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ANSIEDÔMETRO: a technological innovation for monitoring competitive anxiety and the individual zone of optimal functioning

ANSIEDÔMETRO: uma inovação tecnológica para monitorar a ansiedade competitiva e a zona individual de funcionamento ideal

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ABSTRACT

Competitive anxiety plays a pivotal role in athletic performance and remains a central theme in Sport Psychology. Conceptually, it encompasses both somatic (physiological) and cognitive (psychological) dimensions, where the latter may manifest positively as self-confidence or negatively as performance-impairing anxiety. The *Individual Zone of Optimal Functioning* (IZOF) framework acknowledges that athletes respond uniquely to competitive stressors, underscoring the need for personalized monitoring tools. Thus, this study presents the development and evaluation of *Ansiedômetro*, a web and mobile application designed using the Design Science Research (DSR) method to assess and visualize individual competitive anxiety levels. The app was structured through four development stages (planning, research, implementation, and testing), with usability feedback collected from both athletes and coaching staff. Participants praised the app's user interface, analytical capabilities, and real-world utility. Results suggest that *Ansiedômetro* not only facilitates the understanding of competitive anxiety but also empowers users to make informed decisions aimed at performance optimization. The tool was well-received and demonstrated direct impact on users' performance insights. Future steps involve broader dissemination and long-term user engagement to strengthen its role in applied Sport Psychology.

Keywords: Individual Zone of Optimal Functioning (IZOF); Anxiety; Mobile App; Athlete Performance; Sport Psychology.

RESUMO

A ansiedade competitiva desempenha um papel fundamental no desempenho atlético e permanece um tema central na Psicologia do Esporte. Conceitualmente, ela abrange dimensões somáticas (fisiológicas) e cognitivas (psicológicas), sendo que esta última pode se manifestar positivamente como autoconfiança ou negativamente como ansiedade que prejudica o desempenho. O modelo da Zona Individual de Funcionamento Ótimo (IZOF) reconhece que os atletas respondem de forma singular aos estressores competitivos,

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ressaltando a necessidade de ferramentas de monitoramento personalizadas. Assim, este estudo apresenta o desenvolvimento e a avaliação do Ansiedômetro, um aplicativo web e mobile projetado utilizando a metodologia de Pesquisa em Design Científico (DSR) para avaliar e visualizar os níveis individuais de ansiedade competitiva. O aplicativo foi estruturado em quatro etapas de desenvolvimento (planejamento, pesquisa, implementação e testes), com feedback de usabilidade coletado tanto de atletas quanto de treinadores. Os participantes elogiaram a interface do usuário, as capacidades analíticas e a utilidade prática do aplicativo. Os resultados sugerem que o Ansiedômetro não apenas facilita a compreensão da ansiedade competitiva, mas também capacita os usuários a tomarem decisões informadas visando à otimização do desempenho. A ferramenta foi bem recebida e demonstrou impacto direto na percepção de desempenho dos usuários. Os próximos passos envolvem uma disseminação mais ampla e um envolvimento de longo prazo dos usuários para fortalecer seu papel na Psicologia do Esporte aplicada.

Palavras-chave: Zona Individual de Funcionamento Ideal (IZOF); Ansiedade; Aplicativo Móvel; Desempenho do Atleta; Psicologia do Esporte.

1 INTRODUCTION

Competitive anxiety is one of the most studied psychological constructs in Sport Psychology, given its direct influence on athletic performance. This phenomenon encompasses both physiological and cognitive responses that precede competition and can modulate how athletes perceive, experience, and perform under pressure (Weinberg, Gould, 2017). Conceptually, this state of anticipatory tension is divided into competitive somatic anxiety, reflected in physical symptoms such as muscle tension and increased heart rate, and cognitive responses, which include worries, intrusive thoughts, and self-evaluative concerns. When interpreted positively, cognitive anxiety may foster self-confidence; when interpreted negatively, it may impair performance (Martens; Burton; Vealey, 1990).

Traditionally, competitive anxiety has been analyzed through group comparisons, considering variables such as sex, type of sport, or training history (Santos, 2020). However, due to its psychological and phenomenological properties, specific calculations are necessary to better understand the subject individually and the manifestations of anxiety present in the reality of the sports studied (Hanin, 1995).

In this context, the Individual Zone of Optimal Functioning (IZOF) model has gained prominence in the sports scene worldwide. Developed by Hanin (1995), the IZOF framework proposes that each athlete performs best within a unique, personal range of anxiety - neither too low nor too high. Some studies consider IZOF to be a reliable model to measure the optimal state of pre-competition anxiety - going beyond the anxiety-

performance dichotomy - based on the premise that each athlete responds differently to pre-competition stimuli, since they are filled with diverse and individual emotions (Braclow, 2006; Gould; Krane, 1992; Krane, 1993; Ruiz; Raglin; Hanin, 2015). According to the author, competitive anxiety in its manifestations (cognitive, somatic, and self-confidence) varies among individuals and understanding such variations helps improve performance in competition (Hanin, 1995).

Despite its conceptual relevance, the practical application of IZOF remains challenging in real-world sports contexts. Conventional data collection methods - primarily paper-based questionnaires - can be time-consuming and impractical, especially in the immediacy of competitive settings (Ostrow, 1996; Wilson; Batterham, 1999). This logistical barrier often limits the use of individualized psychological monitoring by coaching staff and athletes.

With the evolution of digital technologies, new opportunities emerge for streamlining psychological assessments. In sport, technology has progressed through successive waves: the first involving instrumentation and data tracking (e.g., GPS), the second emphasizing real-time feedback and decision-making tools (e.g., VAR in soccer), and the third focusing on individualized digital experiences tailored to athlete needs (Haake, 2009; Spits et al., 2021; Wiberg, 2018). Developing tools that are both scientifically valid and user-friendly is a central task for applied Sport Psychology.

Thus, this study aimed to develop and validate a web and mobile application – Ansiedômetro - capable of collecting, calculating, and visually presenting IZOF-related anxiety metrics, thereby empowering athletes and coaches to better understand and manage competitive anxiety for performance enhancement.

2 MATERIALS AND METHODS

2.1 Design Approach

The development of the *Ansiedômetro* application followed the principles of the Design Science Research (DSR) methodology, a problem-solving approach that integrates theory and practice through the creation and refinement of technological artifacts (Drechsler; Hevner, 2016). This methodology is divided into four development steps (planning, research, preparation and application, and testing) and is motivated by the possibility of improving a field via innovations.

The first step - planning - is the identification of opportunities and problems in the studied context. This phase involved defining the app's purpose and its potential to impact athletes' performance and psychological self-awareness. These interactions are important to analyze the demand and the need to make the tools to improve it (Drechsler; Hevner, 2016).

In the second step - research - we did an analysis of theoretical foundations, technical requirements, and user needs. This included feasibility studies, timeline definitions, and the integration of academic knowledge with field-based demands. Currently, the orientation, research, and evaluation of the tool are the basis for performing a work that engages with the studied context, aligning the objectives of the technical knowledge necessary to achieve them (Drechsler; Hevner, 2016).

The third step of the DSR - development and application - consists in the translation of research insights into the construction of the tool. This cycle involved designing interface alternatives, reevaluating its applicability and making necessary modifications to achieve the final product according to the objectives already outlined, usability protocols, internal testing, and interactive adjustments based on stakeholder feedback (Drechsler; Hevner, 2016).

And finally, the fourth step - testing and evaluation - is characterized by implementation of the application in real sport contexts, followed by usability and user experience assessments. The usability test is to understand the new demands that emerged throughout the application and solve, when possible, the problems encountered that differ from the objective outlined in the previous cycles. The final product, thus, becomes a tool that is applicable in the environment and that can modify it (Drechsler; Hevner, 2016).

2.2 Participants and Procedures

Usability testing and preliminary implementation were conducted with 55 participants, comprising: 50 university-level athletes (31 men and 19 women), aged between 18 and 30 years, 5 coaches (3 men and 2 women). All participants were involved in team sports (basketball, volleyball, handball, and futsal) and enrolled in a Public Higher Education Institution in São Paulo, Brazil. Average age was 21.8 years (SD = 1.72), with an average of 3.9 semesters of training experience and 3.9 hours/week of training volume (SD = 1.70).

Participation was voluntary, with written informed consent obtained. The study received approval from the Research Ethics Committee of UNICAMP (CAAE 09247219.7.0000.5404; Opinion No. 3.254.120).

Adherence to the study occurred at the moment of user registration (conducted in the participants' training location). After accepting, the users were asked to complete the registration procedures and the initial questionnaires (basal, best competition), as well as answer the questionnaires regarding two official games. As predicted by cycle four of planning the development of an app - according to the DSR - feedback was requested, after the period, on the use of the *Ansiedômetro* app.

2.3 Technological Tools and Platforms

To develop an app, demands must be met and programmed; and thinking of the best tools for this is an important part of the process, encompassed by the second cycle of DSR. One of the criteria for choosing platforms and tools to be used in the *Ansiedômetro* was the possibility of implementing improvements, allowing for a continuity in the project, as well as adding extensions without large restrictions. Thus, detailed research of the available tools was carried out, acknowledging that such tools can contribute to the success (or failure) of a project. Those that met the needs of the project were added.

In this respect, we present below the tools used, followed by a brief explanation of their characteristics and the reasoning behind their choice.

Self-analysis of app intervention. This questionnaire was developed by the authors to complement the data collection within the *Ansiedômetro* app. The questionnaire was composed of three post-competition questions aimed at mapping whether the athletes and coaches used the information provided by the tool and if it made any difference in their performance. It consists of the following questions: "Have you been able to take advantage of the pre-competition results in any way?", "Knowing the results before the competition influenced your performance?", "What did you do when you saw the pre-competition and IZOF results?"

Firebase. It is a digital platform, from Google, used to facilitate the development of web or mobile application programs in a simple and effective way. When choosing this tool, Firebase stood out because it allowed for integrating the multiple platforms that are used by the *Ansiedômetro* in its service, such as real-time database management, user authentication via email, and the storage and sending of data to the database. The service used on the platform is free, another point that contributed to its adherence.

GoDaddy. A platform that allows you to acquire domains, making web pages accessible to the entire internet. To do so, it was necessary to purchase a domain (ansiedometro.com.br). The reason for selecting this platform was the lower price compared to other platforms. A domain corresponds to the address that users type in the browser to visit the desired web page.

GitHub. It is a code hosting platform for version control and collaboration, that is, all modifications made to the project were inserted into the platform to record the progress and changes in the *Ansiedômetro*, as well as security if the app "breaks," allowing the last version to be restored. Another positive element in its choice was the possibility of more than one person working in the project at the same time, by creating a shared repository.

Heuristic evaluation. A method designed by Nielsen (1994) to test the interface of a system to identify usability errors. It consists of 10 items in which the user assigns a score: 0 = does not meet the criterion; 1 = meets superficially to the criterion; 2 = meets little to the criterion; 3 = partially meets the criterion; 4 = meets the criterion; and 5 = meets the criterion very well.

Node JS. Node (as it is most known) was chosen for its characteristics as a server. It is a JavaScript environment focused on performance and low memory usage, used in long-term processes and media (Tilkov; Vinoski, 2010). Node has benefits that have helped in the process of choosing the tool for server development. One is the flexibility and scalability of the project since it uses Node Package Manager (NPM) to manage external libraries. Another point is the high performance and the ability to run multiple requests at once, as well as ease of learning, since it uses standard language for web development (Nodejs, 2016).

Pre- vs. post-game subjective performance questionnaire. This questionnaire was developed to subjectively identify the status of the competition, the level of difficulty, and the athlete's expectation for such competition; it is answered along with the Revised Competitive State Anxiety Inventory-2 (CSAI-2R). The questionnaire is divided in two parts, the first of them is pre-competition, composed of the questions: "Who is your opponent?", "How easy

will this competition be for you" - scores from 0 to 10, with 0 for "very easy" and 10 "very difficult"; "What expectation of result?" - "very negative," "negative," "'without expectation," "positive," and "very positive." And the second part is composed of the questions: "How easy was the competition?" - scores from 0 to 10, with 0 for "very easy" and 10 "very difficult"; "How was your role in defense?" - with 0 for "very bad" and 10 for "very good"; "How was your role in attack?" - with 0 for "very bad" and 10 for "very good"; "How was your role overall?" - with 0 for "very bad" and 10 "very good"; and "Was the result as expected?" - "far below," "below," "remained the expected," "above," "far above."

React Native. It is a framework developed by Facebook, used for developing native Javascript applications for both iOS and Android. The framework is based on ReactJS and has concepts that enable the development of interfaces that are applied in web and mobile navigation. Thus, they are compiled in native codes, enabling better performance when compared to hybrid applications (Dabit, 2019). Thus, the code has high volatility and compatibility with several operating systems, in addition to using less memory space in the mobile device, tablet, or computer (Hartmann et al., 2011). React Native allowed for the use of native elements of the user interface and for a separate execution of the main UI thread. Thus, the performance gain is substantial, allowing for the development of only one app for both iOS and Android.

Thus, the *Ansiedômetro* was built with these features, and can be accessed via the site: ansiedometro.com.br and the Play Store, unfortunately it was not possible to make it available in the Apple Store because the hosting value is approximately R$ 500 per year (Apple, 2022), the value of the Play Store was R$ 100, in one-time payment (Google, 2022). However, users with Apple operating systems can use the *Ansiedômetro* via the internet browser (Safari).

2.4 Assessment Instrument

The *Revised Competitive State Anxiety Inventory*-2 (CSAI-2R) is interconnected with anxiety data collection. Developed by Cox et al. (2003) as a reduced form of CSAI-2 (Martens; Burton; Vealey, 1990), it is used to assess cognitive and somatic anxiety and self-confidence. It consists of 16 items, distributed in three subscales (somatic anxiety, cognitive anxiety, and self-confidence), with each having intensity, direction, and frequency. It was

applied to obtain data regarding anxiety, identifying the zone of optimal functioning of each student athlete.

3 RESULTS AND DISCUSSION

3.1 Usability

The *Ansiedômetro* was developed with a strong focus on user-centered design, aiming for high levels of intuitiveness, simplicity, and practical utility. As suggested by Garrett (2011), digital tools in Sport Psychology must integrate seamlessly into users' routines to ensure adherence. The interface was designed to minimize cognitive load while allowing coaches and athletes to access meaningful data with minimal training.

Figure 1 demonstrates the full range of functionalities, including login, account creation, questionnaire navigation, and visualization of IZOF-based results for both athletes and coaches. These functions were consistently evaluated as user-friendly, with high acceptance among users across different sports.

Figure 1 - Visual process of the Ansiedômetro steps

Figure 1a. Home screen of the *Ansiedômetro* as seen in cell phone device.

Figure 1b. Question that differentiates between the coach and athlete interface.

Figure 1c. Functionality: Login.

Figure 1d. First access to the account - Athlete.

Figure 1e. Layout after the response of the basal-Athlete questionnaire.

Figure 1f. Layout after answering the questionnaire on the best competition - Athlete.

Figure 1g. Layout after answering the pre-match questionnaire with post-match pending - Athlete.

Figure 1h. First access to the account - Coach.

Figure 1i. Screen to create team - Coach.

Figure 1j. Home screen after creating the team - Coach.

Figure 1k. Screen to add athletes to the team - Coach.

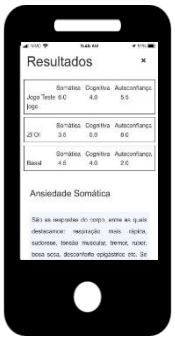

Figure 1l. First tab of the results.

Figure 1m. Detailed results of the competition.

Source: prepared by the authors, 2025

Create account. Figure 1a shows the user's first access, the "Create your account" button is highlighted, following the principles of usability cited by Garret (2011). This functionality allows users to create their account. By clicking on the button, the user is directed to the registration screen, requiring them to fill in all the fields presented and agree to the terms of use. To increase the veracity of the data, validation was conducted by verifying that the email entered is already in the database and by not allowing empty fields. At this point, the user responds whether they are a coach or an athlete (Figure 1b).

Login. This functionality allows the user to access the platform. To do this, it is necessary to enter the registered email and password. Once the required fields have been completed, they are validated. Initially, it is checked that the fields are filled in, and later, it is checked that the email exists in the database, informing the user if it is not found. Once found, the password entered with the registered one is compared. Figure 1c illustrates the interface responsible for performing this functionality.

First access to the account - Athlete. After registering as an athlete and logging in, the user is directed to the home page, where four buttons are shown (Figure 1d). The first, directs the user to the page detailing the use of the *Ansiedômetro* and the technical aspects of anxiety, which is recommended to read. The second button is the first questionnaire: Basal anxiety. At this moment, the athlete answers the questions without the influence of competition, that is, the values generated will reflect the levels without competitive stimulus. For verification, when filling out the questions, a validation is performed certifying that there are no blank fields; with all fields filled out, the save button is made available for the athlete to send the form to the database.

The third button is the results, at this point, nothing happens when you click it because there are no results to be displayed. Finally, the last button is to exit the account, if necessary. At the end of the baseline questionnaire and return to the athlete's home screen, there is a small change in the buttons. The "Instructions" button remains (Figure 1e), the second button is modified to "Best Match'." In this button, the athlete will respond thinking about the best match in which they participated and obtained better performance. The third button (results) becomes active when the results of the baseline questionnaire are already available. The last button (Logout) also remains unchanged. After answering the "Best match," the athlete can use the *Ansiedômetro* in their games (Figure 1f). The layout of the

access screen changes if there is any post-match questionnaire pending; after answering the pre-match questionnaire, data goes through the validation process and, when clicking the save button, another button is automatically created on the home screen, the post-match button. In turn, when the post-match questionnaire is answered and saved correctly, the button disappears (Figure 1g).

First access to the account - Coach. After registering as a trainer and logging in, the user is directed to the home screen where three buttons are shown (Figure 1h). The first, directs the user to the screen detailing the use of the *Ansiedômetro* and the technical aspects of anxiety, which they are recommended to read. The second button allows them to add teams to the home screen (Figure 1i). At this point, the coach creates a team so that it is possible to add athletes to it. Finally, the last button is to logout from the account, if necessary. After creating the team (Figure 1j), the user can add athletes to it. For such, it is only required for them to click on the team on the home screen, click on the button to add athletes, and insert the email of the athlete they want to add (Figure 1k). Once this is done, the user can return to the previous screen, and the athlete will be on the team. To view an athlete's results, click on their name and the results will appear. After the coach and athlete perform the registration and the procedures, they can use the *Ansiedômetro* in competitions, that is, the athlete can answer the questionnaires before and after the match and the coach can access it and use the information, as necessary, to improve the athlete's performance.

To understand and classify the usability problems of the interface, they were classified according to Nielsen's Heuristics (2010, 1994). The questions were read for each user and explained, according to the author, what each question corresponds to, and the scale used to score. The users, 50 athletes and 5 coaches, assigned a score from 0 to 5 in each heuristic, in which 0 = does not meet the criterion; 1 = meets superficially to the criterion; 2 = meets little to the criterion; 3 = partially meets the criterion; 4 = meets the criterion; and 5 = meets the criterion very well (Table 1). The results indicate a strong alignment between interface design and user expectations. The lowest average score was found in the item *"Help users recognize, diagnose, and recover from errors"* (mean = 4.26). Although this was the lowest score, it still reflected a generally positive perception and did not compromise overall usability.

Table 1 - Heuristic evaluation matrix of the interface

Heuristics	Score
Visibility of system status	4.84
Match between system and real world	4.58
User control and freedom	4.78
Consistency and standards	4.74
Error prevention	4.76
Recognition rather than recall	4.86
Flexibility and efficiency of use	4.82
Aesthetic and minimalistic design	4.68
Help users recognize, diagnose, and recover from errors	4.26
Help and documentation	4.78
Total	47.1

Source: prepared by the authors, 2025

According to McCloskey (2014), to observe how users react and use a particular tool, one must provide only basic information, and observe which paths are traveled within the system. Doubts and errors can be discovered by letting the users choose the paths within the app, without a pre-established order of operational sequence; and, with the heuristic feedback of the interface, such paths present themselves as self-explanatory, characterizing one of the positive points of the *Ansiedômetro*.

3.2 Results Tab

After answering the questionnaires, the results are available to the user and can be accessed by the “View Results” button (mentioned above). In this tab, the answered questionnaires are presented, including basal, the best match, and all the games that have been held so far, such data are presented in two tabs.

The first tab shows the summary of the data on anxiety and self-confidence regarding the intensity (Figure 1l). This page also shows simple directions on the meaning of each element analyzed and how to use in practice (cognitive and somatic anxiety and self-

confidence). By clicking on the desired match, the second tab appears, displaying the general results in the direction and frequency dimensions, together with the intensity. As well as the distance of the levels in relation to the athlete's ZOF (Figure 1m).

3.3 Calculation of results

To identify the zone of optimal functioning of each athlete, two methods were elaborated: The Direct and the Empirical model (Hanin, 1995). In the Direct method, anxiety is longitudinally mapped, and it is necessary to perform measurements in different matches. Thus, the matches with the best performances are classified as being closest to IZOF. To collect and quantify these anxiety levels, initially we added and subtracted four anxiety units (approximately half of a standard deviation) from the score found by the tool, thus obtaining the optimal zone of functioning of each athlete. However, when thinking about the applicability of such method, it may take longer to find the athlete's best performance, making it impossible to perform in some studies and teams.

Hanin (1986, 1989) developed an alternative in his second method, the Empirical method. In this, the athletes responded in hindsight about their best performance, recreating the conditions of their best performance. Like the Direct method, four units of anxiety measurement (in the tool) were added to and subtracted from the final score, composing the variation of the ZFOI, serving as a basic technique based on previous experiences of the athlete.

With the CSAI-2R tool, each aspect (cognitive anxiety, somatic anxiety, and self-confidence) is divided into three domains (direction, intensity, and frequency). The calculation of the IZOF respected the particularities of each field predicted by the tool since each score behaves in a different way, but it was tiered for better understanding in practice.

According to the literature, the anxiety levels in the ZFOI of each athlete are found by the intervals of standard deviations of the tool used (Nogueira; Bara Filho; Lawrence, 2019; Woodman; Albinson; Hardy, 1997; Krane, 1993; Hanin, 1978). However, using the mean standard deviation interval, one standard deviation, or even two standard deviations, may interfere with the results. The results found were systematized and tiered so that values from 0 to 10 appear to the user, to facilitate the visualization by the coach and the athlete. For example, the frequency dimension has an amplitude of responses from 10 to 70 units of measurement, that is, there are 60 possibilities of anxiety levels in the frequency dimension. According to the tool, to obtain the level of anxiety in the IZOF, the calculation is done by

the sum of the answers, divided by the number of questions, and multiplied by 10 (ranging from 10 to 70).

For example, an athlete who has cognitive anxiety levels of 30 units of measurement (considered average levels by the tool), when applying the standard deviation, the IZOF changes from approximately 27 to 33 units. With the proposed methodology, this value is converted by applying an interval between 0 and 10, the athlete will have levels equal to 5. Thus, IZOF will have easier and more intuitive visualization for coaches and athletes.

3.4 Usability testing and experience analysis

According to Garrett (2011), user experience is what makes the tool become a part of the everyday life in the real world by creating a routine aligned with the app objectives, which is what we found with the *Ansiedômetro* app and its acceptance by the participants. Moreover, users who cannot learn quickly give up and move on to other alternatives, regardless of whether the tool is correctly developed at the level of functionality; if its usability is not good, the user will reject it (Volpato, 2014).

To test usability and analyze the users experience with the *Ansiedômetro*, a study was conducted with 50 student athletes (31 men) and 5 coaches (3 men) from a Public Higher Education Institution involved in team sports (basketball, volleyball, handball, and futsal), of both sexes, with a mean age of 21.8 years (SD=1.72 years), average practice time of 3.9 semesters (SD=2.91), with 3.9 average hours of weekly training (SD=1.70 hours). The students participated in regional university championships and the games were held on weekends.

In the self-analysis of the use of the app, the first question (“Did you manage to take advantage of the pre-competition results in any way?”) had a positive result from 98% of the athletes (49) and 100% of the coaches (5). In the second question (“Did knowing the results before the competition influenced your performance?”) obtained 90% of positive answers among athletes (45) and unanimity among coaches (100% positive response). In the last question (“What did you do when you saw the pre-competition and IZOF results?”) the actions that appeared the most were: I became calmer because I was very anxious (30%); I remained more confident (26%); I tried to improve my confidence because it was poor (20%); I understood how my body works (10%); did not answer the question (14%).

Among coaches, the main answer to this question is related to knowing the athletes (80%), talking to the athletes to increase their confidence (60%), and avoiding pressuring

them before the game (40%). None of the coaches omitted responses, and some answered twice.

In addition to the answers given via the questionnaires, the *Ansiedômetro* also received positive verbal feedback from the coaches at each collection. With the tool, the possibility of knowing the athlete better was active and contributed to decision making before and throughout the match.

Given the positivity in which the tool was received, the app may be expanded; its usability was considered intuitive, and the relevance of the tool was reinforced with the users' verbal reports; identifying the levels of anxiety and self-confidence helped both athletes and coaches. Based on participant suggestions, the following changes were implemented:

1. Terminology Adjustment: replaced "pre-competition" with "pre-match" to improve user comprehension.
2. Instructional Clarity: added onboarding guides on the home page for first-time users.
3. Accessible Language: simplified technical language used in the result explanations to enhance understanding by non-specialists.

These adaptations reflect the humanization of the digital experience, a crucial element for promoting behavioral engagement with technological tools in sport (Volpato, 2014; McCloskey, 2014). With the usability test and the analysis of the user experience, the cycle proposed by the DSR was complete and the *Ansiedômetro* ready for use on larger scales. Its creation process respected the reality found in the psychology of sport, specifically in pre-match anxiety, and obtaining the ZFOI resulted in improvements in the knowledge of the athlete's own body and the relationship between coaches and athletes strengthening the ties between the parties.

5 CONCLUSION

This study presented the development, application, and evaluation of *Ansiedômetro*, a digital tool grounded in Sport Psychology principles and designed to measure and communicate athletes' competitive anxiety levels within the framework of the Individual Zone of Optimal Functioning (IZOF). By translating theoretical constructs into a practical and intuitive interface, the tool enabled athletes and coaches to monitor anxiety in real time and use this information strategically. This represents a significant contribution to the applied

field of sport psychology, which has long sought effective methods to assess and manage psychological readiness under the pressure of competition.

The results of this study demonstrated strong adherence and positive reception by users: 98% of athletes and 100% of coaches reported that the app's feedback influenced their preparation or performance; heuristic evaluation of usability yielded a high score (47.1 out of 50), reinforcing the interface's accessibility and effectiveness; and participant feedback led to key improvements, such as clarifying language, simplifying technical explanations, and adjusting terminology to better fit the sporting context. Most notably, the app facilitated emotional self-regulation among athletes and created new opportunities for constructive dialogue between athletes and coaches, a core element in the psychosocial dynamics of sport performance. By offering tailored insights into the intensity, direction, and frequency of anxiety responses, *Ansiedômetro* encouraged a more individualized, self-reflective approach to emotional preparation, thus operationalizing the IZOF model in an accessible and evidence-based way. The practical implications of this tool are wide-reaching: athletes gain greater self-awareness and agency over their pre-competition routines, coaches receive meaningful psychological profiles to guide decision-making, and sport psychologists obtain a scalable platform to bridge assessment and intervention.

Therefore, *Ansiedômetro* emerges not only as a technological innovation, but also as a behavioral support system that strengthens the athlete–coach relationship and enhances psychological readiness in competitive settings. Future directions involve expanding user access, integrating the tool with other performance-monitoring systems, and exploring its longitudinal impact across diverse athletic populations. With its scientific foundation, usability, and real-world relevance, *Ansiedômetro* offers a compelling advancement in the field of Sport Psychology, helping to ensure that athletes are not only physically prepared but also psychologically optimized for competition. So, with the advances presented here, the *Ansiedômetro* is available to external users, that is, the next step is the dissemination of the work developed allowing any athlete or coach to use the system through the web page available from www.ansiedometro.com.br.

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