suggested that: the steps to create the lesson plan should be simplified; one should be able to access external resources, such as importing a plan or references from external sources; clearer instructions should be provided; the size of texts should be increased; and more friendly iconographies should be used.

Task 03 had nine participants who managed to perform it and other nine who did it with issues. The main problem identified in the fulfillment of this task was to find the "agenda" page, which contains the organizer with the lesson plans obtained and a calendar with dates and days of the week for the insertion of plans. Among the suggestions for improvement, the agenda link should be visible on the homepage, since it is inside a drop-down menu, thus giving a path alternative which is more direct rather than making the user to go to the My plans page and having to access one of the plans so that they can go to the Agenda page. Another solution would be to show the upcoming schedules on the homepage after the user logs in.

Task 04 presented fifteen successful performances and three performances with issues. Among the issues for the performance of this task, some were related to the size and clarity with which the stars – reputation symbol – were represented. One of the participants, even managing to perform the task with issues, could not accurately say whether they had found the most reputable teacher or not. The three participants with issues have complained that the stars were small, and their filling was confusing (Figure 02).

Common complaints included the presence of small text and links on the tested pages, lack of filters to classify lesson plans, and lack of a more attractive design with more school-oriented and less business-like identity. The participants also had difficulty in getting into the system and returning to the homepage. To minimize this problem, it was suggested the use of a more clear and easy-to-find breadcrumbs feature, as the links were too small.

C. Measurement of satisfaction

In Figure 04, one can view the results in the form of portfolio from the Attrakdiff survey. In the portfolio, the hedonic quality is represented by the vertical axis, whereas the pragmatic quality is expressed by the horizontal axis. According to the dimensions' values which have been translated into the portfolio, the product positioning identifies it in one or more quadrants, as too self-oriented, self-oriented, desired, neutral, task-oriented, superfluous, and also as too task-oriented. In Figure 04, one can also observe the larger and more transparent rectangle of confidence. It shows how accurate the results were. The smaller the rectangle, the more reliable the obtained results are.

Figure 04: Portfolio - presentation

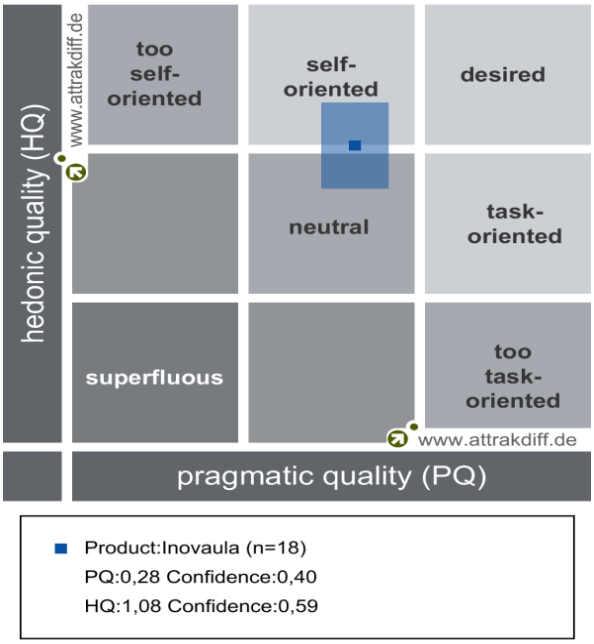
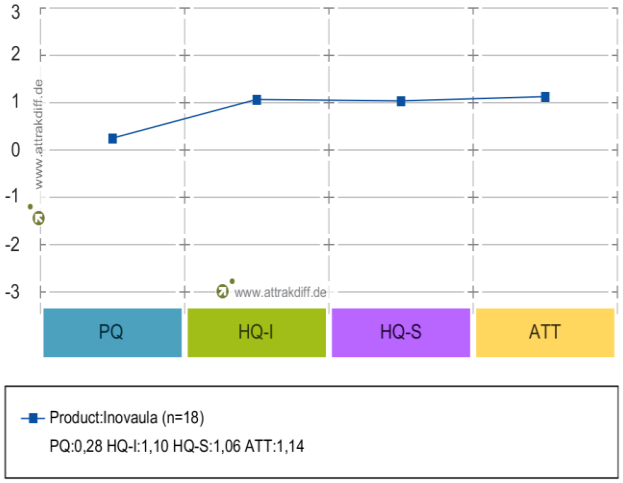


Figure 04 shows the relationship between the average values of the PQ (Pragmatic Quality) and HQ (Hedonic Quality) dimensions, which are represented in the horizontal and vertical axes, respectively. This intersection of mean values expresses the relationship between the user's expectation and experience concerning the system. The rectangle shown in the figure represents the degree of confidence in the results and shows whether users have convergent opinions in the evaluation or not. The smaller the area of the rectangle, the higher the data reliability. Therefore, the larger the confidence rectangle, the more divergent the users' opinions are. Regarding the region of the rectangle, it will be in one or more regions depending on the dimensions' values.

According to Figure 04, the pragmatic quality (PQ) dimension has achieved a reasonable degree of reliability with a 0.28 result, whereas the hedonic quality (HQ) has achieved less reliability with a 1.08 result. Still in Figure 04, one can see that the relationship between the dimensions of hedonic and pragmatic qualities is located between the self-oriented and neutral quadrants, with a more significant proximity to the self-oriented quadrant. This means that, according to such result, the Inovaula platform is perceived as self-oriented to its functionalities. The result also shows that the tested application needs improvements that would make it more attractive.

In Figure 05, the dimensions' average values for the Inovaula platform can be seen. In this diagram, the aspects of HQ-S stimulation and HQ-I identity, which compose the hedonic quality, are presented separately. The results show that the pragmatic quality (PQ) dimension was not well evaluated, having a 0.28 value. This result is explained by the series of usability-related issues found by the research's participants when performing tasks 02 and 03.

Figure 05: Diagram of average values



Even with the presented problems, the hedonic quality dimensions for HQ-I identity and HQ-S stimulation, as well as the measure of attractiveness, reached higher and stable values of 1.10, 1.06 and 1.14, respectively. That is a score which denotes an evolving application that, even with usability issues, presented positive values in aspects such as evolution potential, support to the needs, identification with the user, and overall attractiveness.

D. Ergonomic recommendations

When looking at Figure 06 (Description of Word – Pairs), it is possible to notice that only four pairs of words did not have a positive evaluation. Technical-human, complicated-simple, and cautious-bold have presented a negative evaluation, while the confusing-clearly structured word pair had a neutral evaluation.

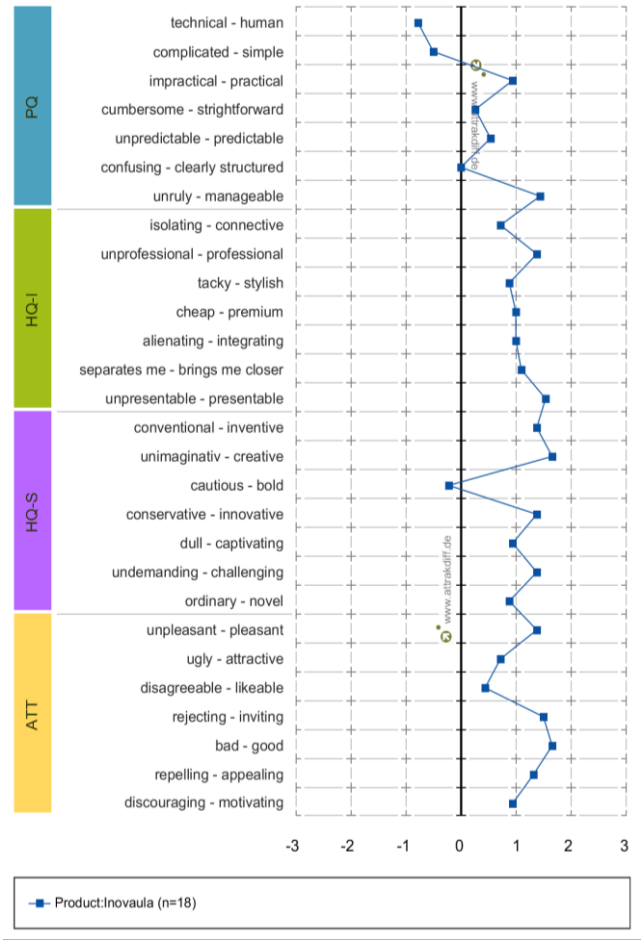
As a highlight, we have the most significant positive values for the following pairs of words: unruly-manageable; unprofessional-professional; unpresentable-presentable; unimaginative-creative; rejecting-inviting; bad-good.

The prototype sought to present, in a virtual environment, links compatible with those of the real world in the act of constructing a lesson plan. The presentation of lesson plans on the homepage was aimed to be similar to an electronic storefront (task 01). The steps for creating a lesson plan were organized and ranked from the target group research (task 02).

The calendar has followed an organization that is similar to that used in educational institutions – a matrix with the schedules in the first column and days of the week in the first line (task 03), and the way the authors' reputation is expressed into visual elements was structured with a scale from one to five stars, following a popular trend in collaboration-based social media, websites, and applications. Even so, the

interfaces have shown Compatibility issues in their style, and users found them too formal.

Figure 06: Description of word - pairs



According to one research participant, the interfaces' visual style was incompatible with users' expectations for conveying a "business, corporate, business-related" idea, when in fact, it should reflect the school environment.

Within the usability recommendation: Meaning of the Codes and Denominations, a problem was detected with the object representing its reference. Two of the users did not relate the stars' graphical representation with their meaning: reputation or ranking.

According to data collected in the research, the presence of the lesson plan search filter on other pages represented a problem related to the usability recommendation: Coherence. The lack of a standard in the elements' distribution in the interfaces for creating a lesson plan also presented problems of Coherence. The functionalities' poor organization was one of the main reasons for the low successful performance rate in task 02.

The lack of error messages and guidelines for performing the tasks in the interfaces designed to create a lesson plan were problems identified as Error Messaging Quality, a subarea from the usability recommendation: Error Management. A problem related to the Error Correction subarea was also detected during the task of creating a lesson plan. The system has not allowed the user to perform corrections on just incorrect parts of a lesson plan while creating it, nor even immediately after completing the task.

The adaptability criteria are subdivided into two others: Flexibility and User Experience. Task 01, which consisted of obtaining a lesson plan, was the one that proved to be more flexible, and could be started in up to four different ways: through the menu located at the top of the interface, by using the search field, by clicking on one of the teaching authors' profiles, or by accessing one of the lesson plans available on the homepage. Task 02 proved to be inflexible in its fulfillment, just presenting a long flow towards its completion. In task 03, the schedule for lesson planning could be accessed through two distinct paths, but the action of scheduling a lesson plan had only one way for being taken, by clicking on the lesson plan and then on the day and time it would be scheduled. The User Experience sub-criteria did not meet the inexperienced users' expectations. No dialog boxes were provided to conduct user actions nor a step-by-step explanation of how a particular task could be performed. The interface has not yet been upgraded to deal with variations in the experience level and users with cognitive limitations, such as color blindness and low vision.

Regarding the usability recommendation: Explicit Control, the following issues were found: In the Explicit User Actions section, when they would hover over the menus and links, they would not change their color or format to indicate that they were active to be accessed. Within the User Control section, the fields intended for text insertion had an automatic completion, as it is a prototype, making it impossible to control the content to be inserted in that field. In the area of media insertion for the creation of a lesson plan, when the media insertion box was open, the visual signs of User Control were not clear, which made it more challenging to be able to insert digital media into the lesson plan.

In the recommendation: Workload, there is the Brevity subarea, which in turn has the Minimum Actions criteria. The latter deals with the workload and number of actions to perform a task. Task 02 presented a high workload with too many actions needed to complete the goal. As the actions required to achieve this goal were numerous, the occurrence of errors was also high.

The recommendation: Handling has presented problems related to the subareas: Orientation, Immediate Feedback, and Legibility. When performing tasks 02 and 03, users found it more difficult to find their ways to complete them. In task 02, the user struggled to locate themselves in the system. When obtaining a lesson plan and creating a plan, the feedbacks were confusing to the user. Users also complained about the size of the fonts present on the interfaces, which had readability problems.

V. Discussion

In the case of creating a lesson plan, in which the processes are extremely dynamic and critical, systems must be designed taking into account the users' opinions and the context in which they will be inserted [21].

In Figure 04, one can observe that the Inovaula platform was evaluated as 'self-oriented'. This result corroborates with the purpose of the study to show that the developed system was intuitive, simple, easy to use, and self-explanatory. From the beginning, the system was developed thinking about practical activities for planning a lesson plan. Therefore, the activities within the system were conceived to be solved quickly, simply, and objectively.

When observing the pragmatic dimension in Figure 04, one can note that the system was evaluated as a product focused on its use, but still very close to the users' desires. The satisfaction comes as a consequence of a product's pragmatic qualities. It will appear as soon as the user can perform the tasks and achieve the desired goals, which was observed with this product. In regard to the aesthetic aspects (Hedonic Quality), the system was also evaluated as very close to the desired one, being therefore considered stimulant, attractive and able to provide an experience and pleasant memories [20].

In Figure 5, one can note that the system was well evaluated by the users, where all the analyzed variables had positive average values. The Pragmatic Quality dimension was the only one that had the lowest value, but it indicates that users consider the system use capable of ensuring the success in achieving their final goal. The dimensions of Hedonic Quality Stimulation and Hedonic Quality Identity had the same values, proving that the system was considered original, exciting, and stimulating to use. The fourth and last dimension (attractiveness) was the one that had the highest score, being therefore considered an attractive system for the potential users in the overall evaluation.

In Figure 06, one can have a more detailed view of each aspect assessed by the user. The most striking point of this evaluation was related to the fact that the evaluators considered the system more technical, complicated and cautious than human, bold and straightforward. Despite being an area where information is technical, confidential, and critical, the education sector requires a humanization and caution in its teaching-learning process, and it is important to evaluate and consider the possibility of improvements in this aspect.

When it comes to a teaching plan, the analysis of dealing with information in education requires a certain caution and care as the data are important for training the individual. In regard to the system being difficult to use and not demanding from the user, this is due to the fact that, in the education area, the target audience is quite heterogeneous, ranging from university-educated to technical professionals, with a lot or very little experience in technology, and of very different ages. But Inovaula was positively evaluated. Therefore, sometimes, it may be interesting that the system does not require so many challenges from its users [21].

Regarding the attractiveness dimension, it was observed that, although being considered pleasant, the system was not considered attractive. This aspect is a factor that must be analyzed by the developers to improve the system's attractiveness in the perception of the user.

In general, although the users' profiles do not contain technological characteristics, the study can evaluate/consider improvements in the technical aspects, which is complicated and bold, if the team find them useful. However, it should be noted that, despite having below-average values, these adjustments should be weighted taking into account the goal, purpose and, especially, the system's target audience. In this case, bringing simple and complex systems to the area of education may not be a desirable feature. The pros of the system were the aspects related to being simple, presentable, and enjoyable. Despite this, the developers may better focus the system for it to become more attractive and less tacky, cheap, and novel.

VI. Conclusion

In this paper, we have described the usability and measured the satisfaction of users, high school teachers from public schools, when using the Inovaula platform, which is currently a high-fidelity prototype of an application designed to enable the exchange of classroom materials and thus increase the teachers' ability to reuse materials in many different formats and with diverse materials, facilitating the insertion of technology in the day-to-day school activities. This way, it is assumed that lessons will become more innovative and productive.

Some requirements have been detected, and from them, alternative solutions were idealized. The ideas were materialized as functionalities through low-fidelity prototypes, which in turn were refined to originate the high-fidelity prototypes. With the interactive prototype, methodology and research protocol, it was possible to evaluate aspects related to the usability and attractiveness of the application to be developed.

The study identified satisfaction and use issues with the tested application. These issues were related to critical tasks and user's aspirations. In this way, we sought to generate a series of improvement recommendations for the next version of the application that, even presenting problems of usability and satisfaction, was classified as an important application for its target audience and that has a potential for evolving.

Acknowledgment

Leandro Marques Queiros is PhD student and receive a scholarship from CNPq. We are also very grateful to all participants for dedicating their time and attention to our research.

REFERENCES

[1] Rienties, B., & Toetenel, L. (2016). The impact of learning design on student behaviour, satisfaction and performance: A cross-institutional comparison across 151 modules. Computers in Human Behavior, 60, 333–341. https://doi.org/10.1016/j.chb.2016.02.074

[2] Yamada, M., Goda, Y., Matsukawa, H., Hata, K., & Yasunami, S. (2016). A Computer- Supported Learning Design Interaction. IEEE Computer Society, (Cmc), 48–59

[3] Wills, S., & Pegler, C. (2016). A Deeper Understanding of Reuse: Learning Designs, Activities, Resources and their Contexts. Journal of Interactive Media in Education, 2016(1), 1–11. https://doi.org/10.5334/jime.405

[4] Bennett, S. Agostinho, S., & Lockyer, L. (2015). Technology tools to support learning design: Implications derived from an investigation of university teachers' design practices. Computers and Education, 81, 211–220. https://doi.org/10.1016/j.compedu.2014.10.016

[5] Oliveira, F., & Gomes, A. S. (2015). *Uma revisão sistemática da literatura sobre ferramentas de autoria de IMS-LD*. In Brazilian Symposium on Computers in Education (Simpósio Brasileiro de Informática na Educação - SBIE) (Vol. 26, p. 376). https://doi.org/10.5753/cbie.sbie.2015.376

[6] Ministério da Educação. (2015). Resolução No 2, de 1º de julho de 2015. Retrieved November 13, 2017, Available from: http://portal.mec.gov.br/index.php?option=com_docman&view=download&alias=17719-res-cne-cp-002-03072015&Itemid=30192

[7] Gomes, A., & Silva, A. (2016). *Design de experiências de aprendizagem: criatividade e inovação para o planejamento das aulas*. (A. Noronha & V. Karla, Eds.). Recife: Pipa Comunicação.

[8] Gros, B., Kinshuk, & Maina, M. (2016). The Future of Ubiquitous Learning: Learning Designs for Emerging Pedagogies. (B. Gros, Kinshuk, & M. Maina, Eds.), Lecture Notes in Educational Technology. https://doi.org/10.1007/978-3-662-47724-3

[9] Balakrishnan, R., Dahlila, D., & Mubarak, M. (2016). Mobile Learning, Effective Integration of New Technologies into Existing Models. (J. E. Luaran, J. Sardi, A. Aziz, & N. A. Alias, Eds.). Singapore: Springer Singapore. https://doi.org/https://doi.org/10.1007/978-981-10-0954-9-28

[10] John, P. D. (2006). Lesson planning and the student teacher: re-thinking the dominant model. Journal of Curriculum Studies, 38(4), 483–498. https://doi.org/10.1080/00220270500363620

[11] Dalziel, J., Conole, G., Wills, S., Walker, S., Bennett l, S., Dobozy, E., Bower, M. (2016). JOURNAL OF INTERACTIVE MEDIA IN EDUCATION The Larnaca Declaration on Learning Design. Journal of Interactive Media in Education, 2016(7), 1–24. https://doi.org/10.5334/jime.407

[12] Fusari, J. C. (1990). *O Planejamento do Trabalho Pedagógico: Algumas Indagações e Tentativas de Respostas*. Série Ideias, 44–53. Retrieved from http://www.crmariocovas.sp.gov.br/pdf/ideias_08_p044-053_c.pdf

[13] Conole, G. (2009). The Role of Mediating Artefacts in Learning Design. In L. Lockyer, S. Bennett, S. Agostinho, & B. Harper (Eds.), Handbook of Research on Learning Design and Learning Objects: Issues, Applications, and Technologies (pp. 187–207). IGI Global. https://doi.org/10.4018/978-1-59904-861-1

[14] Barros, I. (2014). *Um Protótipo de Ferramenta para Assessorar o Professor na criação do Plano de Aula*. Trabalho de Conclusão de Curso. Universidade Federal de Pernambuco, Recife, Brazil.

[15] Creswell, J.W. (2014). *Investigação qualitativa e projeto de pesquisa. Escolhendo entre cinco abordagens*. São Paulo: Penso Editora LTDA

[16] Jovchelovich, S, Bauer MW. (2002). Entrevista Narrativa. In: Bauer MW, Gaskell G. *Pesquisa qualitativa com texto, imagem e som: um manual prático*. Petrópolis: Vozes

[17] Bastien, J. C., & Scapin, D. L. (1993). Ergonomic criteria for the evaluation of human-computer interfaces (Doctoral dissertation, Inria).

[18] Ericsson, K. A., & Simon, H. A. (1993). Protocol analysis: Verbal reports as data, Rev. the MIT Press

[19] Bannert, M., & Mengelkamp, C. (2008). Assessment of metacognitive skills by means of instruction to think aloud and reflect when prompted. Does the verbalisation method affect learning?. Metacognition and Learning, 3(1), 39-58

[20] Hassenzahl, M., Burmester, M. & Koller F. Der User Experience (UX) auf der Spur: Zum Einsatz von. Usability Professionals 2008, S 78-82 Stuttgart: German Chapter der Usability Professionals Association [Internet]. 2008; Available from: http://attrakdiff.de/files/up08_ux_auf_der_spur.pdf

[21] Alve,s D.S., Times, V.C., Araújo, A.M.C. de, Silva, M. U. da, Campos Filho, A.S., Novaes, M. de A., (2017). Usability Analysis of Archetyped Interfaces for the Electronic Health Record: a Comparative Study. ACHI 2017, The Tenth International Conference on Advances in Computer-Human Interactions [Internet]. Available from: https://www.thinkmind.org/index.php?view=article&articleid=achi_2017_8_20_20143