



Engagement of Community Health Workers in the Amazonas in the Development of an Educational Technology: A Co-Design Study

Key Points:

- The active participation of Community Health Workers (CHWs) in the co-design process allowed the development of educational materials adapted to the local reality, accessible and easy to understand, strengthening the confidence of these professionals in providing guidance on the management of type 2 diabetes
- The evaluation using the SUS scale demonstrated that the materials produced are effective in terms of usability. This directly contributed to improving the performance of CHWs, increasing their confidence in passing on information to the community
- Despite regional limitations, the methodology applied has the potential to be replicated in other regions and for other health conditions. The study also reinforces the essential role of CHWs in Primary Health Care (PHC), especially in vulnerable contexts such as Amazonas

Supporting Information:

Supporting Information may be found in the online version of this article.

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Abstract Community Health Workers (CHWs) play a pivotal role in the management of Type 2 Diabetes Mellitus (T2DM) within Primary Health Care settings. Adequate training is essential to strengthen their capacity to deliver care, particularly by fostering dialogue between the health team and the community. This study aimed to describe the co-design process underlying the development of an educational technology (ET) intended to train CHWs in T2DM management in the Brazilian Amazon. This mixed-methods study involved the development of video lectures and printed support materials through the following stages: identification of CHWs' primary training needs; definition of the ET structure; development of thematic content, scripts, and instructional materials; creation of interactive resources; expert review; preliminary presentation to CHWs; and final evaluation and validation by experts. Usability was assessed by CHWs using the System Usability Scale (SUS), with scores ≥ 72.74 considered indicative of acceptable usability. The 17 participating CHWs rated the ET positively, with a mean SUS score of 84 ± 11.1 , reflecting high usability. The educational technology demonstrated strong usability and, given its collaborative and problem-oriented development process, represents a promising tool to enhance CHWs' performance in T2DM management.

Plain Language Summary In the state of Amazonas, Community Health Workers (CHWs) are essential for helping people with type 2 diabetes, especially in regions with few resources. To better support them, this study developed, together with the CHWs themselves, a set of video lessons and educational printed materials. The creation was done in stages, listening to the needs of these professionals and testing the materials with experts. In the end, the CHWs evaluated the material as easy to use and useful for daily life. This new tool can improve care for the population and strengthen the work of CHWs in diabetes prevention and care.

1. Introduction

Diabetes Mellitus (DM) continues to be a public health problem due to its high prevalence and evidence that points to an increase in global projections (GBD, 2023; NDC, 2024). In Brazil, a study revealed that 68.2% of people were aware of having T2DM, of which 92.2% adhered to some type of treatment. However, only 35.8% were able to maintain control of the disease (Tonaco et al., 2023).

Therefore, in order to increase the percentage of successful control, it has been crucial to better understand the context of each population, understanding the disparities and strategies that can be adopted within the multiple and complex contexts (GBD, 2023; NDC, 2024).

In view of this scenario, from the perspective of Primary Health Care (PHC), Community Health Workers (CHWs) have a fundamental role in mediating the dialog between professionals of the Family Health Strategy (FHS) and the community, ensuring that the population's needs are heard and addressed. By deeply understanding the limitations and potential of the territory, CHWs adapt information into accessible language, respecting local culture and customs, which makes them essential in promoting health and developing strategies that truly align with the community's lived reality (Gama et al., 2021; Najafizada et al., 2015; Toledo & Rodrigues, 2017).

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Moreover, their engagement in programs and interventions aimed at adherence to diabetes management strategies contributes to more effective and personalized actions (Babagoli et al., 2021; Olaniran et al., 2017). Thus, they need to be trained for actions aimed at controlling T2DM and also actively collaborate in the development of such training. Involving CHWs in the design of training actions and materials is a co-design strategy that promotes collaboration between different parties to define problems, bring unheard voices from the community, and develop realistic solutions, which increases the delivery and use of the service (Singh et al., 2023). This approach allows for equitable collaboration in the construction of designs, taking into account contextual, cultural, and temporal factors, as well as the interaction between them, a factor that can trigger unexpected results for researchers (Schwoerer et al., 2022).

Studies have demonstrated positive results in the application of co-design in interventions focused on health education and the development of educational technologies (ETs; Silvola et al., 2023; Slater et al., 2022; Spencer et al., 2011). This theoretical and methodological approach is based on the active collaboration among different stakeholders (such as users, researchers, managers, and community members) to co-create solutions aimed at previously defined problems, promoting citizen participation, shared responsibility, and power distribution (Masterson et al., 2024; Vargas et al., 2022).

Co-design is guided by principles such as meaningful involvement, mutual respect, power negotiation, shared responsibility, continuous dialog, and contextual adaptation, ensuring that the developed solutions are socially relevant and culturally appropriate (Cumbo & Selwyn, 2021; Masterson et al., 2024). Its theoretical foundations include Participatory Design of Scandinavian origin, Activity Theory, Change Laboratory, and Community-Based Participatory Research, all oriented toward transforming practices through collaboration between researchers and participants (Ambrosetti et al., 2025; Cumbo & Selwyn, 2021; Masterson et al., 2024).

From this perspective, co-design has proven to be an effective approach in the training of health professionals, fostering the creation of more meaningful, contextualized, and sustainable materials in the long term (Silvola et al., 2023). Although few studies explicitly describe the use of co-design with CHWs in the management of T2DM, evidence from health education programs involving the active participation of community agents and users indicates greater adherence, cultural relevance, and positive clinical outcomes (Desse et al., 2022; Kia-Keating et al., 2024; Slater et al., 2022; Spencer et al., 2011). These initiatives have reported reductions in HbA1c levels, increased participant engagement and satisfaction, and improved cultural adaptation of educational materials, reinforcing the potential of co-design to enhance health interventions aligned with local needs (Slater et al., 2022; Spencer et al., 2011).

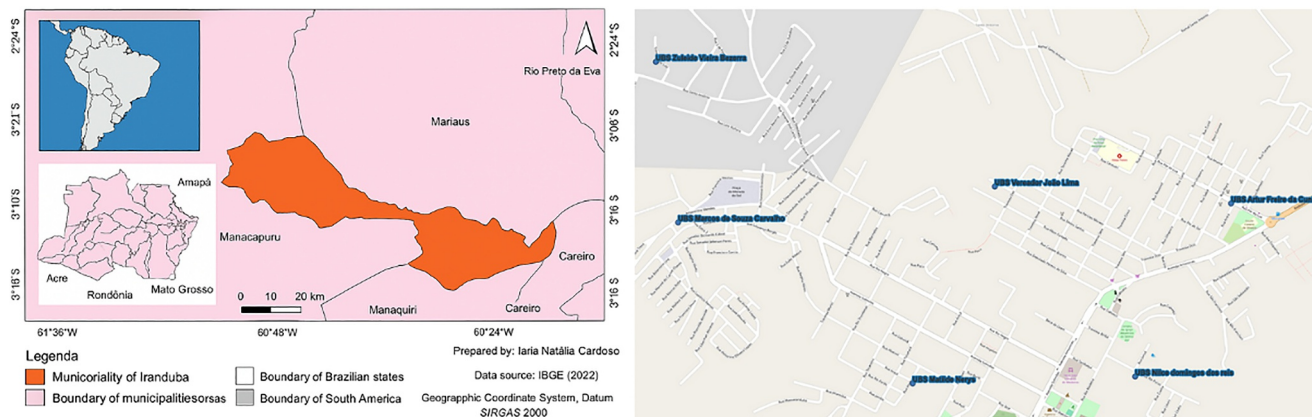
With this in mind, how would the co-design process in which CHWs contribute to the construction of ETs aimed at their training in the management of T2DM in the interior of Amazonas take place? The methodological process of co-design for the development of two ETs was described, as well as their use by CHWs working in Amazonas in training for the management and care of T2DM in the community served by PHC.

2. Methods

This is a mixed-methodological research approach developed in different stages to develop a ET aimed at CHWs in the Amazon context on the management of T2DM. The data used in this article come from the research “Intervention led by CHW for the management of T2DM in the interior of Amazonas” developed by the research group Primary Care Health in the Amazon Population (SAPPA). The study took place between 7 November 2023 and 21 February 2024 and was approved by the Research Ethics Committee.

The study was conducted in the municipality of Iranduba, located approximately 40 km from Manaus, the capital of the state of Amazonas. The municipality was founded in 1981 and has 61,163 inhabitants, of whom 44.1% have a monthly nominal per capita income of up to half the minimum wage, 85.3% of households lack adequate sanitation, and the Human Development Index is 0.613 (CNES, 2025).

The population of Iranduba is composed mainly of descendants of Indigenous peoples and migrants from nearby riverside and rural communities, including families of Tukano, Sateré-Mawé, and Apurinã origin, among others (SEAS-AM, 2021). Portuguese is the predominant language, although in some localities traditional expressions and ways of life are still preserved, especially among older generations (MPI, 2025). The municipality is experiencing a sociocultural transition, characterized by the coexistence of traditional practices and contemporary



Map 1. Location map of the study área (Location of the municipality of Iranduba/Amazon/Brazil and 6 PHC). Source: OpenStreetMap data © contributors—Adapted by authors (2025).

urban values, reflecting the influence of economic expansion and increasing access to public health and education policies.

To ensure territorial and sociocultural representativeness within the municipality, a preliminary mapping of Iranduba's Primary Health Care Units (PHC) was conducted, taking into account population distribution, areas of greater social vulnerability, and FHS coverage. The municipality has 14 PHC, of which 9 are located in urban areas and 5 in rural zones (CNES, 2025). Of these, 6 urban PHC were randomly selected to participate in the study, as shown in Map 1. The focus on urban units was due to greater accessibility and a higher concentration of CHWs available to participate in the co-creation activities.

A total of 34 CHWs participated in the study. However, only 17 were involved in the development process of the educational tools (ETs), due to their allocation into two groups: a control group ($n = 17$) and an intervention group ($n = 17$), with only the intervention group participating in the co-design of the ETs and training sessions. The CHWs were intentionally selected based on their availability and interest in taking part in the study activities. All of them are professionals linked to the FHS in the municipality of Iranduba and work directly within the communities where they live, which ensures close sociocultural proximity with the users, facilitating the identification of local health needs and strengthening community bonds.

CHWs are typically recruited by the municipality in accordance with guidelines from the Brazilian Ministry of Health, which include residing within the catchment area of the primary care unit, having completed secondary education, and demonstrating strong communication and interpersonal skills for educational and family guidance activities (Brasil, 2022). Before beginning their duties, CHWs receive initial and ongoing training on topics related to primary health care, health surveillance, and self-care promotion. In the context of this study, they were provided with additional capacity-building sessions focused on the co-design of ETs aimed at promoting health among patients with T2DM.

In their routine work, CHWs act as mediators between health teams and the community, conducting home visits, educational groups, and community mobilization activities. The intervention was designed to meet the needs of the population served by the CHWs adults and elderly people with T2DM in the urban area of Iranduba, generally a population with different educational levels, as are the CHWs themselves, a common characteristic of a city in the interior of Amazonas.

Both the CHWs and the users demonstrated little knowledge about diabetes as a chronic condition, frequently confusing the types of diabetes, types of treatments and care for the disease, especially regarding diet, which is made difficult by financial constraints, irregular access to medication, food insecurity and the challenge of translating medical recommendations into daily practices. Their active participation in the co-creation process enabled important cultural and linguistic adaptations to the intervention content, ensuring that the educational messages reflected local values, practices, and expressions.

Co-design process of an Educational Technology for CHW

STAGES OF METHODOLOGICAL RESEARCH

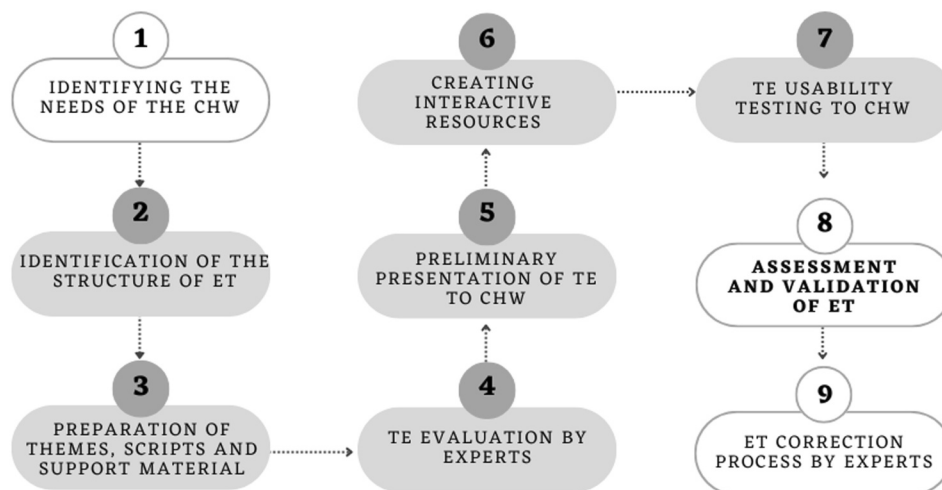


Figure 1. Stages of development and evaluation of the training. *Source:* Authors.

In addition, a multidisciplinary technical and scientific support team participated in the study, composed of researchers from the SAPPA group, faculty members from partner universities, and specialists from the Ministry of Health. This team included professionals trained in Physical Education, Physiotherapy, Public Health, and Health Promotion, with extensive experience in action research, community-based interventions, and the development of educational tools for primary health care. The team members have a strong background in projects focused on physical activity, chronic disease prevention, and strengthening care networks within the FHS, particularly in contexts of social vulnerability and cultural diversity.

3. Methodological Procedures

Initially, to characterize the CHW, a semi-structured questionnaire was applied containing sociodemographic data such as name, age, sex, marital status, number of children, race or skin color, time living in the community (in years), time working as a CHW (in years), number of families served monthly, the PHC in which they are inserted and the time they have worked in the PHC in which they work.

To construct the TEs, the co-design process followed 9 stages organized chronologically, which included the 17 CHW, the 8 researchers from the SAPPA group, the 2 teaching researchers from partner universities and the 3 specialists, as illustrated in Figure 1.

3.1. Identifying the Needs of the CHW

Initially, an on-site visit was scheduled with 34 CHWs to invite them to participate in the study, and 17 workers agreed to participate. The first activity consisted of a qualitative data collection based on the “World Café” method by Brown and Isaacs (2005). This structured approach to exchanging ideas took place in two previously scheduled two-hour virtual meetings, providing a space for dialog with the researchers about the barriers and facilitators in the management of T2DM in the community.

The dynamics were based on the discussion of five themes: healthy eating habits, physical activity, medication adherence, environmental factors, and willingness to change habits, as supported by Krueger and Casey (2015) for the organization and moderation of effective thematic discussions to encourage the participation of CHWs and extract meaningful reflections. Using this method, the needs relevant to disease care in the PHC environment were identified, taking into account the specificities of the interior of Amazonas. The meetings were led by a PhD researcher and two auxiliary researchers from the SAPPA group, and were recorded on video.

3.2. Identifying of the Structure of ET

To identify the training format desired by the CHWs, structured interviews with closed-ended questions were conducted with the aim of understanding the ideal training model from the CHWs' perspective, investigating their previous professional experience, internet access, and learning preferences. The interviews addressed aspects such as length of service, work routine, training history, and the importance of these educational activities. In addition, they explored preferred course formats, in-person, remote, or hybrid, the most suitable schedules, and virtual teaching platforms. Questions regarding the instructional materials they wished to receive, the duration and formats of the training, as well as methods of content delivery, complemented the survey, contributing to the development of an efficient and accessible training program.

3.3. Preparation of Themes, Scripts, and Support Material

Based on the information obtained, the preparation of the themes and scripts for the support material began. To this end, weekly virtual meetings were held via Google Meet over the course of 2 months. These meetings were attended by members of the SAPPA team, which is made up of eight researchers, including two professors from partner universities and three specialists in the areas of Physical Education, Physiotherapy, Nutrition and Nursing.

The process of formulating the themes and outlines of the ET was based on previous scientific surveys of the literature on the main needs of content that is generally lacking for CHWs during their education, training and training.

Therefore, considering the main areas of action in the treatment of T2DM, as well as the testimonies of CHWs, the recommendations by the Brazilian Diabetes Society and the Ministry of Health highlight the importance of a multifactorial approach in the treatment of T2DM, encompassing interventions in diet, physical activity and use of medications (Ambrosetti et al., 2025; Cumbo & Selwyn, 2021). The integration of these approaches, adequate diet, regular practice of physical activity and use of appropriate medications, are fundamental for the effective control of the disease and for improving the quality of life of users.

With this in mind, each pair of SAPPA team worked on a specific theme in their area of expertise under the collaborative monitoring of a professor with a PhD. Thus, the following topics emerged to be addressed: glycemic control; adherence to medication use, healthy eating and physical activity; role and importance of CHW in care; action plan and its implementation by users with T2DM; encouragement of active participation and self-care supported in the treatment of T2DM; individual strategies for acquiring healthy habits; and collective strategies for acquiring healthy habits.

Then, the complementary texts, containing all the information on each topic, were presented for group discussion and review. After this stage, the team proceeded with the development of a support material that CHWs could consult both during the training and in their home visits, with the aim of clarifying their questions about the disease and its management, as well as assisting them in explaining information to community members. For this purpose, a 106-page booklet with seven chapters on the management of T2DM was created, designed according to the CHWs' preferences and intended for printed distribution.

This material was carefully developed to address the linguistic, ethnic, and cultural diversity of the region where it would be implemented, considering that most CHWs and users have varying levels of schooling, unique ways of living, and distinct local dialects and expressions. Therefore, the content was written in simple and direct language, avoiding technical terms and adding additional explanations when needed. Examples, metaphors, and everyday situations from the interior of Amazonas were incorporated, such as local foods, typical travel dynamics between riverside communities, regional expressions, and common family structures.

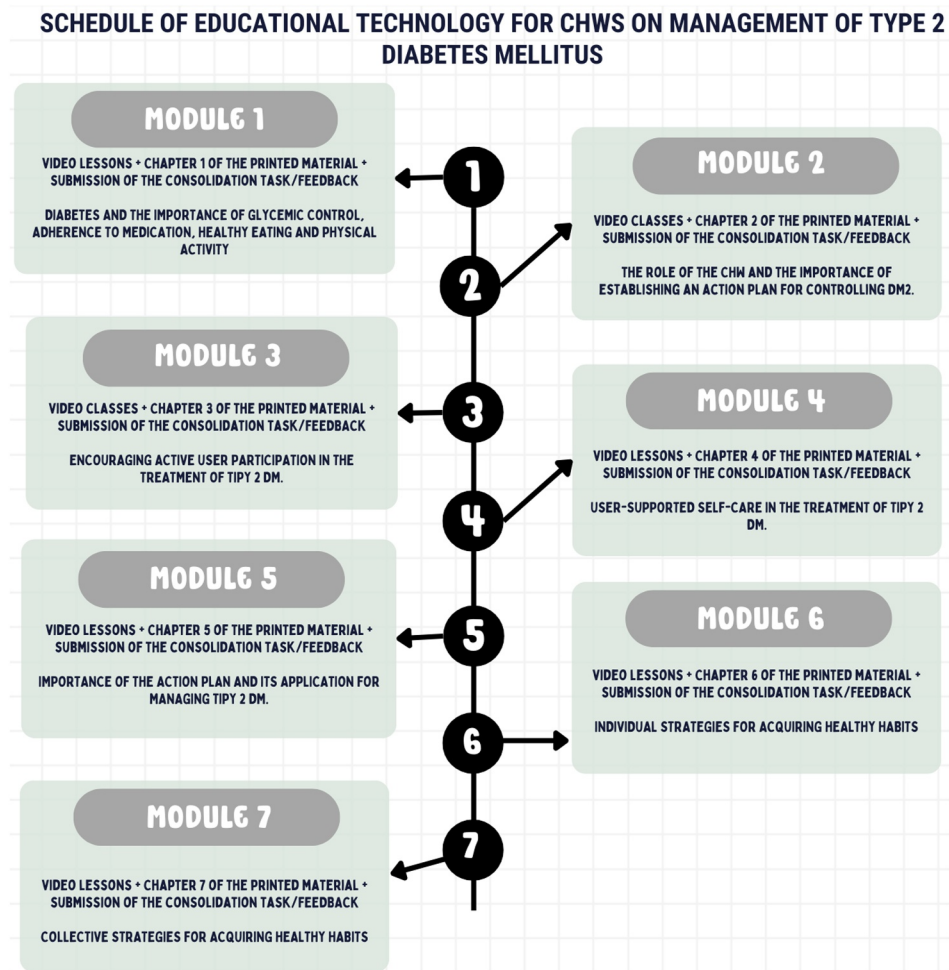


Figure 2. Modules and chapters of the ETs to the CHW. *Source:* Authors.

Additionally, CHWs from the region acted as cultural mediators during the development of the material, reviewing the level of comprehension of sections, videos, and terms, suggesting adjustments in the approach, and ensuring that the guidance aligned with local practices, beliefs, and realities. In this way, the support material was adapted to reflect the cultural identity of the CHWs and the communities they serve, enhancing its practical relevance within the Amazon context.

In addition, a schedule of 5 modules with 4 video classes on the same topics was created, as illustrated in Figure 2.

3.4. Evaluation of the ET by Specialists

After the development of the products (support booklet and video lessons), 3 specialists from the General Coordination for the Promotion of Physical Activity and Intersectoral Actions, the Department of Health Promotion, the Secretariat of Primary Health Care, of the Ministry of Health evaluated the products. With the feedback from the specialists, the requested adjustments were made and the material was reviewed and improved to ensure its quality and suitability to the established criteria.

3.5. Preliminary Presentation of the ET to the CHW

After the stage of adjustments to the materials according to the evaluation of the specialists, a meeting of up to 2 hr was held with all the CHW for the presentation and both were invited to participate in a preliminary evaluation of the material. At this stage, five CHW representing different Basic Health Unit returned with suggestions. With the

ET in hand, the CHW viewed the model and design of the material and were able to discuss and express their opinions and possible adaptations regarding its format.

3.6. Creation of Interactive Resources

In this phase, which corresponds to steps 6, 7 and 8 of Figure 1, the ET was created using interactive slides, video lessons and reinforcement tasks. The graphic design software Canva was used to produce the interactive slides, which also served as a tool to illustrate the video lessons recorded later.

A total of 20 video lessons were recorded, subdivided into 4 units for each module, each lasting 8–10 min. These were taught by four health professionals and members of the SAPPA group, who created a schedule with program content and lesson scripts to compose the interactive slides used to record the classes. These were then thoroughly evaluated by research professors specializing in ET in health. A studio at the University was used to record the classes to ensure the quality of the images and sound.

Finally, based on the lesson plan and the schedule illustrated in Figure 2, the SAPPA group team also created some reinforcement tasks for the CHWs to answer at the end of each module. These tasks consisted of discursive questions along with feedback on the content of the week's module, generating a level of satisfaction of the CHWs regarding the modules and chapters of the TE.

3.7. Usability Test of the ET for the CHWs

With the revised and adjusted material in hand, the modules containing all the ET were presented to the CHWs, including excerpts with the video classes in each module, reading instructions on different pages of the printed material, and the presentation of some exercises as a reinforcement task. For this stage, as mentioned, 5 CHWs participated, a number considered adequate for this type of study (Lynn, 1986).

In this way, each CHW was randomly assigned one or more modules to evaluate. Next, the System Usability Scale (SUS) instrument was applied as applied by Brooke (1996) and validated in different contexts by Bangor et al. (2008, 2009) to address the dimensions of usability and learnability (Lewis, 2018).

The SUS examines the effectiveness and efficiency of the object of study, as well as user satisfaction, in addition to having evidence of reliability, validity and sensitivity regarding the amount of experience with the product and the self-reported levels of knowledge of the equipment tested (Alexandre & Coluci, 2011; Lewis, 2018).

It is a 10-item questionnaire, in which participants rate their perception of the comfort of use and reliability of the ETs. Among the issues addressed about the ET are the frequency of use, complexity of the content, accessibility and ease of use of the resources. It also examines the need for additional support for use, the integration of the ETs' functionalities, possible inconsistencies, the speed of learning and confidence when using the resources. In addition, the perception of the difficulty of adapting to the materials and the need for prior learning are also analyzed.

To calculate the score, participants assign a score from 1 (completely disagree) to 5 (completely agree), where the final score varies from 0 to 100, with Bangor et al. (2008, 2009) defining the “OK” score as 72.74, while “Good” starts at only 72.75 and “Excellent” only at 85.5.

3.8. Evaluation and Validation of the ET

As part of the co-design stages of the ETs, an evaluation of the ETs was carried out according to the methodology proposed by Alexandre and Coluci (2011). In this way, the pre-selection of expert judges in the health area and other areas was carried out using the Lattes platform (an online platform created by the federal government to gather information about the academic and professional lives of researchers and students in a standardized curriculum) as a strategy for analyzing the curricula. Ten expert judges participated, 6 from the health area and 4 from other areas, including one judge with experience in editing and layout. The experts who agreed to participate in this stage received the material in electronic format accompanied by an evaluation questionnaire via Google Forms.

For this, the Suitability Assessment of Materials (SAM) instrument was used, a method used to evaluate the suitability of educational and informative materials, taking into account aspects such as content, language,

graphic illustrations, motivation, cultural suitability, writing style, objectives, structure and presentation. To validate the material, the SAM SCORE completed by each expert judge was calculated from the sum of the points attributed to different criteria, categorizing the materials as: Superior (70%–100%), Adequate (40%–69%) and inadequate (0%–39%), as per Doak et al. (1996).

The evaluation aimed to assess the quality and adequacy of the material in terms of technical-scientific, didactic-illustrative, communication-interface content and specific items such as clarity, relevance, coherence and applicability in professional practice in health and other areas. When completing the questionnaire, the judges provided their perceptions and suggestions, ensuring that the material was validated in a manner similar to the methodological criteria of Pasquali (2010).

3.9. Process of Correction of the ET by Experts

All corrections suggested by the experts were tabulated in spreadsheets and corrected by 3 team members. A meeting was then held with all members of the SAPPA group to inform them of all the changes and to verify that all suggestions had been taken into account. The objective of this stage was to ensure that the material was understandable and applicable in interdisciplinary contexts, reinforcing its validity and usability. The second stage of correction is still in progress.

4. Results

The partial structure of the ET after the first stage of correction carried out by the expert judges was based on the need for a spelling and language review, according to the guidelines proposed by Barone et al. (2022), as described in the Language Matters Guide and updates from the Brazilian Diabetes Society (2024), which were strictly followed. In the support notebook, the main recommendations were directed to making the chapters more objective, thus reducing the amount of content and redistributing the chapters into seven instead of five to improve the logical flow of the material, which after the feedback, were met. And as for the video classes, the recommendations to reduce the duration to a maximum of 5 min and improve the terminology to facilitate understanding were met. However, the second stage of evaluation after this first correction is still underway to finalize the ET validation process.

Regarding the training itself, the identification of the structure and format of the TEs chosen based on active listening, 70% ($n = 12$) showed a preference for remote training given the ease of accessing the internet at other times, 11% ($n = 2$) allowing it to be carried out at any time during ($n = 2$) and 70% ($n = 12$) after work hours, depending on the time available and their interest.

Regarding the format, 52% ($n = 9$) opted for the mixed method, combining video classes and printed material, and suggested that the content be sent via WhatsApp, allowing access at any time via cell phone. Furthermore, with regard to time, the proposal had a duration of 30–60 min. Regarding the CHWs who participated in the usability test ($n = 5$), it is possible to observe important information about the sociodemographic and professional characterization of the participants such as distribution by sex, average age, marital status, ethnicity, number of children and time working in the community, as observed in Figure 3 and Table 1.

4.1. Usability of ET According to the CHWs

The usability of ET was assessed by the CHWs, resulting in an average of 84 ± 11.1 points, indicating a perception of good usability of the material.

When analyzing the questions individually, it was found that 8 of the 10 questions received positive answers. In this context, the CHWs considered that ETs (support material and video lessons) are interesting resources for frequent use, easy to access and learn, presenting harmony between the elements and absence of inconsistencies. In addition, they reported ease both in learning and in using the material by other people, absence of complexity in use, feeling confident in the application and the lack of need for prior learning for its use.

However, although 60% of the participants did not consider the content more complex than necessary, two participants disagreed, evaluating it as more complex than its purpose (Question 2). Another question revealed that, although 60% of the CHW considered the support of a specialist or co-worker unnecessary for the effective use of the material, some of the participants expressed an opposing opinion.

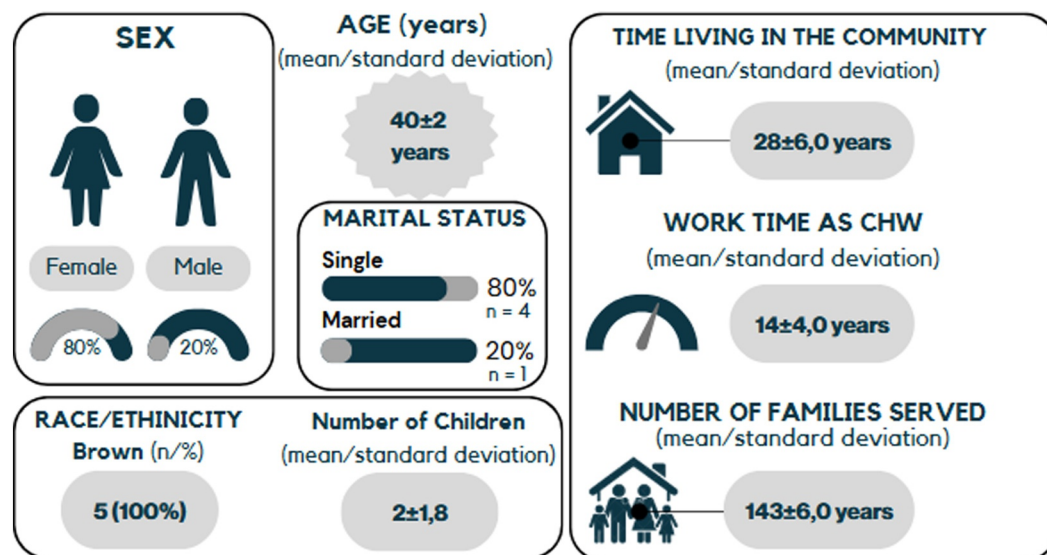


Figure 3. Profile of CHW in the usability phase. *Source:* Authors.

5. Discussion

The main finding reveals that the active participation of CHWs in the co-design process enabled the development of ETs that were highly adapted to their needs and local reality, resulting in accessible and easy-to-understand materials. This stands out as a differentiator by demonstrating that this collaborative approach not only improves the usability of the materials, but also increases the confidence of CHWs in transmitting information about the management of T2DM.

These results suggest that the active collaboration of CHWs not only favors the acceptance and applicability of ETs in the routine of these professionals, but also reinforces the importance of co-design as an essential tool for the creation of effective educational solutions, enhancing professional training and the quality of community care. Based on this observation, we will discuss the implications of these findings and their potential to influence future research and practices in the area.

However, understanding the unique role of CHWs in the communication between PHC professionals and the community is fundamental. To this end, thinking about training actions for these professionals requires their collaboration in the development process. In the case of this article, this participation occurred through co-design (Schwoerer et al., 2022; Singh et al., 2023).

With the participation of the CHWs, this study sought to present the methodology and results of the co-design process for the development of TEs aimed at CHWs working in Amazonas, with the objective of training them to manage T2DM in the community (Fórum DCNTs, 2022; Sociedade Brasileira de Diabetes, 2024). Currently, the development of technologies has been a tool of great importance for health professionals focused on training, assistance and research (Corradi et al., 2011; Fonseca et al., 2013; Grossi & Kobayashi, 2013; Prado et al., 2013; Rangel et al., 2012).

In the specific case of the usability of ETs, the use of the SUS scale allowed us to verify the effectiveness of the support material and video classes. This evaluation highlighted the perception of the CHWs in relation to the resources used, demonstrating that they are accessible and easy to understand. In addition, the results indicated that the quality of usability remains consistent, regardless of the system adopted or the tasks performed, ensuring greater reliability in the analysis (Bangor et al., 2009).

The active participation of the CHWs in the preparation of the ETs proved to be relevant both for the quality of the material produced and for the impact on the performance of the professionals themselves, who reported being more confident in transmitting information about T2DM (Fonseca et al., 2013). In this sense, it is highlighted that increasing the participation and involvement of the main stakeholders can strengthen the innovation, implementation and overall success of population health initiatives (Silva et al., 2019; WHO, 2009).

Table 1
Result of the System Usability Scale (SUS) Questionnaire by Question

Variable	Value n (%)
Question 1. I will frequently use these resources (support material and video lessons) in my professional development	
Strongly disagree	3 (60)
Strongly agree	2 (40)
Question 2. The content is more complex than necessary for the purposes of the course	
Disagree	3 (60)
Agree	1 (20)
Strongly agree	1 (20)
Question 3. The resources (support material and video lessons) are easy to use and accessible for my learning.	
I strongly agree	3 (60)
Agree	2 (40)
Question 4. I would need the support of a specialist and/or another coworker to effectively use these resources (support material and video lessons)	
Strongly disagree	3 (60)
Neither agree nor disagree	1 (20)
Agree	1 (20)
Question 5. The various functionalities of the resources (support material and video lessons) were harmoniously integrated	
Strongly agree	3 (60)
Agree	2 (40)
Question 6. There were several inconsistencies in the resources (support material and video lessons) provided	
Disagree	3 (60)
Strongly disagree	2 (40)
Question 7. Most people would be able to learn how to use these resources (support material and video lessons) quickly	
Strongly agree	3 (60)
Agree	2 (40)
Question 8. The resources (support material and video lessons) are very complicated to use	
Strongly disagree	3 (60)
Disagree	2 (40)
Question 9. I felt confident in using these resources (support material and video lessons)	
Strongly agree	5 (100)
Question 10. I had to learn a lot before I could handle these resources (support material and video lessons)	
I disagree	4 (80)
I strongly disagree	1 (20)
Final score	84 points

Source: Authors.

It was observed how co-design can be used in health-related studies, challenging a traditional positivist approach to science. It is characterized by the partnership between professionals and researchers, aiming to develop technologies to qualify the service provided and, consequently, improve the health of users. Therefore, co-design

establishes a link between those involved, allowing mutual learning and work, generating useful and high-impact products, from planning to final delivery (Vargas et al., 2022).

Although it is a relatively recent approach, there are other studies that evaluated usability through the SUS scale. For example, a study conducted in Norway analyzed the usability of a website and obtained a SUS score of 77.52, indicating good usability. Similarly, national studies have used the SUS scale in different contexts, such as in the evaluation of a neonatal health information system, in which 94% of participants classified the system as “good”, “excellent” or “best possible”⁴⁴, in the analysis of the usability of mobile applications for pregnant women (Andrade & Paiva, 2017) and in the evaluation of an application for electronic recording of pre-hospital care, which obtained a SUS score of 76.67 (Augusto et al., 2021; Borges et al., 2021).

Ensuring the participation of CHWs in the preparation of materials used for training is to give these professionals an active voice, valuing their essential role in promoting health, in the link between the community and health services, in home monitoring and in responding to public health emergencies, as recognized by the WHO (2009). This strengthening of PHC directly contributes to improving community care. In the Amazon context, where almost half of the population lives on up to half the minimum wage (Desse et al., 2022), PHC and the role of CHW become even more fundamental in municipal public policy, since a greater number of people depend on the Unified Health System. Thus, in addition to more efficient, committed and safe care provided by CHW, a reduction in the percentage of cases of people who are unable to maintain control of the disease (35.8%) (WHO, 2021) is expected and, consequently, in the projections of new cases of T2DM (GBD, 2023).

Among the limitations of the study, it is worth highlighting that the ETs were developed specifically for CHW in the Amazon, which may limit their application in other regions with very different realities. In addition, the sample used is not representative of the population, although the proposal of a reduced number of participants to evaluate usability is based on the scientific literature (Lynn, 1986).

However, the study has several potentialities. This is an applied methodology that can serve as a model for the development of other TEs aimed at different health conditions and regions of Brazil. In addition, the collaborative approach resulted in a material that is more adapted to local needs and realities, increasing its acceptance and applicability in the routine of CHWs. This study has the potential to serve as a basis for future research, enabling the expansion of the initiative to evaluate the effectiveness of ETs in the long term, adapt the content to other contexts, develop materials aimed at other chronic non-communicable diseases, such as arterial hypertension, and improve its applicability through new interactive technologies.

6. Conclusion

This study presented the co-design process for the development of ETs aimed at training CHWs in the management of T2DM. The active participation of these professionals was essential for the creation of materials aligned with their needs and local reality, resulting in accessible, relevant and effective video classes and printed materials for their work.

The usability assessment, conducted using the System Usability Scale (SUS), revealed a highly positive perception by CHWs, with an average score of 84 ± 11.1 points, classifying the ETs as having “good” to “excellent” usability. These findings highlight the importance of direct involvement of CHWs in the design of educational materials and demonstrate the potential of these technologies to strengthen their professional training, directly reflecting on the improvement of the quality of care provided to the community.

Conflict of Interest

The authors declare no conflicts of interest relevant to this study.

Data Availability Statement

All data generated and analyzed in this study were produced within the research project “Intervention led by Community Health Workers for the management of Type 2 Diabetes Mellitus in the interior of Amazonas,” conducted by the Primary Care Health in the Amazon Population group. The data sets include: (a)

sociodemographic information from Community Health Workers, (b) structured interview responses and (c) usability assessments using the System Usability Scale (SUS).

Stored in a private Google Drive repository managed by the research team at the Federal University of Amazonas.

The ETs developed in this study, including the printed support material (106 pages), interactive slides, and recorded video lessons—were created exclusively for use by Community Health Agents (CHAs) in the municipality of Iranduba, Amazonas. These materials are currently undergoing a validation process and therefore cannot yet be publicly distributed. However, the final version of the Supporting Information S1 is already corrected and available. Both can be accessed through the following process:

1. Click on the link where the data presented in the study results are located and request access: https://drive.google.com/drive/folders/1yDz8aPJCmVfbzkye_5SsuSdFasUwhaCW?usp=drive_link
2. After access is granted, the data set will remain accessible for at least 10 years.

No DOI is available due to institutional confidentiality policy. No custom software was created for this study. The interactive materials were developed using Canva® (online design platform) and the online meetings were held via Google Meet®. These tools are proprietary platforms publicly available to users, but do not constitute software produced by the study (Canva, n.d., <https://www.canva.com/>; Google, n.d., <https://meet.google.com/>).

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