INFORMATION MANAGEMENT IN THE SCOPE OF EDUCATIONAL TECHNOLOGY: INTEROCEPTIVE PROFILE AS A TECHNIQUE TO PREPARE CONTINUING EDUCATION COURSES FOR TEACHERS

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Abstract

Continuing education courses for teachers are a constant challenge for instructors who seek effectiveness in their own performance and for the institutions that offer them, which need to identify the results of the offered trainings that justify the investments made. The application of LA (learning analytics) to monitor the activities and evaluations of the offered trainings answers some questions, but it is still a posteriori analysis and, at most, *ad hoc*. The application of IM (information management) with LA techniques should act a priori in the training, mapping the interoceptive profiles of the participants before starting the continuing education. Preliminary results reveal that by identifying the emotional response profile of the population in response to different types of attention stimuli, it is possible to increase assertiveness in the choice of pedagogical resources and didactic strategies that generate better engagement among the participants.

Keywords: Continuing Education, Teaching Plan Preparation, Interoception and Learning Analytics, Data Collection Protocol, Cognitive Load Theory.

1 INTRODUCTION

Working with continuing education for teachers offers several challenges, such as the lack of time and resources for courses and training, teachers' resistance to changing their pedagogical practices, the lack of incentive and recognition from educational institutions, and the need for constant updating in the face of changes in society and the world of work [1–3]. The call to awaken reflection in practice can help educators face these challenges and improve their professional performance [1], but it does not seem to offer the transformation that effectively generates engagement in redefining their practice.

According to the studies by Schön [4,5] and Liston and Zeichner [6], reflection-in-action, reflection-on-action, and knowledge-in-action are elements that can generate the transformation of teaching practice. In addition, the use of ICT (information and communications technologies) in the continuing education of teachers and their participation in communities of practice can also contribute to this transformation [7]. However, it is important to note that each teacher must find their own strategies to improve their teaching practice, making use of appropriate didactic strategies and pedagogical resources [8–18].

According to Kolb [19], it is crucial to acknowledge the distinctiveness, intricacy, and fluctuation of individual learning methodologies. The author posits that the comprehension of an individual's learning preferences has the potential to augment their educational journey. This assertion is based on the notion that the learner's intra-individual disparities and their varying inclination towards the four learning modes are the crucial factors determining the most relevant information for them. In contrast to the aforementioned postulate, the present research argues for the importance of discerning an individual's interoceptive response to stimuli that capture their attention, known as stimulus-driven attention. This comprehension would enable the deduction of potential ways in which individuals could enhance their level of engagement and improve their ability to effectively absorb the knowledge they are exposed to. It is imperative to acknowledge that determining an individual's preferred mode of information reception does not necessarily imply that this is the modality that will elicit the most substantial interoceptive activations for them. Numerous empirical studies have provided evidence for the relationship between emotions and memory, thereby supporting the notion that interoception may have a significant impact on the process of learning [20–24].

Preparing a teaching plan with all the necessary components to communicate the contents and articulate the practices so that they make sense to the professionals in their applicability in the day-to-day classroom is a primary activity of teaching; however, this document is a planning piece that emphasizes the contents, practical activities, formative activities, and evaluative actions [25–28]. There does not seem to be a concern about the interoceptive profile of the participants in the continuing education

course, as the didactic technique is adopted and the pedagogical resources that are available are used, regardless of who will receive the training. Important questions about the profiles of people are not known a priori by the instructor in relation to the students.

The most that is done is, in the opening class, to give space for people to introduce themselves, talk about themselves, giving their names, what they expect from the training they will receive, and some aspect of their experience and professional performance [26,29,30]. It is argued that, although this is an opportunity for the instructor to perceive some nuances of each student's interest and, based on their own experience, to conduct the activities using one or another didactic strategy and using this or that pedagogical resource, they are nothing more than a bet by the instructor on how to achieve the best effectiveness with the class of students [31–33].

The cognizant mechanisms that operate in the human mind have been studied very diligently all over the world and in various areas such as neuroscience, learning psychology, cognition, and metacognition, just to name a few [20,34–36]. Recent studies have been proving that there is a close relationship between the process of memorization and the generation of engagement when certain emotions and mental flows are activated in people [37–39].The Flow Theory, for example, has proven that the nature and intensity of attention stimuli applied in formal adult educational contexts can influence the activation of emotions, leading or not leading the student to concentrate and engage deeply, creating a mental flow [40,41]. The Cognitive Load Theory, on the other hand, postulates that there is a limit to the information processing capacity of the human brain, and therefore, to improve learning, it is crucial to consider these limitations when designing instructional materials and methods that do not generate overload, causing negative emotions that harm attention, concentration, and engagement [42,43].

2 METHODOLOGY

2.1 Method

Using the principle of interoception, that is, the conscious perception of physical signals from the body, such as heartbeats or hunger, as a fundamental aspect of emotional self-awareness, assisting in the regulation of emotional states and decision-making [44], a data collection protocol was designed that, through a survey, applies different types of attention stimuli to activate the respondents' emotions, allowing to create a map of which emotions are most activated in the studied population, which allows to indicate didactic strategies and pedagogical resources that are the most suitable to increase engagement and memorization of information.

The objective of the developed methodology is to examine the interoceptive responses of participants to different attentional stimuli. The proposed approach entails the collection of data, statistical analysis, and the development of an "interoceptive heatmap" as means to accomplish this objective “Fig. 1”.

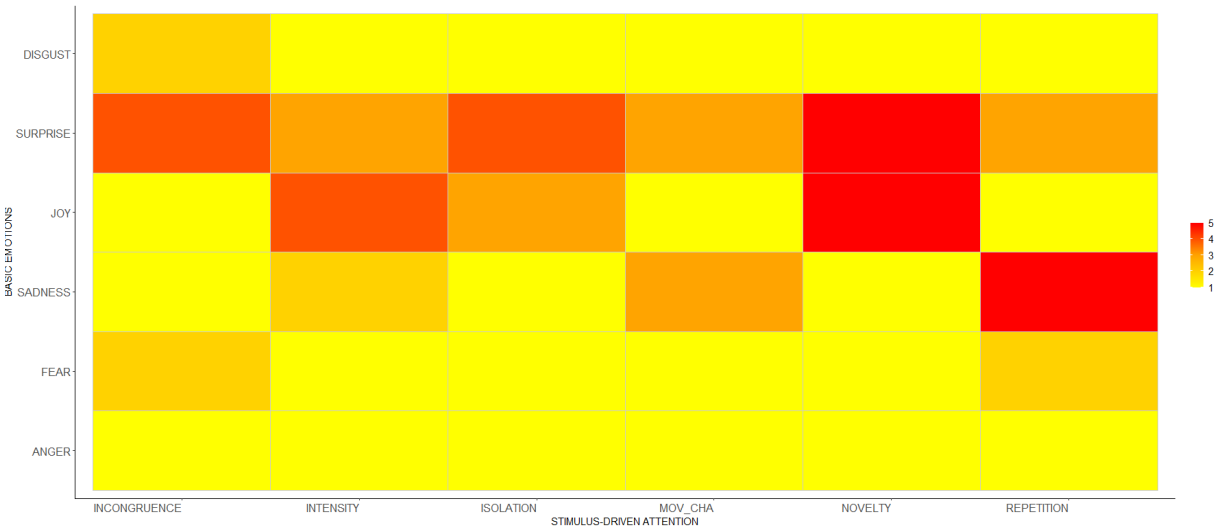


Figure 1. Hitmap of the preliminary results of experimental research.

The heatmap functions as a visual aid that illustrates the types of attentional stimuli that elicited the strongest emotional responses from the participants. The collection of data is conducted through the utilization of a Likert scale, a measurement tool employed to capture the varying degrees of emotional intensity expressed by the participants.

The analysis of the distribution of these responses aims to identify frequencies of interest and potential invalid responses within the specific instrument employed. Furthermore, the methodology encompasses the implementation of interoceptive analyses across various categories of stimuli, including but not limited to intensity, novelty, isolation, movement or change, repetition, and incongruence.

The Omega index is a robust metric for assessing the reliability of a set of items in a test or questionnaire. In the context of interoceptive activation triggered by novelty and repetition, the heatmap results indicate that these attentional stimuli more strongly activate interoceptively when applied to this population. This suggests that educators might prioritize the use of pedagogical resources and didactic strategies that emphasize these types of stimuli “Fig. 2”.

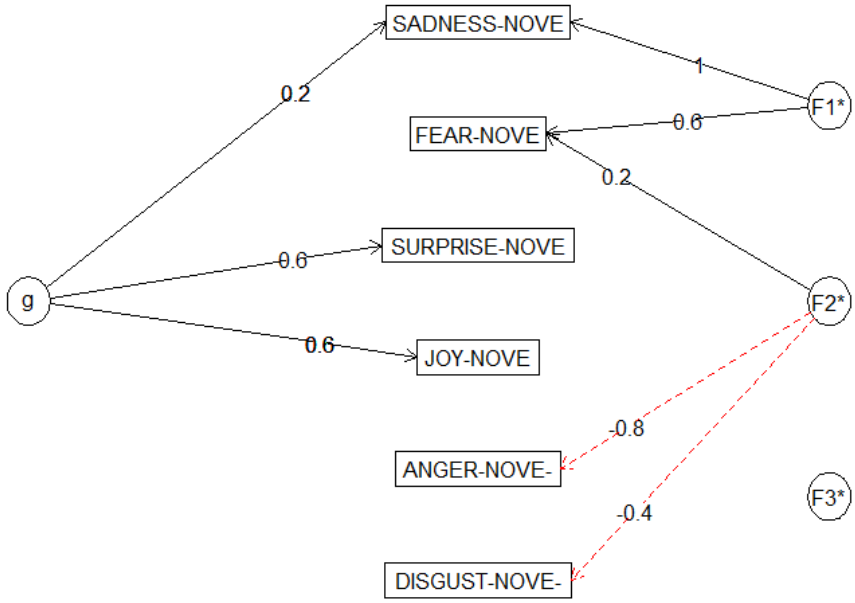


Figure 2. Omega Index Confirming the Reliability of the Measurement.

The data provided by the R software [45,46] reveals a Total Omega of 0.68, indicating moderate reliability for the item set. The Hierarchical Omega was 0.33, suggesting that a significant proportion of the variance is shared among the items. Additionally, the F1* and F2* factors showed Omega values of 0.70 and 0.59, respectively, indicating that both factors significantly contribute to the test's reliability. The analysis also revealed an RMSEA of 0.2, which is a model fit index, and a BIC of -8.89, which is a measure of model adequacy. Moreover, the correlation of scores with the factors was 0.73 for the general factor (g), 0.99 for F1*, and 0.83 for F2*, demonstrating a strong association between the scores and the identified factors.

The data presented in “Table 1”, obtained through the R software, provide a detailed statistical analysis of the reliability of the data collection conducted. The Alpha and Omega indices are essential metrics to assess the internal consistency of items within an instrument. The Alpha value stands at 0.44, while the Total Omega is 0.68, indicating moderate reliability.

The Schmid Leiman factor analysis reveals the factor loadings for different emotions, such as anger, fear, and joy, in relation to various stimuli. These factor loadings assist in understanding the strength and direction of the relationship between the emotions and the stimuli.

The sum of squares values for the factors g, F1*, F2*, and F3* are 0.80, 1.29, 0.89, and 0.00, respectively. These values aid in grasping the variance explained by each factor.

The analysis also includes a comparison of the adequacy of just a general factor and no group factors. The RMSEA index, which is a measure of model fit, stands at 0.2, indicating a reasonable fit of the model to the data.

Table 1. Reliability and Factor Loadings Analysis of Interoceptive Responses to Stimulus-driven Attention.

Description	Group
Summary	Alpha: 0.44 G.6: 0.51 Omega Hierarchical: 0.33 Omega H asymptotic: 0.48 Omega Total 0.68
Schmid Leiman Factor loadings greater than 0.2	g F1* F2* F3* h2 u2 p2 ANGER-NOVE- -0.80 0.65 0.35 0.01 FEAR-NOVE 0.57 0.21 0.40 0.60 0.03 SADNESS-NOVE 0.22 0.98 1.00 0.00 0.05 JOY-NOVE 0.59 0.36 0.64 0.99 SURPRISE-NOVE 0.59 0.35 0.65 0.98 DISGUST-NOVE- -0.44 0.24 0.76 0.14
With Sums of squares of:	g F1* F2* F3* 0.80 1.29 0.89 0.00
Min / Max	general/max 0.62 max/min = 1209.69 mean percent general = 0.37 with sd = 0.48 and cv of 1.31 Explained Common Variance of the general factor = 0.27
degrees of freedom	The degrees of freedom are 0 and the fit is 0 The number of observations was 45 with Chi Square = 0 with prob < NA The root mean square of the residuals is 0 The df corrected root mean square of the residuals is NA
Descriptive details	Compare this with the adequacy of just a general factor and no group factors The degrees of freedom for just the general factor are 9 and the fit is 0.63 The number of observations was 45 with Chi Square = 25.37 with prob < 0.0026 The root mean square of the residuals is 0.19 The df corrected root mean square of the residuals is 0.24
RMSEA	RMSEA index = 0.2 and the 10 % confidence intervals are 0.112 0.299 BIC = -8.89
Measures of factor score adequacy	g F1* F2* F3* Correlation of scores with factors 0.73 0.99 0.83 0.03 Multiple R square of scores with factors 0.54 0.98 0.69 0.00 Minimum correlation of factor score estimates 0.07 0.96 0.37 -1.00
Total, General and Subset omega for each subset	g F1* F2* F3* Omega total for total scores and subscales 0.68 0.70 0.59 NA Omega general for total scores and subscales 0.33 0.33 0.03 NA Omega group for total scores and subscales 0.43 0.37 0.56 NA

Lastly, the measures of factor score adequacy indicate the correlation of scores with the factors, as well as the multiple R squared of scores with the factors. These measures provide additional insights into the quality and reliability of the scores obtained.

Following the completion of data collection and subsequent analysis, a graphical representation illustrating the interoceptive heatmap is produced “Fig. 1”. This visual tool serves the purpose of validating identified patterns and informing pedagogical suggestions and instructional approaches.

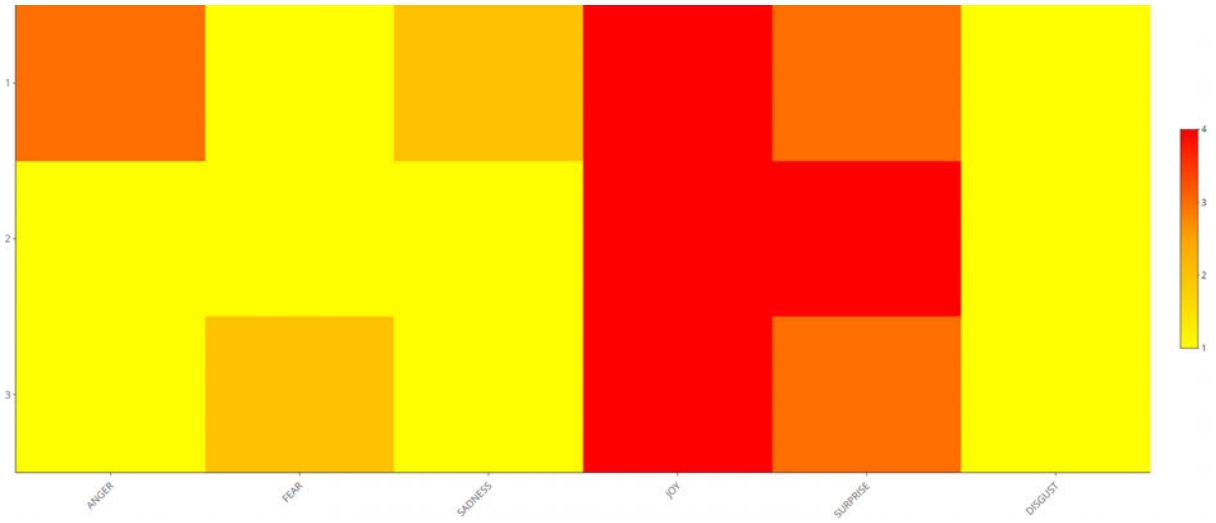


Figure 3. Hitmap of the preliminary results of experimental research of focus group.

The methodology also integrates the utilization of the focus group “Fig. 3” approach to authenticate the gathered data, employing a randomized sample from the entire pool of respondents to guarantee a comprehensive representation of the entire population. This methodology facilitates a comprehensive and qualitative examination of the participants' feedback, enhancing the understanding acquired from the heatmap visualization.

3 RESULTS

3.1 Preliminary Results

The preliminary results, obtained by application in two populations with N=16 and N=45, demonstrated that the data collection protocol, operated through a survey built under the premises of LA, is effective in capturing the emotional variations in the population and that after the application of the recommended didactic strategies and pedagogical resources, it is identified that the results of the manifested emotions are coherent with the results obtained with the survey collection.

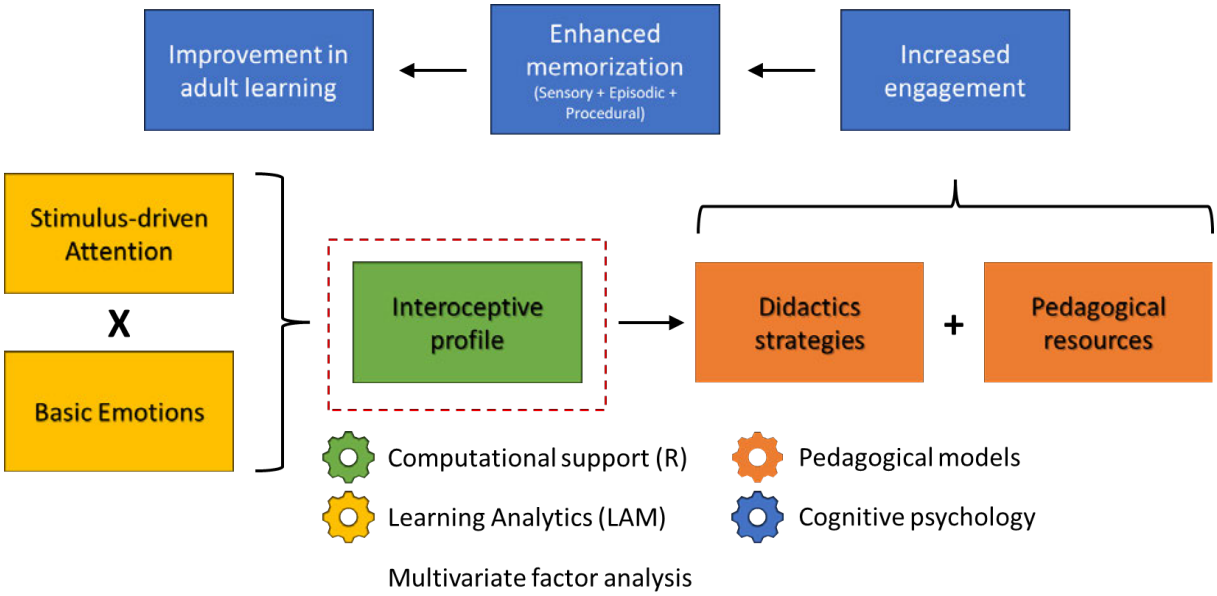


Figure 4. A Theoretical Model Linking Attentional Stimuli, Emotions, and Enhanced Adult Learning Outcomes.

The theoretical model presented in "Fig. 4", grounded in preliminary results, stands out for establishing a direct connection between the type of attentional stimulus and basic emotions, enabling the construction of an interoceptive profile of students. This characterization is of paramount importance, as it serves as a guide for adapting educational and pedagogical resources. By doing so, there's an anticipated increase in student engagement, enhancing memorization levels. Such improvement is crucial to boosting the efficacy of adult learning.

In addition to the preliminary results presented, further experiments are currently underway (N=100; N=35). These experiments are being conducted using both an experimental group and a control group, as well as a single sample with a randomized focus group. The aim of these additional experiments is to deepen our understanding of the relationship between types of attentional stimuli and emotions. It is anticipated that these experiments will provide additional insights and reveal aspects that may confirm the consistency and robustness of the relationship identified in the preliminary results. Through these ongoing efforts, we seek to solidify the empirical foundation of our theoretical model and ensure its practical applicability in enhancing adult learning.

4 CONCLUSIONS

This method, which expands the assumptions of LA to collect data a priori, considering the interoceptive manifestations of the researched population through interoception, shows potential to be applied to a larger population in the context of continuing education to collect indicators that can reinforce or refute the preliminary conclusions.

Furthermore, while the results in a controlled laboratory environment have already shown consistency, it's imperative to note that these findings are currently being validated in real-world training settings. This includes hybrid training modalities that combine both online synchronous and asynchronous sessions (a 36-hour course) and a fully face-to-face format (a 15-hour course). Such rigorous testing in diverse educational settings not only ensures the robustness of the method but also its adaptability and relevance across different learning environments. The transition from controlled to real-world scenarios is crucial in determining the practicality and effectiveness of the method in broader educational contexts.

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