REVISTA ELECTRÓNICA DE INVESTIGACIÓN EN EDUCACIÓN EN CIENCIAS
ISSN 1850-6666

Número especial - 20 Años REIEC

The impact of a groupware lesson planning system on teachers' well-being

Leandro Marques Queiros, **Aluisio José Pereira**, **Rosane Maria Alencar da Silva, Alex Sandro Gomes**

lmq@cin.ufpe.br , ajp@cin.ufpe.br , rmas@cin.ufpe.br , asg@cin.ufpe.br

UFPE, Universidade Federal de Pernambuco, Centro de Informática, e Av. Jorn. Aníbal Fernandes, s/n, Cidade Universitária, Recife - PE, Brasil.

Abstract

This study addresses the issue of teachers' well-being in the context of lesson planning activities, which are often characterized by professional isolation, workload overload, and limited use of collaborative technologies. The objective of the research was to analyze how a collaborative lesson planning groupware system impacts teachers' perceived well-being, considering the domains of affect, community, and work. A mixed-methods approach was adopted, grounded in the design science research paradigm. The participants were 30 public school teachers from the state of Pernambuco, Brazil, who interacted with a high-fidelity groupware prototype and completed a well-being questionnaire based on the IEEE P7010-2020 standard, in addition to performing tasks using the think-aloud protocol. The results indicate that the use of groupware elicited predominantly positive affects, such as happiness and calmness, enhanced teachers' sense of belonging to a professional community, and increased perceptions of productivity and job satisfaction. Although negative affects were identified, they were not predominant. The study concludes that collaborative lesson planning supported by groupware can significantly contribute to teachers' well-being by reducing professional isolation, fostering collaboration, and optimizing pedagogical work processes.

Keywords: teacher well-being; collaborative lesson planning; educational technology; groupware; basic education.

O impacto de um sistema de groupware para o planejamento de aulas no bem-estar dos professores

Resumo

Esta pesquisa aborda a problemática do bem-estar docente diante das exigências do planejamento pedagógico, frequentemente marcado por isolamento, sobrecarga de trabalho e uso limitado de tecnologias colaborativas. O objetivo do estudo foi analisar de que forma um sistema de groupware para planejamento colaborativo de aulas impacta o bem-estar percebido de professores da educação básica, considerando os domínios de afeto, comunidade e trabalho. O método adotado foi de natureza mista (qualitativa e quantitativa), fundamentado no paradigma da design science research. Participaram 30 professores da rede pública do estado de Pernambuco, que interagiram com um protótipo de groupware de planejamento de aulas e responderam a um questionário baseado no padrão IEEE P7010-2020, além de realizarem tarefas com protocolo de pensamento em voz alta. Os resultados indicam que o uso do groupware despertou predominantemente afetos positivos, como felicidade e calma, fortaleceu o sentimento de pertencimento à comunidade docente e aumentou a percepção de produtividade e satisfação no trabalho. Embora afetos negativos tenham sido identificados, estes não se mostraram predominantes. Conclui-se que o planejamento colaborativo apoiado por groupware pode contribuir significativamente para a promoção do bem-estar docente, ao reduzir o isolamento profissional, favorecer a colaboração e otimizar o tempo de trabalho, destacando-se como uma alternativa promissora para práticas pedagógicas mais saudáveis e sustentáveis.

Palavras-chave: bem-estar docente; planejamento colaborativo; tecnologias educacionais; groupware; educação básica.

El impacto de un sistema de groupware para la planificación de clases en el bienestar de los docentes

Resumen

Esta investigación aborda la problemática del bienestar docente frente a las exigencias del planeamiento pedagógico, caracterizado frecuentemente por el aislamiento profesional, la sobrecarga laboral y el uso limitado de tecnologías colaborativas. El objetivo del estudio fue analizar cómo un sistema de groupware para la planificación colaborativa de clases impacta el bienestar percibido de profesores de educación básica, considerando los dominios de afecto, comunidad y trabajo. Se adoptó un enfoque metodológico mixto (cualitativo y cuantitativo), basado en el paradigma de la design science research. Participaron 30 docentes de escuelas públicas del estado de Pernambuco, Brasil, quienes interactuaron con un prototipo de groupware y respondieron a un cuestionario fundamentado en el estándar IEEE P7010-2020, además de realizar tareas con la técnica de pensamiento en voz alta. Los resultados evidencian que el uso del groupware promovió principalmente emociones positivas, como felicidad y calma, fortaleció el sentido de pertenencia a la comunidad docente y aumentó la percepción de productividad y satisfacción laboral. Aunque se identificaron emociones negativas, estas no fueron predominantes. Se concluye que la planificación colaborativa mediada por groupware contribuye de manera significativa al bienestar docente, al fomentar la colaboración, reducir el aislamiento profesional y mejorar la organización del trabajo pedagógico.

Palabras clave: bienestar docente; planificación colaborativa; tecnologías educativas; groupware; educación básica.

L’impact d’un système de groupware pour la planification des cours sur le bien-être des enseignants

Résumé

Cette recherche aborde la problématique du bien-être des enseignants face aux exigences de la planification pédagogique, souvent marquée par l’isolement professionnel, la surcharge de travail et l’utilisation limitée des technologies collaboratives. L’objectif de l’étude est d’analyser dans quelle mesure un système de groupware destiné à la planification collaborative des cours influence le bien-être perçu des enseignants de l’éducation de base, en considérant les domaines de l’affect, de la communauté et du travail. La méthodologie adoptée repose sur une approche mixte (qualitative et quantitative), ancrée dans le paradigme de la design science research. Trente enseignants de l’enseignement public de l’État de Pernambuco, au Brésil, ont participé à l’étude en interagissant avec un prototype de groupware de planification de cours, en répondant à un questionnaire basé sur la norme IEEE P7010-2020 et en réalisant des tâches selon le protocole de la pensée à voix haute. Les résultats montrent que l’utilisation du groupware a principalement suscité des affects positifs, tels que le bonheur et le calme, renforcé le sentiment d’appartenance à une communauté enseignante et accru la perception de productivité et de satisfaction au travail. Bien que des affects négatifs aient été identifiés, ceux-ci ne se sont pas révélés prédominants. En conclusion, la planification collaborative soutenue par un groupware contribue de manière significative à la promotion du bien-être des enseignants, en réduisant l’isolement professionnel, en favorisant la collaboration et en optimisant le temps et l’organisation du travail pédagogique.

Mots clés: bien-être des enseignants; planification collaborative; technologies éducatives; groupware; éducation de base.

1. INTRODUCION

El Well-being has been the subject of studies for decades by encompassing the components of affect and cognition (Ostrom, 1969; Diener Et Al., 1999; Schiff Et Al., 2021) in physical and digital environments. In the educational context, the search for promoting subjective well-being in the activities developed by teachers is a constant practice in didactic and pedagogical studies and procedures (Hakami & Hernandez-Leo, 2021; Olszewska, 2021; Saastamoinen Et Al., 2022).

Subjective well-being is essential for human development (Wagner et., al, 1999). The concept of well-being adopted in this study is "The continuous and sustainable physical, mental, and social flourishing of individuals, communities, and populations where their economic needs are cared for within a thriving ecological environment." (IEEE, 2020, p. 19).

The IEEE (2020), proposes well-being metrics to enable designers to know how the products and services created can impact well-being, based on a broad spectrum of measures, which range from affect, collaboration, and work to psychological well-being.

Wiese et al. (2019) argue that technology design and products contribute to people's well-being. The contribution is in its potential to create artifacts that can support activities that improve the well-being of individuals, and not in its material value. Duque et al. (2021) complement by arguing that design can support or enable positive and meaningful activities for people.

1.1. Educational Technologies

Creativity, digital literacy, collaboration, and communication are some key 21st century skills needed for professionals to succeed in their professional activities, but to do so one must have time available to develop them (Lemke, 2002; Van Laar et al., 2017; Chalkiadaki, 2018; Dishon; Gilead, 2021). These skills can be developed and established from educational teaching-learning planning.

The availability of Digital Information and Communication Technologies in education has become fundamental in the development of teachers' digital skills (Hökkä & Eteläpelto, 2014). When adopted effectively, it provides an intensification and improvement of planned pedagogical practices (Oliveira; Moura; Sousa, 2015; Cardoso Almeida; Silveira, 2021), as they can generate diverse teaching-learning experiences. However, the use of TDIC in classrooms is unique to each context of teachers, particularly due to the teachers' TDIC training needs to master TDIC and the low levels of collaboration between teachers (Gil-Flores; Rodríguez-Santero; Torres-Gordillo, 2017; Powell; Bodur, 2019).

For this collaborative work context, groupware type tools are recommended as an alternative for supporting group work. The proposal allows people to collaborate connected to computer networks in order to perform tasks together toward established goals, whether or not they are in geographically distinct locations (Tarrag; Hoppen, 1999).

1.2. Purpose of the study

Over the years, the United Nations Educational, Scientific and Cultural Organization (UNESCO) and many countries have been motivated to contribute and knowledge about the factors that influence the sharing of knowledge and digital educational resources among teachers in basic education (UNESCO, 2022; Dimitriadis Et Al., 2009; Silva Et Al., 2016; Hitzschky, Castro Filho, Freire, 2020; Medeiros et al., 2021). Based on the literature on collaborative lesson planning and lesson planning tools, and a sequence of field studies performed (previous sections), we propose a set of design recommendations for groupware development that support knowledge and resource sharing, educational and participatory groupware design.

In the context of this research, we analyzed the domains of affect and well-being for community and work. The literature indicates that the sharing of knowledge and digital educational resources among teachers cannot be fully understood without considering these issues (Otto; Kerres, 2022).

This study seeks to assess the level of preceptors' perceived well-being when using a groupware prototype that supports knowledge sharing and educational resources.

Therefore, we asked whether well-being could be improved by adopting CLP groupware. This considers that there are limitations and challenges in the mediating systems of collaborative classroom planning activities (Mor; Craft; Hernández-Leo, 2013; Eradze; Rodríguez-Triana; Laanpere, 2019; Queiros Et At., 2019; Zalavra Et Al., 2021). The answer to this question may contribute to the literature in that it will inform the level of well-being of these professionals perceived in the groupware that supports their craft, especially lesson planning activities. Therefore, well-being is the primary construct. Thus, we formulated the following research question: How can a collaborative lesson planning groupware impact teacher well-being ?

To answer the main question, this study proposes to answer the following research questions:

(i) What levels of affect are aroused in teachers, and how do these affect correlate, particularly when doing collaborative lesson planning activities in groupware?

(ii) Which Community indicators have the most impact when doing collaborative lesson planning activities in groupware?

(iii) Which Work indicators have the greatest impact when performing collaborative lesson planning activities in a groupware?

The paper is organized as follows: in section 4.2, we describe the methodological approach, data collection, and analysis procedures. The main results are presented in Section 4.3, where we highlight the evidence of the main findings. Finally, in Section 4.4, we discuss the important results, implications, and limitations of this study.

2. METODOLOGY

In this paper, we adopt a projective research paradigm (Nelson; Stolterman, 2012), which allows us to advance knowledge about the new desire for knowledge to be designed by proposing transformations on an evolving artificial artifact (Hevner; Chatterjee, 2010).

This research is qualitative and quantitative (Appolinário, 2016). We use quantitative data generated from the responses of the survey applied to the participants. The qualitative data was generated from thinking aloud when using groupware.

2.1. Participants

Thirty teachers participated in our investigation (see Table 5), ten female (33.33%) and twenty male (66.66%), distributed among fourteen municipalities in the state of Pernambuco (Brazil). About four (13.33%) of these teachers have up to 4 years of teaching experience, and twenty-six are specialists (86.66%).

In the sampling process and test plan (Nielsen, 1994; Goodman; Kuniavsky, 2012), inclusion criteria were considered: a. being a school teacher in public education; b. being willing to voluntarily participate in the research; c. having a personal computer to access the Internet and test the prototype via browser in the Figma tool.

For the study, the following exclusion criteria were defined: i. participants who did not want or refused to sign the consent form; ii. respondents who deliberately provided false answers or did not respond to more than half of the survey items. We asked fellow researchers if they knew any teachers who met the inclusion and exclusion requirements in the sampling process.

The author researching asked other researchers for indications of teachers who are included in the research profile. They made inquiries via WhatsApp® messages. They then asked their colleagues if they would like to collaborate in the research. The recruited teachers teach various subjects, such as mathematics, biology, physics, physical education, geography, among others. The data was collected between the months of January through March 2022.

The demographics of the participants are below. Names below are changed so that participants cannot be recognized or identified.

Table 5 - Profiles of participating teachers

Participants	Academic Education	Teaching Time (years)	Age (years)
Participant 1	Experimental Sciences and Practices	0-3	18 to 25
Participant 2	Informatics, Technical Base for Development of Computer Systems and Networks	8-11	26 to 30
Participant 3	Math	11+	56 to 60
Participant 4	Arts, Geography, History, Philosophy and Sociology	11+	51 to 55
Participant 5	Math and Physics	11+	41 to 45
Participant 6	Physical Education, Geography, History and Math	11+	46 to 50
Participant 7	Physics and Math	11+	36 to 40
Participant 8	Computing	8-11	41 to 45
Participant 9	Math	4-7	18 to 25
Participant 10	Math	8-11	31 to 35
Participant 11	Math	0-3	26 to 30
Participant 12	History	11+	56 to 60
Participant 13	Math	8-11	36 to 40

Participant 14	Arts, philosophy	11+	41 to 45
Participant 15	Research Methodology Applied to Projects, Socioemotional Education, Learning Laboratories, Socioemotional Skills and preneurial Behavior; Integrating Project (Computer Networks), Structured Network Project	4-7	31 to 35
Participant 16	Informatics, Logic and Computational Thinking I, II, and III; Database	4-7	31 to 35
Participant 17	Math and Scientific Research	4-7	26 to 30
Participant 18	Computing, Completion of Course Work and Scientific Research	8-11	41 to 45
Participant 19	Math	11+	46 to 50
Participant 20	Physical	0-3	31 to 35
Participant 21	Geography, History, Sociology	11+	46 to 50
Participant 22	Portuguese Language, Multipurpose Teacher - Elementary School, Education of Young People and Adults (EJA)	11+	41 to 45
Participant 23	Various disciplines in the field of graphic design and communication	4-7	31 to 35
Participant 24	Arts, Foreign Language, Portuguese Language and Philosophy	11+	51 to 55
Participant 25	Math	0-3	31 to 35
Participant 26	Computing	11+	51 to 55
Participant 27	Physical	4-7	31 to 35
Participant 28	Taxes and Tax Documents, Quality Management, Integrating Project 2, Elective, Production and Operations Management, Life Project.	4-7	31 to 35
Participant 29	Foreign language	4-7	31 to 35
Participant 30	Arts, design and advertising	4-7	46 to 50

The measurements (section 4.2.2) were administered in online sessions via Google Meet (± 1 hour). The teachers were asked to direct their answers to one of the online Google forms (Appendix A). They agreed to the informed consent form, which presented the research objectives, the researchers, their rights, guarantees that they would not be personally identified, and that participation could be stopped at any time without penalty.

This study used the IEEE standard P7010–2020 'Recommended Practice for Assessment on the Impact of Autonomous and Intelligent Systems on Human Well-being', developed by Olszewska (2020). We used a 37-item questionnaire rated on a 5-point Likert scale (1. Totally disagree, 2. Disagree, 3. Neither agree nor disagree, 4. Agreed, 5. I totally agree) (Ibid.). It explored the three domains of well-being: affect, community, and work (APPENDIX A). The choice of domains was due to the strict relationship with the objective of the study.

Participants reported their perceptions (Likert scale) about well-being for the items (see Table 6) related to: affect, community, and work.

Table 6 - Well-being domain: affects, community and work

Well-being domain	**Survey items. Using the prototype can:**	**Variable**
Affect	makes me feel happy	FELI
	makes me feel sad	TRIS
	makes me feel calm	CALM
	makes me feel stressed	ESTR

	makes me feel frustrated	FRUS
Community	makes me feel like I belong to a community	PECO
	makes me feel that I am rejected by a community	NPEC
	increases the approximate total hours a month that I was involved in voluntary activities	AHAV
	makes me feel that if I were in trouble, I would have relatives or friends I can count on to help me whenever I need them	AJUD
	makes me feel that I can trust people	CONF
	makes me feel that I need to be careful in dealing with people	CUID
Work	increases my satisfaction with work	SATR
	decreases my satisfaction with work	DSAT
	makes me feel that my work life is interesting	VIPI
	makes me feel that my work life is uninteresting	VIDE
	makes me feel that my supervisors have respect for and care about my welfare	SBE
	makes me feel that I get help and support from my co-workers	AJCO
	enhances my work productivity	PROD
	increases my satisfaction with the balance between the time spent on the job and the time spent on other aspects of life	EQTE
	decreases my satisfaction with the balance between the time spent on the job and the time spent on other aspects of life	DEQT
	increases my satisfaction with the opportunities for professional development and promotion in my current primary job	DEPR

2.2. Procedures

The data collected was divided into two moments. First, the teacher was asked to freely navigate and manipulate the interface of the high-fidelity prototype. Next, the teachers were invited to perform five (05) tasks (see Table 7), which were defined as activities performed by the teachers.

These were: Search educational resources (Resource library), Create and Co-create traditional and dynamic lesson plans (Authoring tools), Reuse resources (Teacher community), Knowledge management (Practices, notes, and Reflections), Organization (Educational resources) and Time management (Calendar). The tasks of the digital well-being and attractiveness test are:

Table 7 - Task of the third assessment cycle

#	Tasks
T1	Search, open, and save an environmental sustainability lesson plan
T2	Create a traditional plan, with an image of Trees (illustrative figure)
T3	Create a dynamic plan with an image of Trees (illustrative figure)
T4	In Repositories, find and open an environmental sustainability educational resource
T5	Create a digital sheet and share with a teacher

During the test, participants were asked to think aloud (Nielsen, 1994). Data was collected by recording the computer screen and the participants' audio. Each task was completed when the participants considered that they had completed it or reported that they were unable to perform the task. No manual was made available for the participants to perform the requested activities.

The variables for task analysis were: time spent per participant to perform a task, the ratio between tasks performed correctly by the total number of tasks suggested for completion, the ratio between tasks performed correctly

by the total time spent for completion, number of errors that occurred until the user considers the task completed, requests for help while performing the task, and total correct tasks.

In the second stage, the participants were asked to complete a demographic and well-being questionnaire. At the end, the teachers were able to make final comments on any aspects that they felt were pertinent to the test (Oliveira, 2017).

2.3. Statistical analysis

An exploratory multivariate data analysis was performed (Moita; Moita, 1998; Husson; Lê; Pagès, 2011). The data were tabulated and formatted in a spreadsheet editor, then descriptive statistical analysis of the data was performed using R software (TEAM, 2013).

We utilized the unsupervised linear principal component analysis method (PCA) to reduce the dimensionality of an input data set while ensuring that it preserved as much information as possible (NIKETBORADE, DESHMUKH, 2014). The goal of the PCA is to minimize the dimensions of the data set to obtain a set of principal components that explain the most significant percentage of the variability in the data (Abdi; Williams, 2010). Discriminant Analysis was performed, as the name implies, to discriminate and classify the participants into groups (Johnson; Wichern, 2007).

Hierarchical and non-hierarchical methods were adopted in the analysis of the groups (Rencher, 1997). The classification was obtained in order to make appropriate decisions and analyses for each group. The formation of the clusters is associated with metrics responsible for quantifying the similarity or dissimilarity between the observations. For the determination of the groups dendrograms were used (Murtagh; Contreras, 2012).

Where, the Euclidean distance with Average method was employed in the study, a measure of similarity between two clusters, where the distance between the clusters is taken as the average between two elements in each cluster.

In summary, the techniques utilized were (Moita; Moita, 1998; Gibbons; Chakraborti, 2014): Technique 0: Exploratory Analysis - Density, Correlation (to examine and study the characteristics of a dataset before it is submitted to an application); Technique 1: PCA (to analyze interrelationships between a large number of variables); Technique 2: Correspondence Analysis (to describe matrices with a large volume of discrete data and without a clearly defined a priori structure); Technique 3: Hierarchical clustering (to find patterns in a dataset); Technique 4: Non-hierarchical clustering - K-means method, Average (to group individuals where the variables are independent); Technique 5: Discriminative analysis (to see if a set of independent variables discriminates between groups); Technique 6: One-way ANOVA - Kruskal-Wallis and Wilcoxon (to perform the comparison of three or more groups in independent samples).

The representation of the data will be presented in the next section through the analysis of the tasks, by means of graphs, and in some cases, analysis of well-being in relation to teaching time and frequency of lesson planning.

3. RESULTS AND DISCUSSION

3.1. Task Analysis

The tests were conducted with 30 participants. The proposed tasks were: (i) Search, open and save an Environmental Sustainability Plan (search and organize in resource library). (ii) Create and fill a traditional plan and add an image of trees (authoring and co-creation tool). (iii) Create and fill in a dynamic plan that will already have an image of trees (authoring and co-creation tools). (iv) In repositories, find and open an Environmental Sustainability Education resource (reuse resource from teacher community). (v) Create a digital sheet, fill it out and share it with another teacher (knowledge management of practices, notes and reflections). Initially, the tests were analyzed by an activity based on effort, effectiveness, efficiency, errors, help, completion evaluation and total correct tasks.

For activity (i) Research, open and save an Environmental Sustainability Plan (see Figure 1), all 30 (100%) participants completed the activity. Among them, there were 3 (10%) requests for help and 6 (20%) deviations in the course of the task. The average time to perform the task was 01 minute and eighteen seconds. The minimum time was forty seconds and the maximum time was two minutes and fifty seconds.

The participants demonstrated their perceptions of using groupware to accomplish activity (i). It was emphasized that the exchange of classroom experiences allows us to bring innovation and enhance teaching and learning. In addition, it was commented that the exchange between teachers is valuable, even for the sense of knowing who is correctly approaching a certain content.

From activity (i), it is possible to identify that the proposed design serves the purpose of supporting teachers in carrying out the activity. The availability of educational resources and communication channels in groupware helps teachers realize that they can help or be helped by the teacher community, in addition to promoting increased job satisfaction. In this sense, it is understood that the relationship built between teachers can be presented as the construction of relationships of trust and belonging to a community.

After carrying out the task, suggestions were made and errors were identified in the prototype. It is worth highlighting the suggestion that when creating a copy of the lesson plan, it is worthwhile keeping a record of the author and who made subsequent changes visible. As an action plan, documentation of best practices in the use of groupware can be proposed, which involves transparency among users and descriptions of usage rights. The errors were related to the lack of interface feedback to users, such as feedback that the

lesson plan has been saved to their plans and that a plan has actually been downloaded.

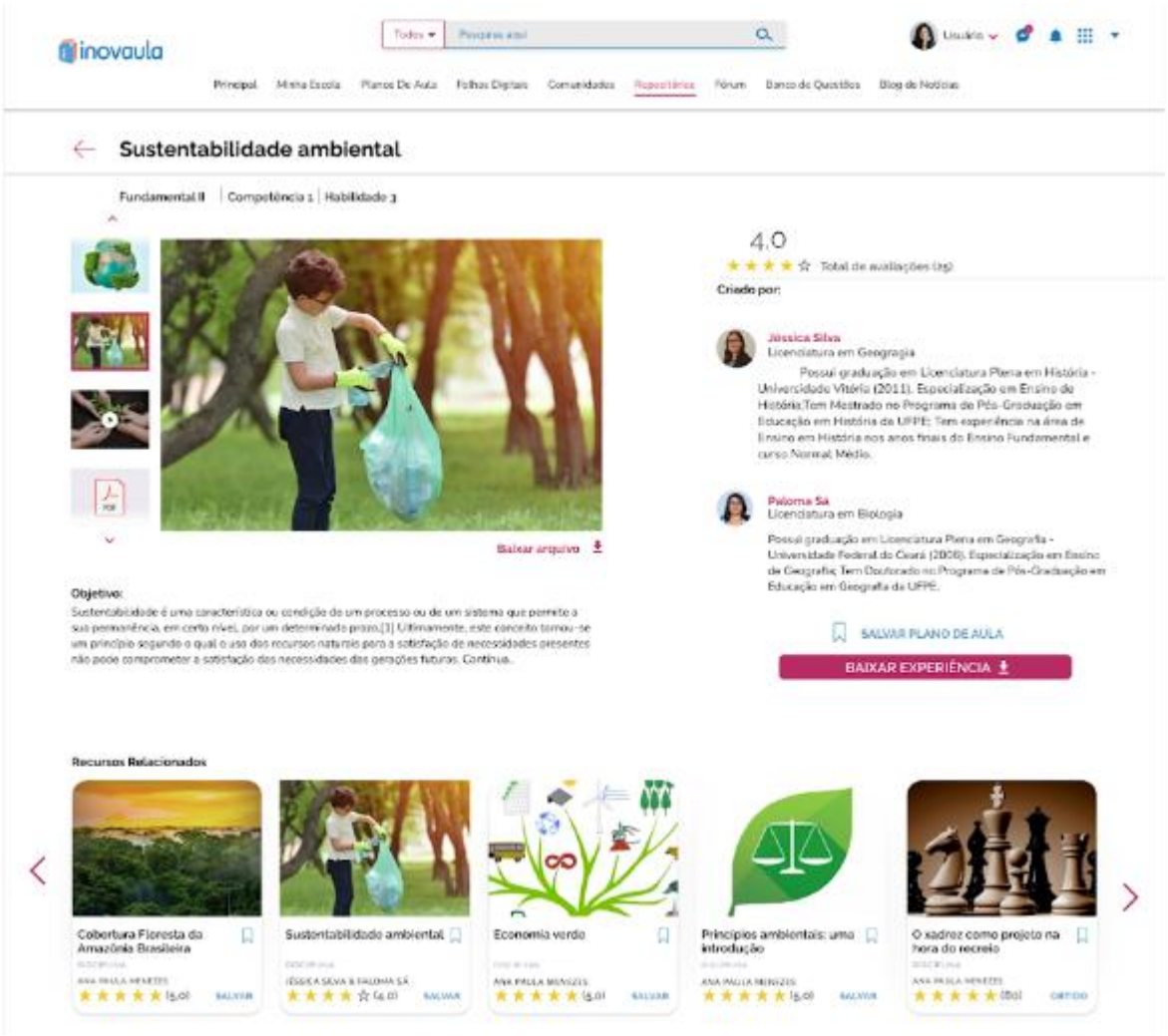

Figure 1 - Environmental Sustainability lesson plan screen (high-fidelity prototype)

For activity (ii) Create and fill a traditional plan and add an image of trees (see Figure 2), all 30 (100%) participants completed the activity. Among them, there were 8 (26.7%) requests for help and 8 (26.7%) deviations in the course of the task. The average time to perform the task was two minutes and fifteen seconds. The minimum time was forty-eight seconds and the maximum time was five minutes and forty-five seconds.

The proposed design for lesson plan creation allowed the perception that they could perform the activity in a faster way than usual - to quote one teacher, "any gain of time allows you to focus on other things, new methodologies and even innovate in the classroom". The relationship between the creation of the lesson plan and the skills and competencies of the BNCC was indicated as relevant for planning. Resources in the same lesson plan creation environment may indicate reduced effort from external Internet searches.

Despite the completion of the activities, the participants presented difficulties in performing the activity due to the flow of screens and interaction with the prototype being limited to clients and pre-built sequences.

REVISTA ELECTRÓNICA DE INVESTIGACIÓN
EN EDUCACIÓN EN CIENCIAS
ISSN 1850-6666

Número especial - 20 Años REIEC

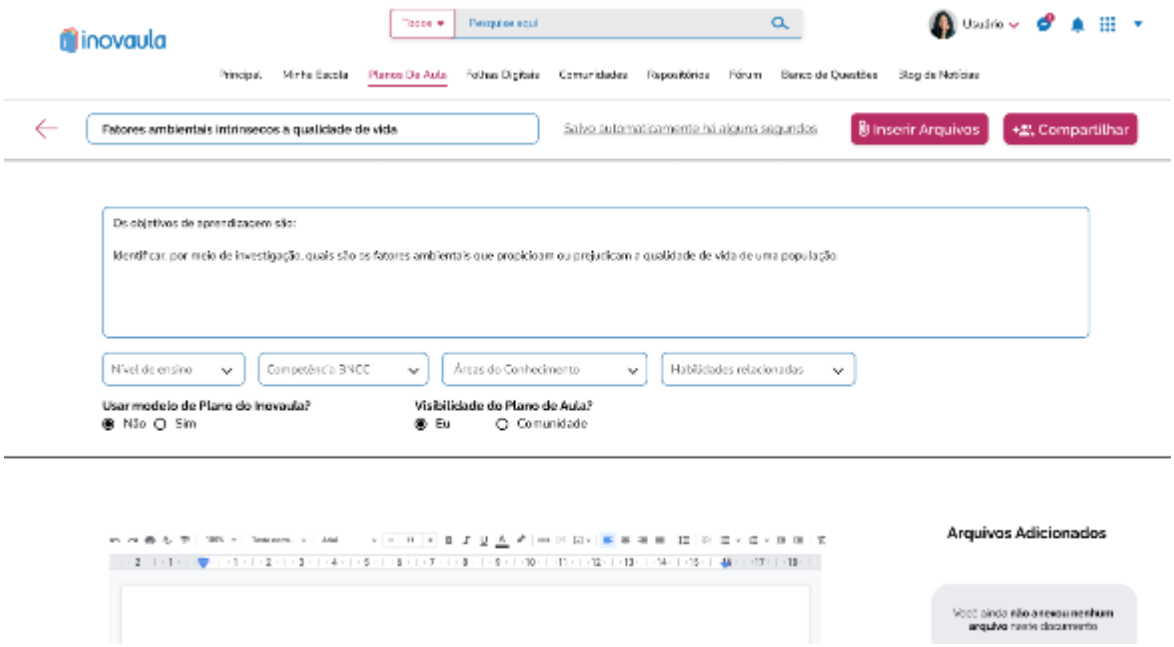

Figure 2- Traditional lesson plan creation screen (high-fidelity prototype)

For activity (iii) Create and fill in a dynamic plan (see Figure 3) that will already have an image of trees (authorship and co-creation tools), the 30 (100%) participants completed the activity. Among them, there were 14 (46.7%) requests for help and 10 (33.3%) deviations in the course of the task. The average time to perform the task was two minutes and 16 seconds. The minimum time was twenty-seven seconds and the maximum time was five minutes and forty seconds.

The dynamic lesson plan creation feature has proven to be suitable for the practice of collaborative lesson planning, which can create unstructured plans, that is, it can be created based on the teachers' own desires and needs. It can be seen that the environment was recognized as a place for exchanging experiences and co-creation of resources. In addition, the advantage that the dynamic plan could be shared with students was highlighted. In other words, it would have the function of a lesson plan and a resource. Such a practice could minimize the time spent between having to create the traditional lesson plan - which is mostly useful for the school's legal compliance purposes - and reporting to the state information system. The creation interface was received as a novelty by the teachers. Therefore, interface elements that explain certain functionalities were desirable. The results may relate to feeling helped and supported by co-workers and increased satisfaction with professional development opportunities.

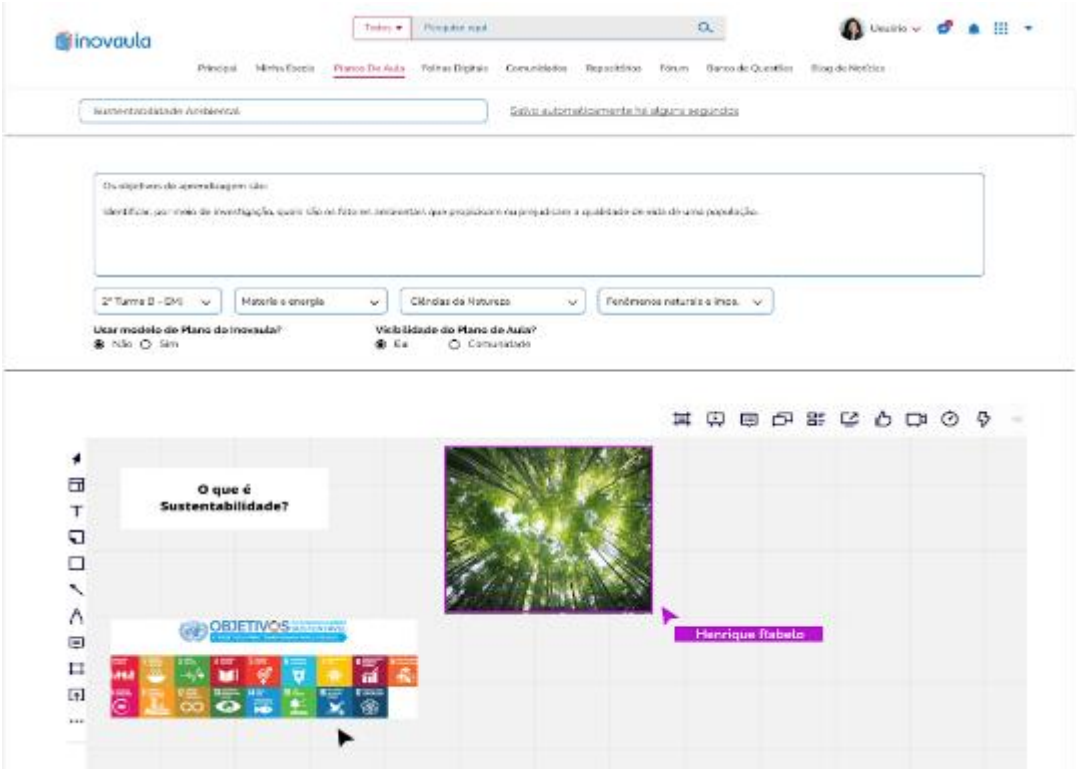

Figure 3 - Dynamic lesson plan creation screen (high-fidelity prototype)

For activity (iv) in repositories, find and open an Environmental Sustainability Education resource (see Figure 4), all 30 (100%) participants completed the activity. Among them, there was 1 (3.3%) request for help and 3 (10%) deviations in the course of the task. The average time to perform the task was thirty-five seconds. The minimum time was five seconds and the maximum time was four minutes and twenty-six seconds.

Offering resources from different digital educational repositories allows teachers to carry out their collaborative lesson planning activities in groupware. The repository feature was perceived as useful for use in contingency situations. The use of offline resources was a desired feature. This desire must be associated with creative improvisations, since it is often necessary to make adaptations to the classroom.

Collaboration through open resources, enabling the reuse of educational resources, can be a practice to connect with the lack of time for lesson preparation. The availability of resources from external sources in groupware allows teachers scenarios for lesson preparation according to their circumstances. A participant stressed the importance of being able to exchange experiences, know-how planning is carried out in other places and also being able to present how the user of the groupware performs.

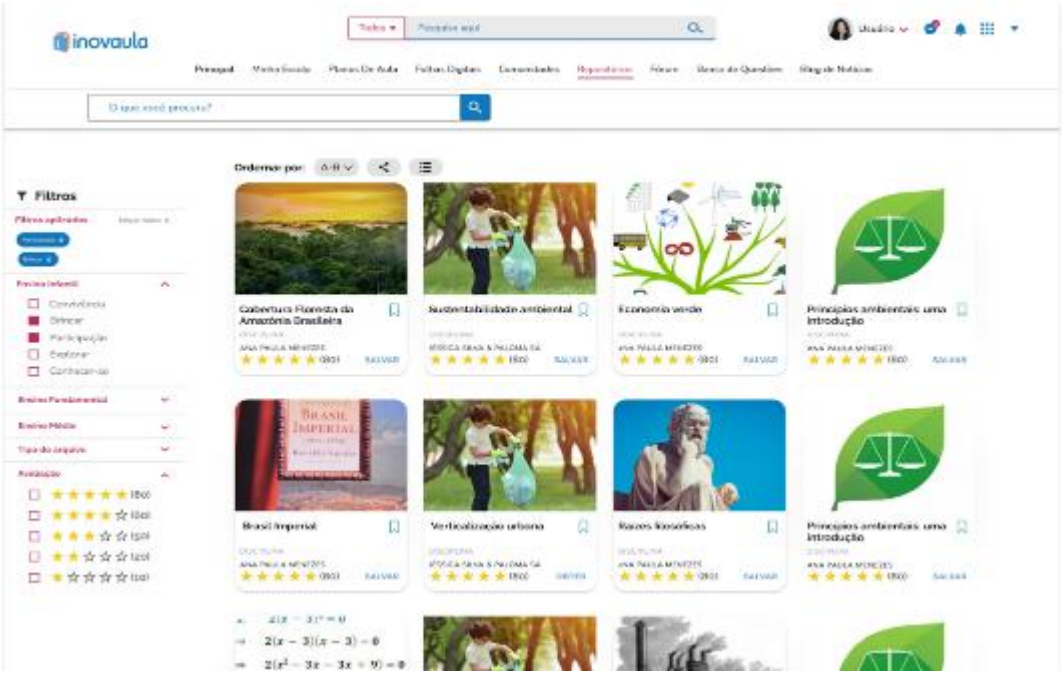

Figure 4 - Resource repositories screen (high-fidelity prototype). Source: The authors (2022)

.

Finally, for activity (v) Create a digital sheet, fill it out, and share it with another teacher (see Figure 5), all 28 (93.3%) participants completed the activity. Among them, there were 3 (10%) requests for help and 4 (13.3%) deviations in the course of the task. The average time to perform the task was 1 minute and ten seconds. The minimum time was fourteen seconds and the maximum time was three minutes and twenty-two seconds.

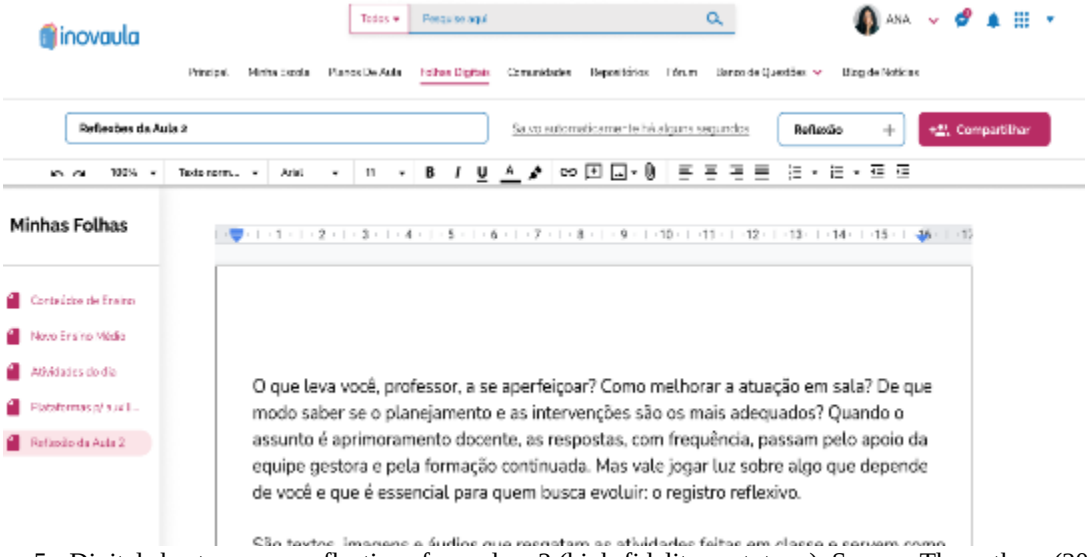

Figure 5 - Digital sheet screen - reflections from class 2 (high-fidelity prototype). Source: The authors (2022).

The manipulation of the digital sheet allowed the teachers to relate the practice of recording physical artifacts to the possibility of doing it via groupware. Teachers associated the feature with date management activities, activity control, and personal organization. This may have occurred because metaphors were adopted from artifacts used in the daily life of teachers, such as notebooks, calendars (located on the homepage), and file organizers.

3.2. Statistical Analysis

3.2.1 Levels of Well-being Aroused in the Teacher: correlations when performing a collaborative lesson planning activity in groupware

In this section, the results of the well-being questionnaire are presented from the manipulation of the class planning groupware prototype. The results present the domains of affect, community, and work. Besides the reaction in teachers, there is the correlation of the variables for each domain and the association of the collaborative lesson planning activity in groupware.

3.2.2 Awakened Well-being Levels and Their Correlations

The analysis considers the affect domain of well-being in the following: happy (FELI), calm (CALM), sadness (TRIS), stress (ESTR) and frustration (FRUS). In hypothesis H2, the analysis considers the indicators for community domain, which are the following: PECO, NPEC, AHAV, AJUD, CONF and CUID. For hypothesis H3, the analysis considers the indicators for the work domain: SATR, DSAT, VIPI, VIDE, SRBE, AJCO, PROD, EQTE, DEQT and DEPR.

Figure 6 illustrates how affects, perception of community, and work are aroused for well-being when manipulating the prototype collaborative lesson planning system. The 'X' axis shows the values of the teachers' perceptions. The 'Y' axis corresponds to the response of each participant.

It can be seen that happiness (FELI) was the most reported affect for the teachers, with a mean equal to 4.60. The second highest perception was calmness (CALM), with a mean equal to 4.20. Therefore, the affects of happiness and calmness represent the affections most aroused in teachers when performing collaborative lesson planning activities in a groupware.

It can be seen that the variable of sense of belonging to a community (PECO) was the most highly perceived by teachers, with a mean equal to 5.00. The second and third variables that showed highest response were feelings of help from friends or relatives (AJUD) and feelings of trust in people in the community (CONF), both with mean scores of 4.00. The feeling that the participant would be rejected by a community was (NPEC) ($\underline{X} = 1)\underline{X} = 1)$, with a mean of 1.00. Therefore, the feeling of belonging to a community represents the most perceived indicator for teachers when performing collaborative lesson planning in a groupware prototype.

It is noticeable that the increase in work productivity (PROD) was the teachers' highest perception, with a mean equal to 4.70. The second highest perception was that of increased job satisfaction (SATR), with a mean equal to 4.67. Therefore, perceptions of increased productivity and job satisfaction represent the work indicators most aroused in teachers when performing collaborative lesson planning activities in groupware.

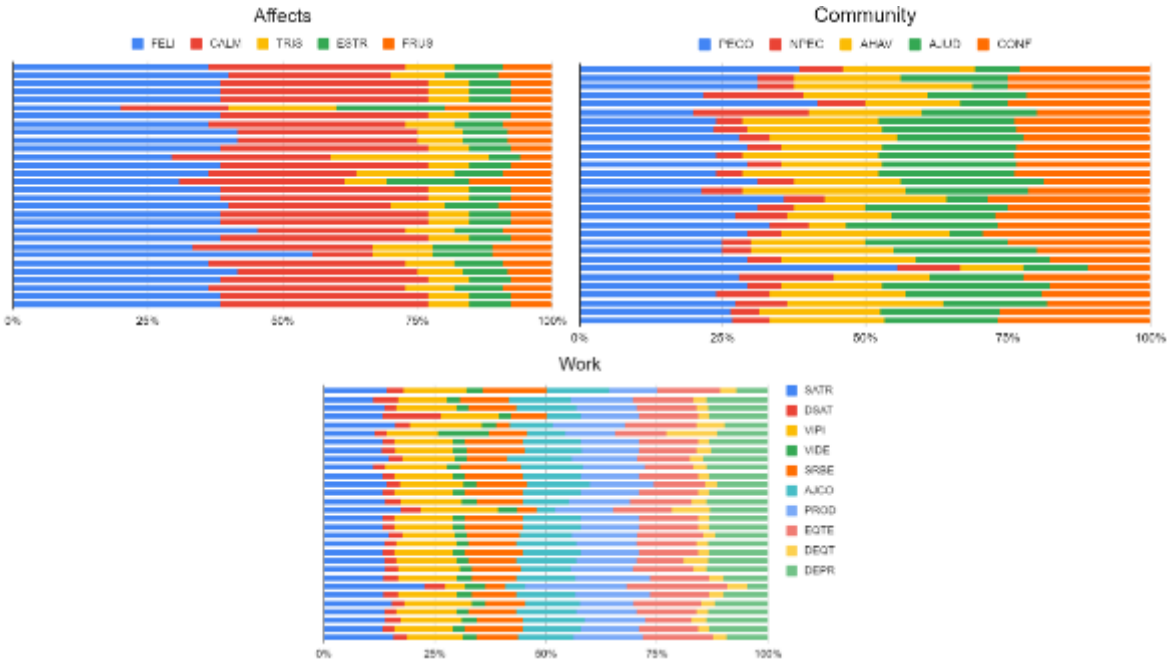

Figure 6 - Perceived Affects of Well-Being

Figure 7 presents the correlation matrix of the variables for affect, community, and work domains of well-being. We can observe positive correlations between the variables AHAV and CONF. This allows us to understand that when planning in groupware more teachers get involved in voluntary activities (AHAV), proportionally increasing the feeling of confidence (CONF). A similar correlation can be seen between AJUD and CONF, which for teachers can be established as a mutual relationship: the more that trust is established (CONF), the more help is created (AJUD). Negative correlations can be seen between CUID and AJUD, which leads us to emphasize that when teachers are more careful in dealing with people (CUID) they offer less help (AJUD). The inverse is also valid.

It can be seen how positive and negative correlations can occur. For example, there is a positive correlation between happy (FELI) and calm (CALM) affect, i.e., teachers who planned in groupware felt happy and calm. There is a positive correlation between sad affect (TRIS) and stressed affect (STR) and frustrated affect (FRUS). Inversely, teachers did not have negative feelings aroused when carrying out lesson planning activities.

There is a strong correlation between feeling that their supervisors respect and care about their well-being, (SRBE), and feeling that they get help and support from co-workers (AJCO) This allows us to understand that when planning in groupware, the more teachers perceive that their supervisors care about their well-being and respect them, the feeling of support from co-workers increases It is noticeable that there is a strong correlation between the SRBE and AJCO variables and the VIPE variable, showing a feeling of interest in professional life for teachers.

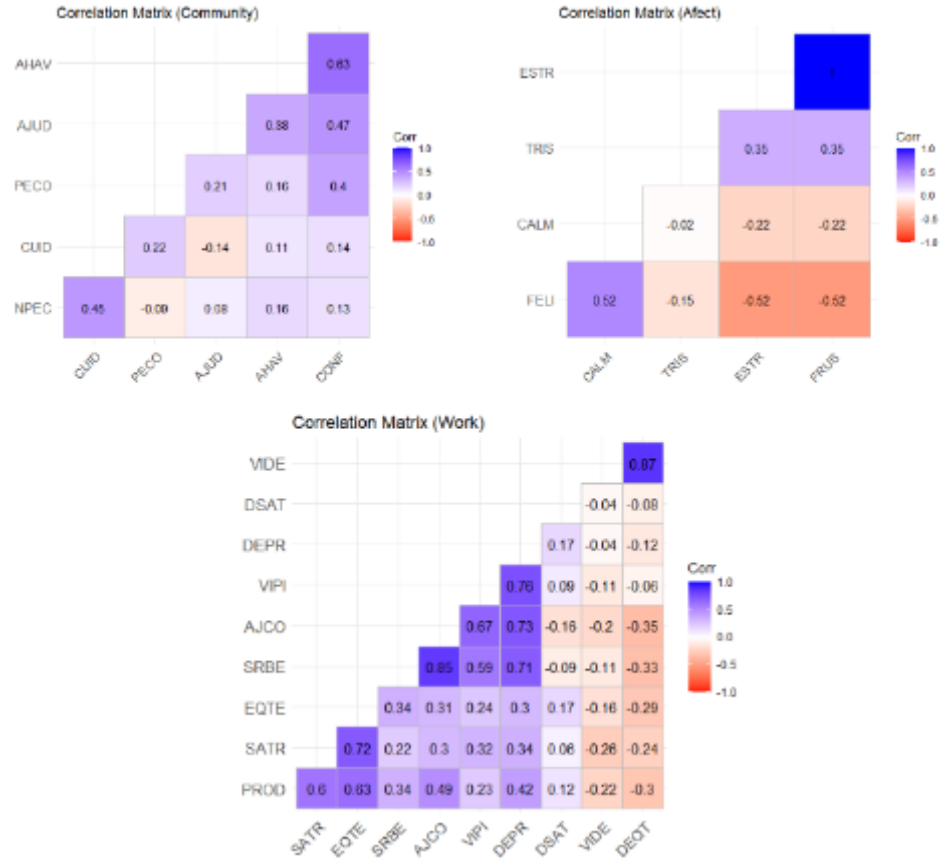

Figure 7 - Correlation matrix of Community, Affects, and Work

There is a strong correlation between feeling that work life is uninteresting (VIDE) and decreasing satisfaction with the balance between time spent at work and time spent in other dimensions of life (DEQT). This shows us that when planning in groupware, the more teachers balance between time spent at work and time spent on other aspects of life, the greater the perception that work life is uninteresting.

There is a strong correlation between feeling that professional life is interesting (VIPI) and increased satisfaction with professional development and promotion opportunities in the current main job (DEPR). This allows us to understand that when planning in groupware teachers perceive that the greater the feeling that professional life is interesting, there is a proportional increase in satisfaction with professional development opportunities and promotion in the current main job.

There is a strong correlation between the increase in job satisfaction (SATR) and the increase in satisfaction with the balance between time spent at work and time spent on other aspects of life (EQTE); which allows us to understand that when planning in groupware teachers perceive that the greater the satisfaction with work, there is a proportional increase in the satisfaction with the balance between the time spent at work and the time spent on other aspects of life.

When asked about their teaching experience, the teachers in the sample have zero to more than eleven years of experience, distributed as: between zero and three years (13.3%), four and seven years (30%), between eight and eleven years (16.7%), and more than eleven years (40%).

In figure 8, all intervals of teaching time can be seen (TEDO). The distributions of density cursors of negative affects (TRIS, FRUS and ESTR) have a value close to 1. Therefore, when performing collaborative lesson planning activities, no negative affect is perceived in any range of teaching time. The positive affections (FELI and CALM) have dispersed density between values 3 and 5 for all ranges, with the range of teachers with more than eleven years of experience standing out, where it is possible to observe that there is a higher concentration in the value close to five.

The distributions of density in the work domain (VIDE, DSAT and DEQT) have a proportion close to the value 1. Therefore, when doing the collaborative lesson planning activities, there is no perceived decrease in satisfaction, no feeling that work life is uninteresting, and no decrease in satisfaction with the balance between time spent at work and time spent on other aspects of life for any range of time spent teaching. The indicators SATR, VIPI, SRBE, AJCO, PROD, EQTE and DEPR have dispersed density between values 3 and 5 for all ranges, highlighting the range of teachers with more than eleven years of experience, where it is possible to observe that there is a higher concentration in the value close to five.

In the distributions of the density cursors of the NPEC indicator, the work domain has a proportion close to the value 1. Therefore, when carrying out collaborative lesson planning activities, it is not rejected by a community. The indicators CONF, AJUD and AHAV have dispersed density between values 3 and 5 for all ranges.

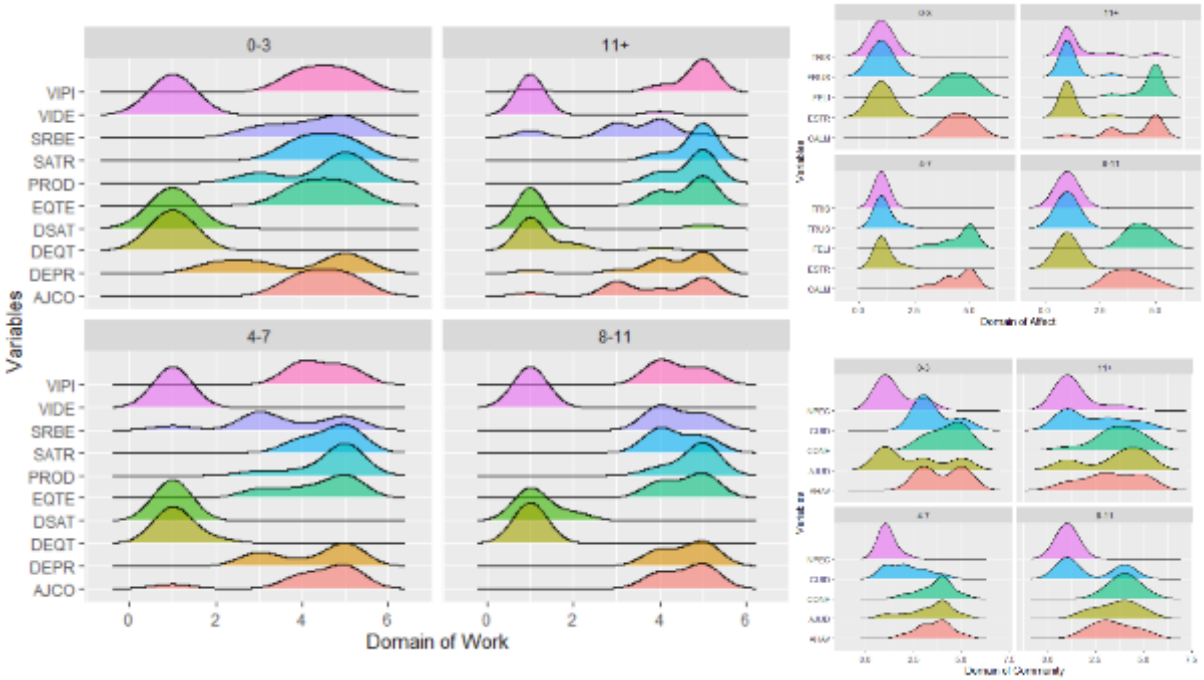

Figure 8 - Density curves between affects and teaching time

In figure 9, it can be seen that density distributions were noticed among teachers who plan daily (10%) and weekly (66.7%) and bimonthly (16.7%). The teachers who plan semiannually and annually correspond to three point three percent (3.3%) each.

The distributions of densities of affections (TRIS, FRUS and ESTR), of community (NPEC and CUID) daily and bimonthly, and of work VIDE, EQTE and DSAT have a proportion close to the value 1 (Figure 9).

In the affect domain, no negative affect is perceived in teachers who perform the planning activities daily, weekly, and bimonthly. For the group that plans lessons daily, normal curves can be observed, except for the feeling of calm (CALM), where the curve is dispersed. The positive affections (FELI and CALM) have densities between the values of 3 and 5 for all ranges, highlighting that there is no distribution for teachers who plan semiannually and annually, which may indicate that among the observed sample, teachers

neither agree nor disagree, agree and totally agree that performing the collaborative lesson planning activities in groupware could have positive feelings.

In the community domain, the indicators CONF, AJUD, and AHAV have densities between values 3 and 5 for the whole group that conducts weekly lesson planning, which may indicate that groupware can promote the perception of trust, helpfulness, and volunteer work. The teachers did not completely agree that using groupware made them feel rejected by a community.

In the community domain, the other indicators have densities between values 3 and 5 for all ranges, except for teachers who plan semi-annually and annually.

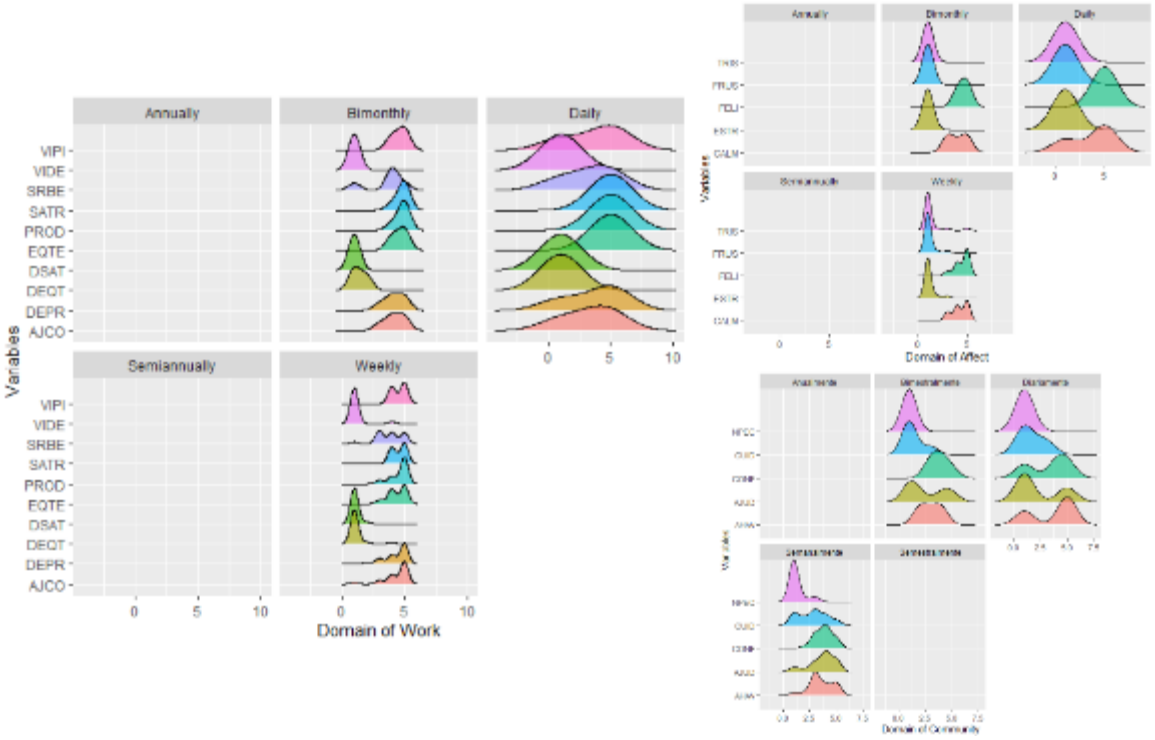

Figure 9 - Smoothed density curves between affect and planning frequency

3.2.3. Principal Component Analysis

Based on the results of the principal component analysis technique, the first two principal components (PCs) explained 77.14% of the dispersion of the original data, regarding the positive and negative affects perceived by teachers when performing collaborative lesson planning activity in a groupware. Among them, PC1 is responsible for 54.16% and PC2 is responsible for 22.98% of the original data dispersion (see Figure 10).

The research participants are dispersed across the components (PC1 and PC2). PC1 can be described as being sensitive to negative feelings (TRIS, ESTR and FRUS) and to positive feelings (FELI, CALM). PC2, on the other hand, can be described as being sensitive to negative feelings.

In the same way, the components were related to the community. We can see that the technique (PCA) returned an explanation for 61.4% of the data dispersion. In PC1 it represents 37.32% and PC2 represents 23.72% (see Figure 10). Scattered across the components, all community-related variables are arranged in the negative quadrants for PC1; the same can be observed for the variables (NPEC and CUID) for PC2. The variables (AJUD, CONF, AHAV and PECO), on the other hand, are arranged in the positive quadrant for PC2.

For the labor-related components, the (PCA) technique returned results for 60.25% (PC1 = 41.73% and PC2 = 18.52%) (see Figure 12). Scattered across the components, the variables (VIPI, DEPR, SRBE and AJCO) contribute positively to both PC1 and PC2. The variables (DEQT and VIDE) contribute positively to PC2 but contribute negatively to PC1. Similar but opposite behavior can be seen for the variables (DSAT, PROD, EQTE, and SATR) that contribute positively to PC1, but negatively to PC2.

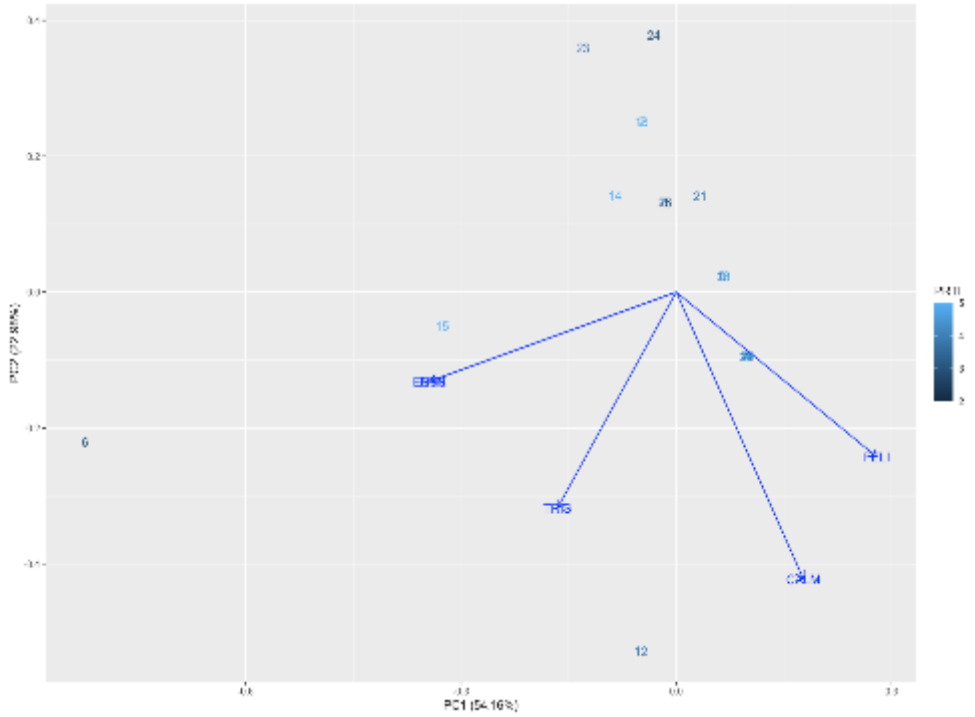

Figure 10 - Affects - scores and factor loadings of the affects for components PC1 and PC2

Figure 11 - Community - scores and factor loadings for components PC1 and PC2

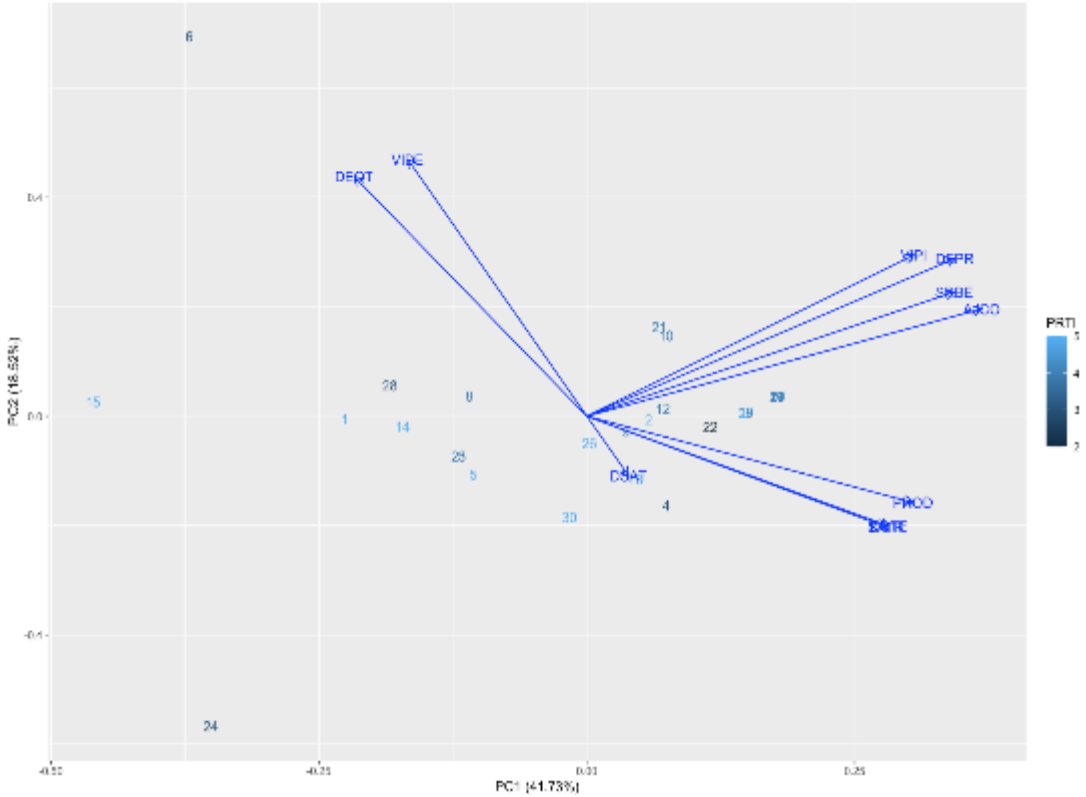

Figure 12 - Work - scores and factor loadings for components PC1 and PC2

It can be understood that the affects of happiness and calm are the ones with positive modules among the perceptions of all affects. However, the higher the value of the modulus, the greater the influence on the component. We can see that component (PC1) is most influenced by the variables TRIS, ESTR and FRUS. Therefore, when teachers perform a collaborative lesson planning activity in groupware, negative affects have the most influence when it comes to well-being in collaborative lesson planning.

The results of the community-related PCs allow us to interpret that, for example, the greater the feeling of rejection by the community (NPEC) and of feeling that you need to be careful when dealing with people (CUID), the lower the value of this component when related to the other variables.

Regarding work-related PCs, they allow us to compare the influence of the variables perceived as satisfaction with work (SATR), decreased satisfaction with work (DSAT), increased productivity at work (PROD), and increased satisfaction with the balance between time spent at work and time spent on other aspects of life (EQTE) with the other variables. The lower the PC1 values, the higher the perceptions of the other variables, and vice-versa.

3.2.4 Correspondence Analysis

Based on the results of the correspondence analysis (CA) technique, the two dimensions (Dim) of CPs explain 52.23% of the original variability in the data, concerning the positive and negatives affect aroused in teachers when performing collaborative lesson planning activities in a groupware. Here, Dim 1 accounted for 31.74% and Dim 2 accounted for 20.49% of the variations in the data. For the community domain, the first five dimensions of PCs explain 52.898% and for the work domain, the first three dimensions of PCs explain 50.602% of the original variability of the data

All events are located in the first quadrant, as all values are positive values (See Figure 14). The negative affects of stress and frustration have high proximity, considered mutually equivalent, with values of 0.933 in Dim 1 and 0.751 in Dim 2, respectively. The positive affects that arouse calm and happiness are located independently. Sadness shows itself in Dim 1 and closes to zero in Dim 2, i.e., teachers consider that lesson planning supported by groupware does not arouse the feeling of sadness. The three negative affects display a result close to 1 in the first dimension. There is also the feeling of

help (AJUD) from the community domain, with values of 0.716 in Dim and Dim 2. The perception that makes one feel that professional life is interesting (VIPI) and makes one feel that professional life is uninteresting (VIDE) display high proximity, considered mutually equivalent, with values of 0.603 in Dim 1 and 0.09 in Dim 2, respectively. The increase in productivity at work (PROD) is similar to the decrease in satisfaction with the balance between time spent at work and time spent in other aspects of life (DEQT). Decreased job satisfaction (DSAT) has values close to zero in the first two dimensions.

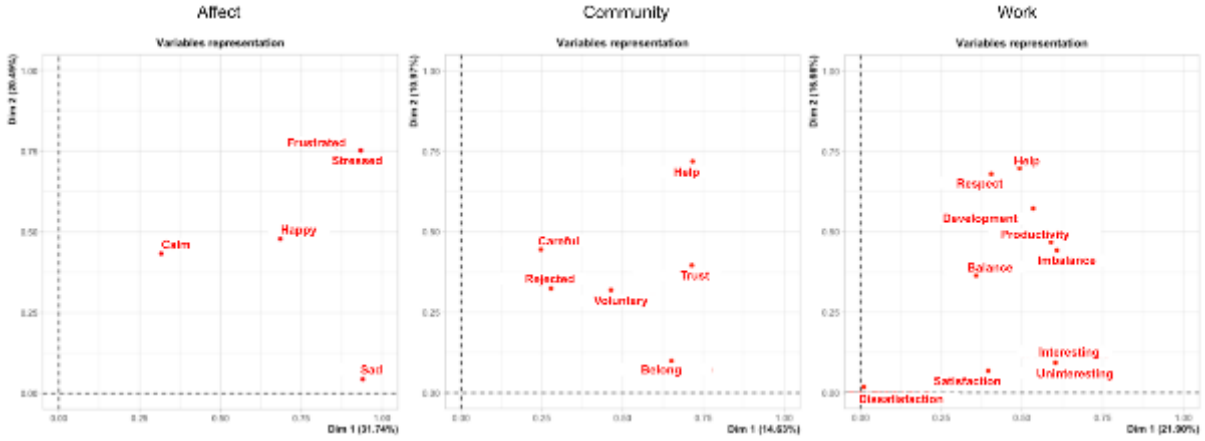

Figure 13 - Contributions of the variables to the formation of the dimensions

3.2.5 Hierarchical and Non-hierarchical Grouping

A hierarchical clustering was created using Euclidean distance and the Average clustering method for the variables related to similarity of affect, community, and work. For affects, there is the formation of 6 clusters (cluster 1 = 1, cluster 2 = 1, cluster 3 = 1, cluster 4 = 1, cluster 5 = 18 e cluster 6 = 8). For communities, there is the formation of 5 clusters (cluster 1 = 1, cluster 2 = 2, cluster 3 = 4, cluster 4 = 18 and cluster 5 = 5). Finally, for work the formation of 7 clusters is indicated (cluster 1 = 1, cluster 2 = 1, cluster 3 = 1, cluster 4 = 1, cluster 5 = 1, cluster 6 = 19 and, cluster 7 = 6). The results presented in the dendrogram regarding similarity allow us to observe the individuals in their receptive clusters according to the observed variables (see Figure 15).

In the affect domain, the individuals in cluster 5, which has the largest number of individuals (=18), show similarities regarding positive feelings and negative feelings. There are similarities between feeling happy and calm and between not feeling sad, stressed and frustrated. This must have occurred because, in feeling happy and calm, doing activities in groupware can help them in their collaborative lesson planning activities. That is, it would meet their needs and not promote negative feelings. Cluster 6 is formed by participants who show similarity between agreeing to feel happy and agreeing, and neither agreeing nor disagreeing, about feeling calm.

In the community domain, individuals in cluster 4, which has a greater number of individuals (=18), present similarities in relation to the perception of feeling that they belong to a community (PECO), disagreeing that they felt rejected by a community (NPEC) and feeling that if were in trouble, they would have friends or relatives they could count on to help whenever they needed them (AJUD). The 5 individuals in cluster 5, as well as in cluster 4, show similarities of the same variables, but with all responses completely agreeing for PECO and AJUD and completely disagreeing for NPEC. The 4 individuals in cluster 3 show similarities only in the perception of feeling that they belong to a community (PECO).

In the work domain, individuals in cluster 6, which has the highest number of individuals (=19), show similarities in terms of the perception of increased job satisfaction (SATR), feeling that professional life is interesting (VIPI), getting help and support from co-workers (AJCO), increased productivity at work (PROD) and increased satisfaction with balancing time spent at work and time spent in other aspects of life (EQTE); The 6 individuals in cluster 7 show similarities for the variables SATR and VIPI in agreeing (Likert = 4). There is a relationship between completely disagreeing that it decreases job satisfaction (DSAT), that it makes one feel that professional life is uninteresting (VIDE) and that satisfaction decreases with the balance between time spent at work and time spent on other aspects of life (DEQT). This must have occurred because, when carrying out collaborative lesson planning activities in a groupware, they realized that there could be an increase in job satisfaction, an interesting professional life, help from colleagues and an increase in

productivity. That is, the denial of these perceptions would not be perceived.

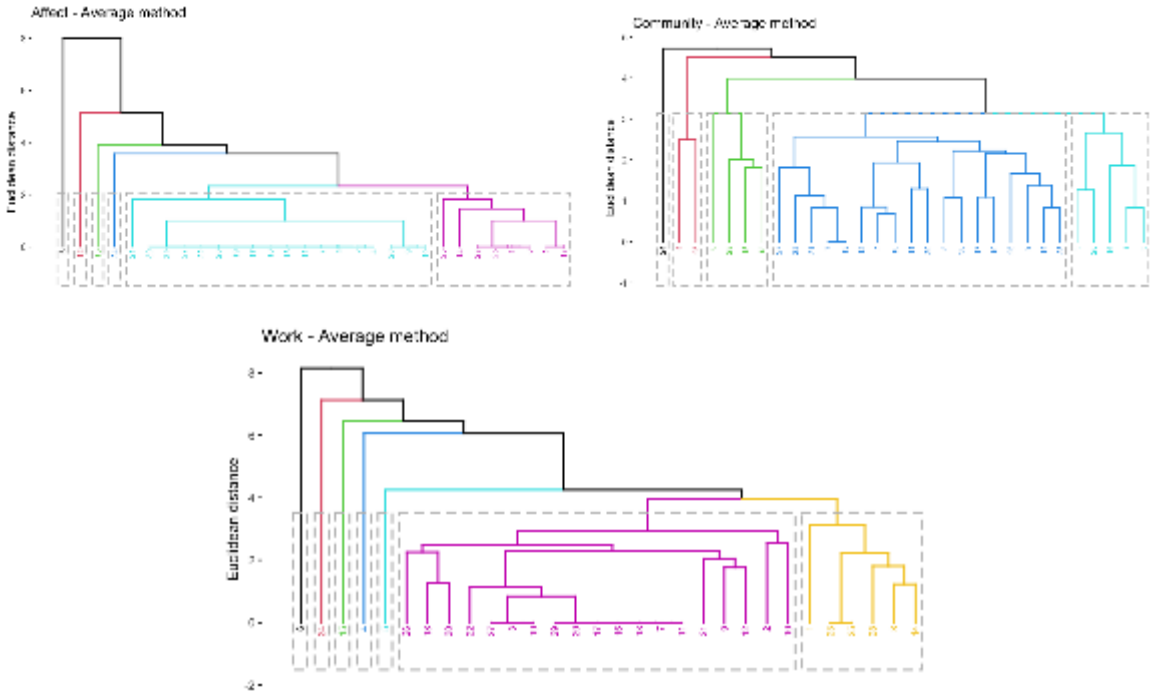

Figure 14 - Dendrogram of the affects of participants by the Average method

In Figures 15, 16 and 17, the principal components technique was used (k-means). The method uses the first two dimensions to generate a two-dimensional graph. As the resulting dimensions are linear combinations of the variables of affect, community and work, the clusters formed in each graph make it possible to identify groups of individuals with intersecting similarities. The method's algorithm allows the visualization of 6 clusters for affect, 5 clusters for the community domain, and 7 clusters for the work domain.

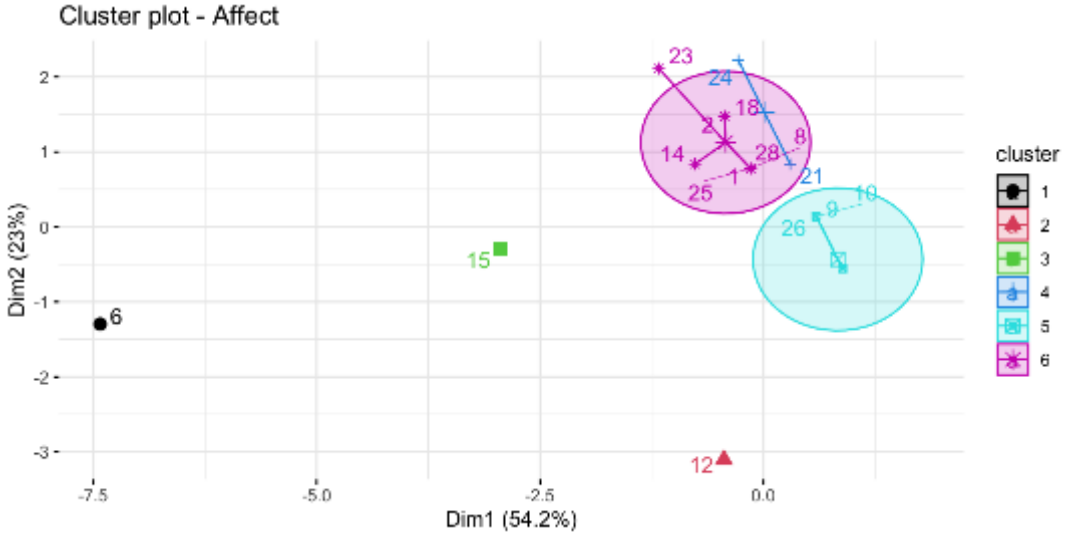

Figure 15 - Clusters generated by the variables of affect

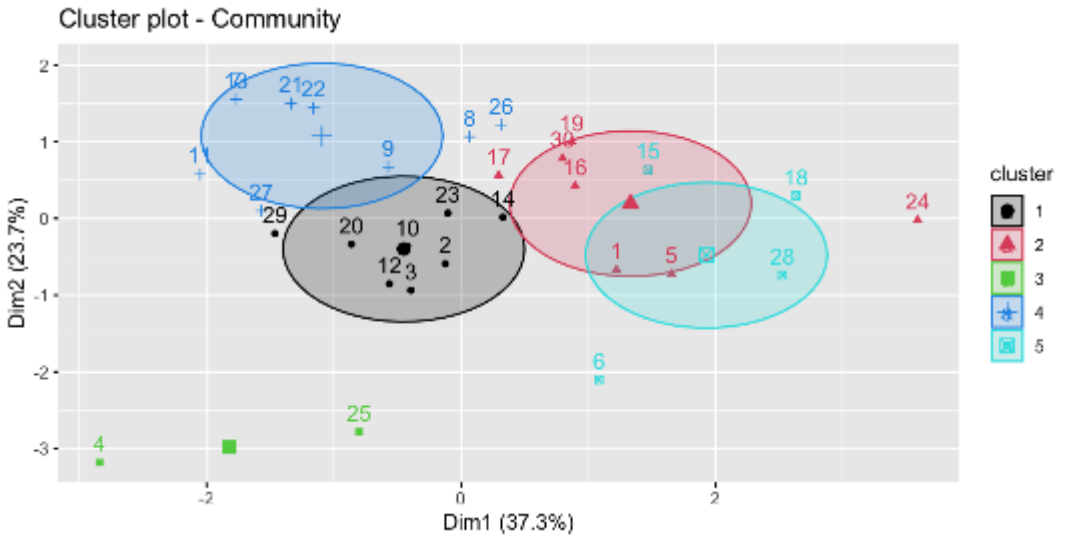

Figure 16 - Clusters generated by the variables of community

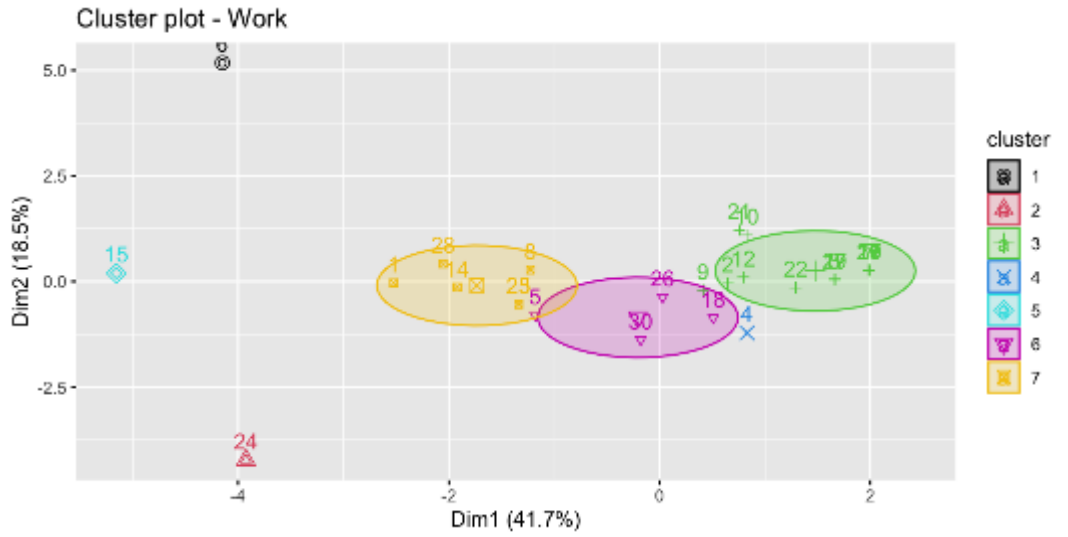

Figure 17 - Clusters generated by the variables of work

In affects, the individuals in clusters 5 and 6 differ from those in clusters 1, 2, 3 and 4. This may have occurred because the variability of perceptions of affect occurred as follows: P6 felt indifferent to all affects, P12 felt happy, calm and sad proportionally, and P15 disagrees that he felt stressed and frustrated. In the domain Individuals in clusters 3, 6 and 7, there is a contrast with other clusters.

3,2.4 Discriminant Analysis and ANOVA

In figure 31, the discriminant function analysis was used to observe discrimination assigned to the groups for affects, community, and work. The plotted points are the elements rewritten as a function of their linear combinations. A rate of 96.6%, 100% and 96% was obtained for the accuracy of data discrimination, respectively. When we analyze the positioning of the groups, it is confirmed that the proposed group formation has high accuracy rates.

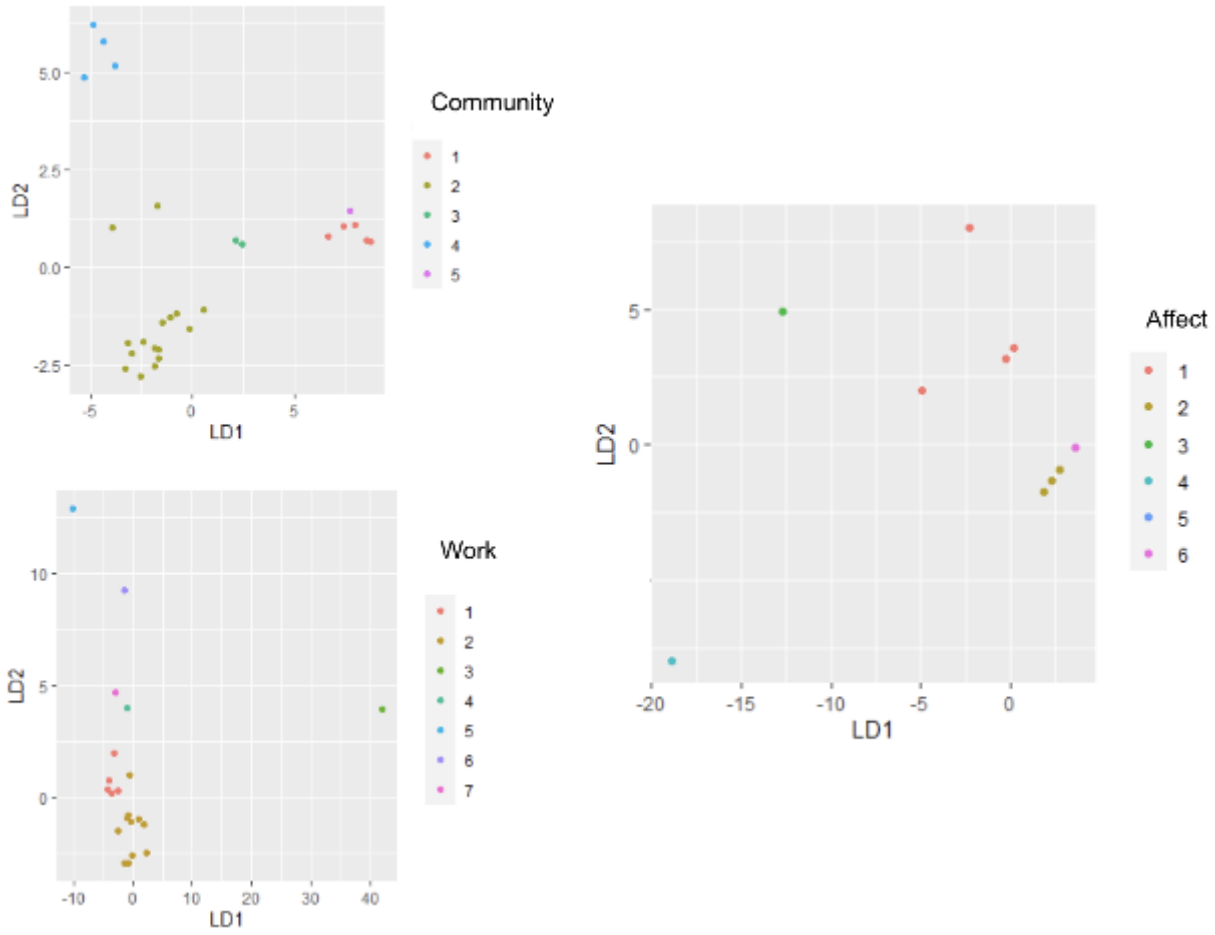

Figure 18 - Discriminant analysis of affect, community, and work

When analyzing the group formations, we observed that the groups were well-defined in all three domains. In community, group 1 and group 5 show closeness to each other. In affect, there is a proximity between groups 2 and 6. Finally, there is the proximity between groups 1 and 2.

A Wilcoxon post-test was carried out to test whether the medians of the samples are equal in cases where the normality assumption is not satisfied or when it is not possible to check this assumption. Different letters indicate that the groups differ from each other at a level of 5% by the Wilcoxon post-test, given that the Kruskal-Wallis test was significant. The Kruskal-Wallis test was significant (see Tables 8, 9 and 10).

Table 8 - Wilcoxon post-test - Affects

Cluster	FELI	TRIS	CALM	ESTR	FRUS
1	3,88^{a}	1,12^{ab}	3,50^{a}	1,00^{a}	1,00^{a}
2	5,00^{b}	1,00^{a}	4,72^{b}	1,00^{a}	1,00^{a}
3	3,00^{a}	3,00^{b}	3,00^{ab}	3,00^{b}	3,00^{b}
4	5,00^{ab}	5,00^{b}	5,00^{ab}	1,00^{ab}	1,00^{ab}
5	4,00^{a}	1,00^{ab}	4,00^{ab}	2,00^{b}	2,00^{b}
6	5,00^{ab}	1,00^{ab}	1,00^{ab}	1,00^{ab}	1,00^{ab}

Table 9 - Wilcoxon post-test - Community

Cluster	PECO	NPEC	AHAV	AJUD	CONF	CUID
1	3,00[a]	1,50[ab]	3,00	2,50[a]	2,75	2,00
2	4,89[a]	1,11[a]	4,44	4,78[b]	4,33	1,44
3	5,00[ab]	1,00[b]	3,75	3,12[abc]	4,00	3,75
4	5,00[b]	3,50[ab]	4,00	3,50[c]	4,50	5,00
5	4,86[ab]	1,00[ab]	2,14	2,14[abc]	3,29	1,71

Table 10 - Wilcoxon post-test - Work

Cluster	SATR	DSAT	VIPI	VIDE	SRBE	AJCO	PROD	EQTE	DEQT	DEPR
1	5,00	1,00[a]	1,00[a]	1,00[a]	1,00[a]	1,00[a]	5,00[a]	5,00	1,00[a]	1,00[a]
2	4,88	1,06[a]	4,88[b]	1,00[a]	4,44[b]	4,94[b]	5,00[b]	4,75	1,06[a]	4,94[b]
3	4,00	1,00[b]	4,00[ab]	1,00[ab]	3,33[ab]	3,83[a]	4,17[ab]	3,83	1,00[ab]	3,33[ab]
4	4,00	1,00[ab]	4,00[ab]	4,00[ab]	3,00[ab]	3,00[a]	4,00[ab]	4,00	4,00[b]	4,00[a]
5	5,00	5,00[ab]	5,00[ab]	1,00[b]	3,00[ab]	3,00[a]	5,00[a]	5,00	1,00[b]	5,00[a]
6	4,00	1,00[ab]	4,00[ab]	1,00[ab]	1,00[ab]	1,00[a]	3,00[a]	3,00	2,00[b]	3,00[a]
7	5,00	1,00[ab]	4,50[ab]	1,00[ab]	2,75[ab]	3,75[a]	4,75[ab]	5,00	1,25[ab]	3,50[a]

4. CONCLUSIONS

To conclude, this study shows that conducting collaborative lesson planning activities on a lesson planning groupware prototype designed from participatory design with basic education (K-12) teachers is a perceived approach, as it enables the design of meaningful artificial artifacts for teachers. The teachers felt happy and calm when performing activities. However, negative affects have a greater influence when it comes to well-being in collaborative lesson planning. In other words, negative feelings are relevant facts for using a groupware.

We believe that these results are related to the work of teachers, as they work under visible stressful conditions (Bakkenes Et Al., 1999; Vangrieken Et Al., 2015), and isolation in lesson planning activities (Patton; Parker, 2017; Rossitto, 2018). When doing collaborative lesson planning activities on groupware they realized that they felt they belonged to a community and could be helped by it, and that they did not feel rejected by the community of teachers.

This study has some limitations, related to the number of participants. The sample for future work could be larger. A future study can be conducted in a real work context. The study, in real working conditions and followed for a longer period, can help us to better understand how each feature (design recommendation) of a groupware can contribute to the well-being of teachers. Therefore, it is suggested that further studies examine the affects of perceptions of improvement in collaborative lesson planning practice for groupware.

5. REFERENCIAS

Alarcão, I. (Ed.). (2005). *Formação reflexiva de professores: estratégias de supervisão*. Porto Editora.

Almeida, A. R. S. (2022). *A emoção na sala de aula*. Editora Papirus.

Anderson, R. J. (1994). Representations and requirements: The value of ethnography in system design. *Human-Computer Interaction*, 9(2), 151–182.

Appolinário, F. (2006). *Metodologia da ciência: filosofia e prática da pesquisa*. Thomson.

Asensio-Pérez, J., Dimitriadis, Y., Pozzi, F., Hernández-Leo, D., Prieto, L., Persico, D., & Villagrá-Sobrino, S. (2017). Towards teaching as design: Exploring the interplay between full-lifecycle learning design tooling and teacher professional development. *Computers & Education*, 114, 92–116.

Batsila, M., Vavougios, D., Tsihouridis, C., & Ioannidis, G. (2014). Teachers' attitudes towards the use of Web 2.0 tools in educational practice—A critical approach. In *2014 International Conference on Interactive Collaborative Learning (ICL)* (pp. 464–472). IEEE.

Badawi, M. F. A. (2017). Using collaborative lesson-preparation for developing EFL prospective teachers' lesson plan quality and pedagogical performance. *Journal of Arabic Studies in Education & Psychology (ASEP)*, 87(2), 451–480.

Bahng, E., & Lee, M. (2017). Learning experiences and practices of elementary teacher candidates on the use of emerging technology: A grounded theory approach. *International Electronic Journal of Elementary Education*, 10(2), 225–241.

Bakkenes, I., De Brabander, C., & Imants, J. (1999). Teacher isolation and communication network analysis in primary schools. *Educational Administration Quarterly*, 35(2), 166–202.

Balakrishnan, R., Dahnil, D. P. B., & Ben Mubarak, M. A. A. (2016). Mobile learning, effective integration of new technologies into existing models. In *Envisioning the Future of Online Learning* (pp. 317–331). Springer.

Baleghizadeh, S., & Shahri, M. N. N. (2017). The effect of online planning, strategic planning and rehearsal across two proficiency levels. *The Language Learning Journal*, 45(2), 171–184.

Bardin, L. (1977). *Análise de conteúdo*. Lisboa: Edições.

Batista, S., Brito, D., Melo, E., Oliveira, A., Oliveira, N., & Maia, D. (2017). Reconstrução de um repositório de objetos de aprendizagem para Matemática. In *II Congresso sobre Tecnologias na Educação (Ctrl+E 2017)*.

Bland, D. (2012). Agile coaching tip–What is an empathy map. http://www.bigvisible.com/2012/06/what-is-an-empathy-map

Blaschke, L. M., & Hase, S. (2016). Heutagogy: A holistic framework for creating twenty-first-century self-determined learners. In *The future of ubiquitous learning* (pp. 25–40). Springer.

Body, G., Munoz, G., & Bourmaud, G. (2014). Une analyse de l'activité de planification des enseignants vers la conception d'instruments. In *3ème colloque international de Didactique professionnelle «Conception et Formation»*.

Brasil, C. G. da I. no. (2018). *Pesquisa sobre o uso das tecnologias de informação e comunicação nas escolas Brasileiras – TIC educação*. http://cetic.br/media/docs/publicacoes/2/tic-educacao-2013.pdf

Brasil. Inep, Ministério da Educação. (2018). *Sistema de Avaliação da Educação Básica (Saeb)*.

Brasil, C. G. da I. no. (2022). *Pesquisa sobre o uso das tecnologias de informação e comunicação nas escolas Brasileiras – TIC educação*. https://www.cetic.br/media/analises/tic_educacao_2021_coletiva_imprensa.pdf

Caeiro-Rodríguez, M., Llamas-Nistal, M., Blanco-Pesqueira, A., & Álvarez-Lires, F. (2016). A survey about the use of lesson plans as an approach to OER: A proposal based on action research. In *2016 International Symposium on Computers in Education (SIIE)* (pp. 1–6). IEEE.

Caldwell, H. (2018). Mobile technologies as a catalyst for pedagogic innovation within teacher education. *International Journal of Mobile and Blended Learning (IJMBL)*, 10(2), 50–65.

Candotti, C., & Hoppen, N. (1999). Reunião virtual e o uso de groupware-uma nova possibilidade de realizar trabalho em grupo. *Anais do Encontro Nacional da Associação Nacional de Pós-Graduação e Pesquisa em Administração*.

Cardoso, M. J. C., Almeida, G. D. S., & Silveira, T. C. (2021). Formação continuada de professores para uso de Tecnologias da Informação e Comunicação (TIC) no Brasil. *Revista Brasileira de Informática na Educação*, 29, 97–116.

Castro, P., Tucunduva, C., & Arns, E. (2008). A importância do planejamento das aulas para organização do trabalho do professor em sua prática docente. *ATHENA Revista Científica de Educação*, 10(10), 49–62.

Chalkiadaki, A. (2018). A systematic literature review of 21st century skills and competencies in primary education. *International Journal of Instruction*, 11(3), 1–16.

Charalambous, C. Y., et al. (2021). Working more collaboratively to better understand teaching and its quality: Challenges faced and possible solutions. *Studies in Educational Evaluation*, 71, 101092.

Charteris, J., Wright, N., Trask, S., Khoo, E., Page, A., Anderson, J., & Cowie, B. (2021). Patchworks of professional practices: Teacher collaboration in innovative learning environments. *Teachers and Teaching*, 27(7), 625–641.

Clark, C. M., & Yinger, R. J. (1977). Research on teacher thinking. *Curriculum Inquiry*, 7(4), 279–304.

Diener, E., Suh, E., Lucas, R., & Smith, H. (1999). Subjective well-being: Three decades of progress. *Psychological Bulletin*, 125(2), 276.

Do Carmo Machado, J., & Neves, R. (2015). As contribuições da memória na formação continuada de professores. *Revista Eletrônica Debates em Educação Científica e Tecnológica*, 5(03), 49–66.

Carstensen, P., & Schmidt, K. (1999). Computer supported cooperative work: New challenges to systems design. In K. Itoh (Ed.), *Handbook of Human Factors*.

Chacon, J., & Hernández-Leo, D. (2014). Learning design family tree to back reuse and cooperation. In *Proceedings of the 9th International Conference on Networked Learning*.

Clark, C., & Yinger, R. (1979). Three Studies of Teacher Planning. *Research Series*, No. 55.

Craft, A. (2003). The limits to creativity in education: Dilemmas for the educator. *British Journal of Educational Studies*, 51(2), 113–127.

Cravens, X., & Hunter, S. (2021). Assessing the impact of collaborative inquiry on teacher performance and effectiveness. *School Effectiveness and School Improvement*, 32(4), 564–606.

Da Silva, J. B., Bilessimo, S. M. S., & Da Silva, I. N. (2020). Collaborative virtual community to share class plans for STEAM education. In *2020 IEEE Global Engineering Education Conference (EDUCON)* (pp. 158–163). IEEE.

Dalziel, J., Conole, G., Wills, S., Walker, S., Bennett, S., Dobozy, E., Cameron, L., Badilescu-Buga, E., & Bower, M. (2016). The Larnaca Declaration on Learning Design. *Journal of Interactive Media in Education*, 7. http://doi.org/10.5334/jime.407

Darling-Hammond, L. (2010). Evaluating teacher effectiveness: How teacher performance assessments can measure and improve teaching. *Center for American Progress*.

De Oliveira, C. (2015). TIC'S na educação: a utilização das tecnologias da informação e comunicação na aprendizagem do aluno. *Pedagogia em ação*, 7(1).

Diehl, L., Marin, A. H. (2016). Adoecimento mental em professores brasileiros: revisão sistemática da literatura. *Estudos interdisciplinares em Psicologia*, 7(2), 64–85.

Dishon, G., & Gilead, T. (2021). Adaptability and its discontents: 21st-century skills and the preparation for an unpredictable future. *British Journal of Educational Studies*, 69(4), 393–413.

Dourish, P. (2006). Implications for design. In *Proceedings of the SIGCHI conference on Human Factors in computing systems* (pp. 541–550).

Duffy, G., & Gallagher, T. (2017). Shared Education in contested spaces: How collaborative networks improve communities and schools. *Journal of Educational Change*, 18(1), 107–134.

Ellis, V., Souto-Manning, M., & Turvey, K. (2019). Innovation in teacher education: towards a critical re-examination. *Journal of Education for Teaching*, 45(1), 2–14.

Eradze, M., Rodríguez-Triana, M. J., & Laanpere, M. (2019). A conversation between learning design and classroom observations: A systematic literature review. *Education Sciences*, 9(2), 91.

Eshchar-Netz, L., & Vedder-Weiss, D. (2021). Teacher learning in communities of practice: The affordances of co-planning for novice and veteran teachers' learning. *Journal of Research in Science Teaching*, 58(3), 366–391.

Even, S. (2020). Presence and unpredictability in teacher education. *Scenario: A Journal for Performative Teaching, Learning, Research*, 14(1), 1–10.

Fagan, C., Lyonette, C., Smith, M., & Saldaña-Tejeda, A. (2012). The influence of working time arrangements on work-life integration or 'balance': A review of the international evidence. *International Labour Organization*.

Faucon, L., Olsen, J., Haklev, S., & Dillenbourg, P. (2020). Real-Time Prediction of Students' Activity Progress and Completion Rates. *Journal of Learning Analytics*, 7(2), 18–44.

Ferreira, B., Conte, T., & Barbosa, S. D. J. (2015). Eliciting requirements using personas and empathy map to enhance the user experience. In *2015 29th Brazilian Symposium on Software Engineering* (pp. 80–89). IEEE.

Ferreira, B., Silva, W., Oliveira, E., & Conte, T. (2015). Designing Personas with Empathy Map. In *SEKE*.

Flinders, D. J. (1988). Teacher isolation and the new reform. *Journal of Curriculum and Supervision*, 4(1), 17–29.

Friend, M., & Cook, L. (1992). *Interactions: Collaboration skills for school professionals*. Longman Publishing Group.

Fuks, H., et al. (2003). Do modelo de colaboração 3c à engenharia de groupware. *Simpósio Brasileiro de Sistemas Multimídia e Web–Webmidia*, 0–8.

Fullan, M., & Hargreaves, A. (2000). *A escola como organização aprendente: buscando uma educação de qualidade*. Artmed.

Gak, D. M. (2011). Textbook-An important element in the teaching process. *Hatchaba Journal*, 19(2), 78–82.

García-Martínez, I., Montenegro-Rueda, M., Molina-Fernández, E., & Fernández-Batanero, J. (2021). Mapping teacher collaboration for school success. *School Effectiveness and School Improvement*, 32(4), 631–649.

Giannakos, M., Sharma, K., Martinez-Maldonado, R., Dillenbourg, P., & Rogers, Y. (2018). Learner-computer interaction. In *Proceedings of the 10th Nordic Conference on Human-Computer Interaction* (pp. 968–971).

Gibbons, J. D., & Chakraborti, S. (2014). *Nonparametric statistical inference*. CRC Press.

Goodman, E., & Kuniavsky, M. (2012). *Observing the user experience: A practitioner's guide to user research*. Elsevier.

GUTIEREZ, S. (2021). Collaborative lesson planning as a positive 'dissonance' to the teachers' individual planning practices: characterizing the features through reflections-on-action. Teacher Development, 25(1), 37–52.

Hakami, E., & Hernandez-Leo, D. (2021). Teachers' views about the impact of Learning Design Community platforms on Well-being. In 2021 International Symposium on Computers in Education (SIIE) (pp. 1–5). IEEE.

Haleta, Y., & Balanutsa, O. (2021). Theory and Practice of Organization of Independent Cognitive Activity of Future Teachers by Means of Information and Communication Technology in Quarantine Conditions in Ukraine. In International Conference on Economics, Law and Education Research (ELER 2021). Atlantis Press.

Hernández-Leo, D., Asensio-Pérez, J., Derntl, M., Prieto, L., & Chacón, J. (2014). ILDE: Community environment for conceptualizing, authoring and deploying learning activities. In the European conference on technology enhanced learning (pp. 490–493). Springer.

Hevner, A., & Chatterjee, S. (2010). Design science research in information systems. In Design research in information systems (pp. 9–22). Springer.

Hitzschky, R. A., de Castro Filho, J. A., & Freire, R. S. (2020). Recurso Educacional Digital (RED) para os anos iniciais do Ensino Fundamental aspectos pedagógicos e a Base Nacional Comum Curricular. RENOTE, 18(2), 408–417.

Hjorth, L., Horst, H., Galloway, A., & Bell, G. (2017). The Routledge companion to digital ethnography. Routledge.

Hökkä, P., & Eteläpelto, A. (2014). Seeking new perspectives on the development of teacher education: A study of the Finnish context. Journal of Teacher Education, 65(1), 39–52.

Horn, I. S., & Little, J. W. (2010). Attending to problems of practice: Routines and resources for professional learning in teachers' workplace interactions. American Educational Research Journal, 47(1), 181–217.

Husserl, E. (1990). The train of thoughts in the lectures. In The Idea of Phenomenology (pp. 1–12). Springer.

Husson, F., Lê, S., & Pagès, J. (2011). Exploratory multivariate analysis by example using R. CRC Press.

Hutz, C. S. (2014). Avaliação em psicologia positiva. Artes Médicas Editora.

IEEE Standards Committee et al. (2020). IEEE Recommended Practice for Assessing the Impact of Autonomous and Intelligent Systems on Human Well-Being: IEEE Standard 7010-2020. IEEE. https://doi.org/10.1109/IEEESTD.2020.9084219

IEEE international conference on systems, man, and cybernetics (SMC). (2020). IEEE, 2746–2753.

Ingold, T., & Hallam, E. (2021). Creativity and cultural improvisation: An introduction. In T. Ingold & E. Hallam (Eds.), Creativity and cultural improvisation (pp. 1–24). Routledge.

Iqbal, R., James, A., & Gatward, R. (2005). Designing with ethnography: An integrative approach to CSCW design. Advanced Engineering Informatics, 19(2), 81–92.

Jalongo, M. R., Rieg, S. A., & Helterbran, V. R. (2007). Planning for learning: Collaborative approaches to lesson design and review. Teachers College Press.

John, P. D. (2006). Lesson planning and the student teacher: re-thinking the dominant model. Journal of Curriculum Studies, 38(4), 483–498.

Johnson, R. A., & Wichern, D. (2007). Applied multivariate statistical analysis (6th ed.). Prentice Hall.

Kaplan, K. (2017). Facilitating an effective design studio workshop. Nielsen Norman Group, 2, 2017.

Knight, B. A. (2015). Teachers' use of textbooks in the digital age. Cogent Education, 2(1), 1015812.

Koberstein-Schwarz, M., & Meisert, A. (2022). Pedagogical content knowledge in material-based lesson planning of preservice biology teachers. Teaching and Teacher Education, 116, 103745.

Koper, R., & Tattersall, C. (2005). Learning design: A handbook on modelling and delivering networked education and training.

Koskinen, I., Zimmerman, J., Binder, T., Redstrom, J., & Wensveen, S. (2011). Design research through practice: From the lab, field, and showroom. Elsevier.

Lave, J. (1988). Cognition in practice: Mind, mathematics and culture in everyday life. Cambridge University Press.

Lau, S. M. C., & Stille, S. (2014). Participatory research with teachers: Toward a pragmatic and dynamic view of equity and parity in research relationships. European Journal of Teacher Education, 37(2), 156–170.

Lemke, C. (2002). enGauge 21st Century Skills: Digital Literacies for a Digital Age.

Levin, B., & Rock, T. (2003). The effects of collaborative action research on preservice and experienced teacher partners in professional development schools. Journal of Teacher Education, 54(2), 135–149.

Liu, S., Lu, J., & Yin, H. (2022). Can professional learning communities promote teacher innovation? A multilevel moderated mediation analysis. Teaching and Teacher Education, 109, 103571.

Liu, S. Q., & Zou, D. D. (2014). Preliminary Study on Collaborative Lesson Planning based on Cloud Platform. In Applied Mechanics and Materials (pp. 1433–1437). Trans Tech Publications Ltd.

Marcelo, C. (2010). O professor iniciante, a prática pedagógica e o sentido da experiência. *Formação docente*, 2(3), 11–49.

Marconi, M., & Lakatos, E. (2017). *Metodologia científica* (7ª ed.). Atlas.

Medeiros, R., Doarte, M., Viterbo, J., Maciel, C., & Boscarioli, C. (2021). Uma análise comparativa entre repositórios de recursos educacionais abertos para a educação básica. In *Anais do XXXII Simpósio Brasileiro de Informática na Educação* (pp. 213–224). SBC.

Merriam, S. B., & Tisdell, E. J. (2015). *Qualitative research: A guide to design and implementation*. John Wiley & Sons.

Merrill, D. (2002). Mental models, knowledge objects, and instructional design. Brigham Young University, 19.

Milkova, S. (2012). Strategies for effective lesson planning. *Center for Research on Learning and Teaching*, 1(1), 1–29.

Moita Neto, J. M., & Moita, G. C. (1998). Uma introdução à análise exploratória de dados multivariados. *Química Nova*, 21, 467–469.

Mor, Y., Craft, B., & Hernández-Leo, D. (2013). The art and science of learning design: Editorial. *Research in Learning Technology*, 21.

Moreira, H. (1997). Investigação da motivação do professor: a dimensão esquecida. *Revista Educação & Tecnologia*, 1, 88–96.

Murtagh, F., & Contreras, P. (2012). Algorithms for hierarchical clustering: an overview. *Wiley Interdisciplinary Reviews: Data Mining and Knowledge Discovery*, 2(1), 86–97.

Munoz, G., & Bourmaud, G. (2012). Éléments de système d'instruments pour enseignants: une analyse auprès de conseillers pédagogiques. *Actes du colloque OUFOREP*, Université de Nantes, 427–436.

Murphy, E. (2004). Recognising and promoting collaboration in an online asynchronous discussion. *British Journal of Educational Technology*, 35(4), 421–431.

Nacak, A., Bağlama, B., & Demir, B. (2020). Teacher candidate views on the use of YouTube for educational purposes. *Online Journal of Communication and Media Technologies*, 10(2), e202003.

Neale, D. C., Carroll, J. M., & Rosson, M. B. (2004). Evaluating computer-supported cooperative work: models and frameworks. In *Proceedings of the 2004 ACM conference on Computer supported cooperative work* (pp. 112–121).

Nelson, H. G., & Stolterman, E. (2014). *The design way: Intentional change in an unpredictable world*. MIT Press.

Nguyen, G. N. H., & Bower, M. (2018). Novice teacher technology enhanced learning design practices: The case of the silent pedagogy. *British Journal of Educational Technology*, 49(6), 1027–1043.

Nias, J. (1998). Why teachers need their colleagues: A developmental perspective. In *International handbook of educational change* (pp. 1257–1271). Springer.

Nielsen, J. (1994). *Usability engineering*. Morgan Kaufmann.

Nunes, L. de O. (2015). "A tensão da coletividade": uma etnografia sobre a construção do planejamento coletivo na educação física do I Ciclo da Rede Municipal de Ensino de Porto Alegre/RS [Tesis de maestría, UFRGS].

Oliveira, P. P. M. (2016). O YouTube como ferramenta pedagógica. In *SIED: EnPED-Simpósio Internacional de Educação a Distância e Encontro de Pesquisadores em Educação a Distância*.

Oliveira, F. K. de. (2017). *Modelo de reuso de unidades de aprendizagem para múltiplos sistemas de aprendizado eletrônico* [Tesis doctoral, Universidade Federal de Pernambuco]. Centro de Informática.

Oliveira, W. (2019). O planejamento como instrumento de uma ação educativa no processo de ensino-aprendizagem. *Diversitas Journal*, 4(2), 521–527. https://doi.org/10.17648/diversitas-journal-v4i2.806

O'Malley, C. (Ed.). (2012). *Computer supported collaborative learning*. Springer Science & Business Media.

Olszewska, J. (2020). IEEE recommended practice for assessing the impact of autonomous and intelligent systems on human well-being: IEEE Stand 7010–2020.

Olszewska, J. (2021). The virtual classroom: a new cyber physical system. In *2021 IEEE 19th world symposium on applied machine intelligence and informatics (SAMI)* (pp. 000187–000192). IEEE.

Onyango, G., Gitonga, R., & Rugar, T. (2017). Technology integrated lesson plan based on experiential learning. In *Proceedings of the 2017 International Conference on Education and E-Learning* (pp. 34–40).

Ostovar-Nameghi, S. A., & Sheikhahmadi, M. (2016). From teacher isolation to teacher collaboration: Theoretical perspectives and empirical findings. *English Language Teaching*, 9(5), 197–205.

Otto, D., & Kerres, M. (2022). Increasing sustainability in open learning: Prospects of a distributed learning ecosystem for open educational resources. *Frontiers in Education*. https://doi.org/10.3389/feduc.2022.866917

Patton, K., & Parker, M. (2017). Teacher education communities of practice: More than a culture of collaboration. *Teaching and Teacher Education*, 67, 351–360.

Perlman, D. (1982). *Loneliness: A sourcebook of current theory, research and therapy*. John Wiley & Sons Incorporated.

Petko, D., et al. (2019). Metapholio: A mobile app for supporting collaborative note taking and reflection in teacher education. *Technology, Knowledge and Learning*, 24(4), 699–710.

Pimentel, M., & Fuks, H. (Eds.). (2012). *Sistemas colaborativos*. Elsevier.

Pink, S. (2021). Digital futures anthropology. In *Digital Anthropology* (pp. 307–324). Routledge.

Pink, S., Akama, Y., & Sumartojo, S. (2018). *Uncertainty and possibility: New approaches to future making in design anthropology*. Bloomsbury Publishing.

Pink, S., Horst, H., Postill, J., Hjorth, L., Lewis, T., & Tacchi, J. (2015). *Digital ethnography: Principles and practice*. SAGE.

Pink, S., & Mackley, K. L. (2015). Social science, design and everyday life: refiguring showering through anthropological ethnography. *Journal of Design Research*, 13(3), 278–292.

Pink, S., Sumartojo, S., Lupton, D., & Heyes La Bond, C. (2017). Mundane data: The routines, contingencies and accomplishments of digital living. *Big Data & Society*, 4(1), 2053951717700924.

Powell, C., & Bodur, Y. (2019). Teachers' perceptions of an online professional development experience: Implications for a design and implementation framework. *Teaching and Teacher Education*, 77, 19–30.

Queiros, L., Bouckaert, Y., De Oliveira, I., Oliveira, F., Moreira, F., & Gomes, A. S. (2019). The adoption of learning experience design tools in classroom planning activity: A systematic literature review. In *Proceedings of the Seventh International Conference on Technological Ecosystems for Enhancing Multiculturality* (pp. 704–710).

Queiros, L., Jofilsan, N., Campos Filho, A., Gomes, A. S., De Oliveira, F., & Da Silva, C. (2018). Usability testing for teachers' lesson planning services. In *2018 IEEE Frontiers in Education Conference (FIE)* (pp. 1–8). IEEE.

Queiros, L., & Gomes, A. (2019). Co-design de groupware para planejamento entre professores do ensino médio. In *Anais do Workshop de Desafios da Computação Aplicada à Educação* (pp. 54–55).

Queiros, L. M., Gomes, A. S., & De Oliveira, F. (2019). Collaborative strategies for professional development of high school teachers: Groupware co-design for learning experience design. In *Anais do II Workshop on Advanced Virtual Environments and Education* (pp. 9–12). SBC.

Queiros, L., et al. (2019). Context analysis of teachers' learning design practice through activity theory, distributed cognition, and situated cognition. In *International Workshop on Learning Technology for Education in Cloud* (pp. 247–259). Springer, Cham.

Queiros, L., Gomes, A. S., & Munoz, G. (2018). Lessons planning instrumental genesis: between teachers' instrument systems and professional development. In *EARLI SIG 14 Learning and Professional Development conference* (pp. 1–6).

Queiros, L., Gomes, A., & De Oliveira, F. (2017). Learning experiences design: Integration of e-learning environments. In *2017 12th Iberian Conference on Information Systems and Technologies (CISTI)* (pp. 1–4). IEEE.

Rencher, A. C., & Schimek, M. G. (1997). Methods of multivariate analysis. *Computational Statistics*, 12(4), 422–422.

Robinson, H., Segal, J., & Sharp, H. (2007). Ethnographically-informed empirical studies of software practice. *Information and Software Technology*, 49(6), 540–551.

Rossitto, C., & Lampinen, A. (2018). Co-creating the workplace: Participatory efforts to enable individual work at the Hoffice. *Computer Supported Cooperative Work (CSCW)*, 27(3), 947–982.

Saad, A. (2011). *A case-based system for lesson plan construction* (Doctoral dissertation). Loughborough University.

Saad, A., Chung, P. W. H., & Dawson, C. W. (2014). Effectiveness of a case based system in lesson planning. *Journal of Computer Assisted Learning*, 30(5), 408–424.

Saastamoinen, U., Eronen, L., Juvonem, A., & Vahimaa, P. (2022). Wellbeing at the 21st century innovative learning environment called learning ground. *Journal of Research in Innovative Teaching & Learning*, ahead-of-print.

Sampaio, M. M. F., & Marin, A. J. (2004). Precarização do trabalho docente e seus efeitos sobre as práticas curriculares. *Educação & Sociedade*, 25, 1203–1225.

Santos, C. S. dos. (2019). Relevância do planejamento colaborativo de aulas na prática (práxis) pedagógica da docência nos anos iniciais, à luz das competências gerais da base nacional comum curricular [Trabajo final, Instituto Federal Goiano – IFGOIANO, Ipameri-GO].

Santos, C. F. dos. (2016). O sistema de instrumentos de professores de ensino médio em escolas públicas estaduais [Tesis de maestría, Universidade Federal de Pernambuco, Recife-PE].

Scardamalia, M., & Bereiter, C. (1994). Computer support for knowledge-building communities. *The Journal of the Learning Sciences*, 3(3), 265–283.

Schiff, D., Ayesh, A., Musikanski, L., & Havens, J. (2020). IEEE 7010: A new standard for assessing the well-being implications of artificial intelligence. In *2020 IEEE international conference on systems, man, and cybernetics (SMC)* (pp. 2746–2753). IEEE.

Silva, C. J. P. da. (2020). Design de um sistema de informação para apoiar a atividade de planejamento de aulas: uma abordagem situada [Tesis de maestría, Universidade Federal de Pernambuco, Recife-PE].

Silva, C., Osmundo, M., Hitzschky, R., Brito, M., Castro Filho, J., & Medeiros, M. (2016). Processo de criação de um repositório educacional digital: Procedimentos de busca, seleção e categorização de recursos educacionais digitais (RED). In *Anais do Congresso Regional sobre Tecnologias na Educação* (pp. 427–437).

Simon, H. A. (2019). *The sciences of the artificial* (3rd ed., reissue with a new introduction by John Laird). MIT Press.

Skinner, E., & Beers, J. (2016). Mindfulness and teachers' coping in the classroom: A developmental model of teacher stress, coping, and everyday resilience. In *Handbook of mindfulness in education* (pp. 99–118). Springer, New York, NY.

Sonia, G., et al. (Ed.). (2017). *Educational research and innovation pedagogical knowledge and the changing nature of the teaching profession*. OECD Publishing. https://doi.org/10.1787/9789264270695-en

Sosa, O. G., & Manzuoli, C. H. (2019). Models for the pedagogical integration of information and communication technologies: A literature review. *Ensaio: Avaliação e Políticas Públicas em Educação*, 27, 129–156.

Spillane, J. P., & Shirrell, M. (2018). The schoolhouse network: How school buildings affect teacher collaboration. *Education Next*, 18(2), 68–74.

Stanovich, P. J. (1996). Collaboration: The key to successful instruction in today's inclusive schools. *Intervention in School and Clinic*, 32(1), 39–42.

Sudirman, S. (2017). Efforts to improve teacher competence in developing a lesson plan through sustainable guidance in SMKN 1 Mamuju. *Journal of Education and Practice*, 8(5).

Tabares-Díaz, Y. A., Martínez-Daza, V. A., & Matabancho-Tulcán, S. M. (2020). Síndrome de burnout en docentes de Latinoamérica: Una revisión sistemática. *Universidad y Salud*, 22(3), 265–279.

Tadjine, Z., Oubahssi, L., Piau-Toffolon, C., & Iksa, S. (2016). Rethinking learning design for learning technologies: A formalized vision to operationalize pattern-based scenarios. In *2016 IEEE 16th International Conference on Advanced Learning Technologies (ICALT)* (pp. 57–61). IEEE.

Team, R. Core et al. (2013). *R: A language and environment for statistical computing*.

Tarazi, J., & Akre, V. L. (2013). Enabling e-collaboration and e-pedagogy at an academic institution in the UAE. In *2013 International Conference on Current Trends in Information Technology (CTIT)* (pp. 118–124). IEEE.

Thomazi, Á. R. G., & Asinelli, T. M. T. (2009). Prática docente: considerações sobre o planejamento das atividades pedagógicas. *Educar em revista*, 181–195.

Tichenor, M., & Tichenor, J. (2019). Collaboration in the elementary school: What do teachers think? *Journal of Curriculum and Teaching*, 8(2), 54–61.

Trevisan, K. R. R. (2020). *Avaliação da associação entre carga mental de trabalho, fatores de risco psicossociais ocupacionais e agravos à saúde mental de professores* [Master dissertation, Universidade Federal de Santa Catarina, Florianópolis-SC].

Tyler, R. W. (2013). Basic principles of curriculum and instruction. In *Curriculum Studies Reader E2* (pp. 60–68). Routledge.

UNESCO. (2002). *Forum on the impact of open courseware for higher education in developing countries–Final Report*. Technical report, UNESCO.

Vangrieken, K., Dochy, F., Raes, E., & Kyndt, E. (2015). Teacher collaboration: A systematic review. *Educational Research Review*, 15, 17–40.

Vassão, C. A. (2019). *Metadesign: ferramentas, estratégias e ética para a complexidade*. Editora Blucher.

Vu, T. M. H., & Tchounikine, P. (2021). Supporting teacher scripting with an ontological model of task-technique content knowledge. *Computers & Education*, 163, 104098.

Vuopala, E., Näykki, P., Isohätälä, J., & Järvelä, S. (2019). Knowledge co-construction activities and task-related monitoring in scripted collaborative learning. *Learning, Culture and Social Interaction*, 21, 234–249.

Weiland, A. (2021). Teacher well-being: Voices in the field. *Teaching and Teacher Education*, 99, 103250.

Wiercinski, A. (2020). *Hermeneutics of education

Woodland, R., & Mazur, R. (2019). Examining capacity for "cross-pollination" in a rural school district: A social network analysis case study. *Educational Management Administration & Leadership*, 47(5), 815–836.

World Bank. (2019). The education crisis: Being in school is not the same as learning. https://www.worldbank.org/en/news/immersive-story/2019/01/22/pass-or-fail-how-can-the-world-do-its-homework

Xiaofeng, W., Qi, W., & Ling, C. (2015). A case study of online-based collaborative lesson planning. In *Proceedings of the Eighth International Conference on E-Learning in the Workplace (ICELW 2015)*. Kaleidoscope Learning.

Yeh, Y.-F., Chan, K. K. H., & Hsu, Y.-S. (2021). Toward a framework that connects individual TPACK and collective TPACK: A systematic review of TPACK studies investigating teacher collaborative discourse in the learning by design process. *Computers & Education*, 171, 104238.

Yildirim, N. (2014). Nature inspired design paradigms for design ideation: A study on packaging design [Master dissertation, Middle East Technical University].

Yuan, R., Zhang, J., & Yu, S. (2018). Understanding teacher collaboration processes from a complexity theory perspective: A case study of a Chinese secondary school. *Teachers and Teaching*, 24(5), 520–537.

Zalavra, E., Papanikolaou, K., Dimitriadis, Y., & Sgouropoulou, C. (2021). Exploring teachers' needs for guidance while designing for technology-enhanced learning with digital tools. *In European Conference on Technology Enhanced Learning* (pp. 358–362). Springer, Cham.

Zalavra, E., Papanikolaou, K., Dimitriadis, Y., & Sgouropoulou, C. (2021). Teachers' perceptions of learning design recommendations. In *2021 19th International Conference on Information Technology Based Higher Education and Training (ITHET)* (pp. 1–8). IEEE.