Evaluation of Cohesive Affective Design Model for People With Visual Challenges Through Expert Review Method

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***Abstract* – Affective design plays a crucial role in creating satisfying user experiences by incorporating emotional elements into product or interface development. However, visually impaired individuals often face challenges in accessing positive interactions that cater to their unique needs. This research presents an iterative approach to developing and evaluating an affective design model specifically tailored for visually impaired users. The iterative triangulation methodology (ITM) was employed across theoretical, construction, and evaluation phases, incorporating expert reviews to refine the model. Results from the expert review revealed the need for a more nuanced breakdown of elements, particularly in content, user, design, multimedia and learning, affective, technology, and interaction components.**

The revised model addresses these insights, emphasizing adaptability for visually impaired users. Key enhancements include specific design components, multimedia theories, and learning approaches. The revised affective design model offers improved clarity and readability, reflecting a comprehensive synthesis of expert insights. It contributes to creating an inclusive interaction environment for visually impaired individuals, aligning with broader goals of accessibility and inclusivity in design. This research serves as a valuable resource for educators, curriculum developers, and policymakers working towards fostering inclusive learning experiences.

***Keywords* – Interaction design, assistive technology, affective design, iterative triangulation methodology, user centred approach, expert review, visual impairment.**

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1. Introduction

Affective design can be found in various industries, including technology, automotive, fashion, and user interfaces. Affective design recognizes the importance of emotions in the user experience and strives to create designs that elicit positive emotional responses, leading to a more satisfying and enjoyable interaction between users and products or interfaces [1]. The goal of affective design is to go beyond mere functionality and usability to engage users on an emotional level, making the overall user experience more enjoyable, satisfying, and memorable [2].

The elements of affective design include:

(i) Emotional Appeal: Affective design seeks to create an emotional connection between the user and the product or interface. This includes taking into account how various design elements like colors, shapes, and imagery evoke emotional responses [2].

(ii) User Engagement: Designers aim to keep users engaged by incorporating elements that captivate their attention and elicit positive emotions. This can enhance the overall user experience and contribute to user satisfaction and loyalty [3].

(iii) Aesthetic Pleasure: Affective design places importance on aesthetics, recognizing that the visual appeal of a product or interface can significantly impact how users feel about it. This may involve attention to details such as typography, color schemes, and overall visual harmony [3].

(iv) Personality and Branding: Infusing products or interfaces with a distinct personality or aligning them with a brand's identity can create a more emotional and memorable experience for users. Consistency in design elements can contribute to a cohesive and recognizable brand image [2].

(v) Usability and Functionality: While emotional design focuses on feelings and emotions, it is essential to ensure that the product remains usable and functional. Emotional design should not compromise the core purpose and usability of the product [3].

(vi) User Feedback and Iteration: Continuous improvement based on user feedback is crucial in affective design. Understanding how users respond emotionally to different design choices allows designers to refine and enhance the emotional impact of their creations [3].

Numerous works in literature have contributed to the understanding of how emotions can be integrated into the design process. There are influential works that have shaped the discourse on affective design. This includes "Emotional Design: Why We Love (or Hate) Everyday Things" by Donald A. Norman. Donald Norman's book is a seminal work that explores the emotional aspects of design [4]. He introduces the concept of three levels of design which are visceral, behavioral, and reflective in which each influences users' emotional responses to products [4]. Norman argues that designers should consider these levels to create products that not only function well but also evoke positive emotions [4]. Next is "Affective Computing" by Rosalind Picard. Rosalind Picard, a pioneer in affective computing, lays the foundation for understanding emotions in the context of human-computer interaction [5]. Her work introduces the concept of affective computing, where technology can recognize, interpret, and respond to human emotions. While not exclusively about design, the book has influenced how designers approach the emotional aspects of user interactions [5]. Another previous work is "Affective Design in Human-Computer Interaction: From Theory to Applications" by Mehmood Khan. This book provides a comprehensive examination of affective design, covering theoretical foundations and practical applications in human-computer interaction [6]. It discusses emotional modeling, affective user interfaces, and the integration of emotions into the design process [6]. Then, "Designing for Emotion" by Aarron Walter. Aarron Walter's book focuses on web design and emphasizes the importance of designing with emotion in mind. He introduces the concept of "Designing for Delight," arguing that understanding users' emotional needs can lead to more engaging and satisfying user experiences [7].

This explains that affective design often emphasizes the need to move beyond traditional usability concerns to address users' emotional experiences [17]. It acknowledges that emotional responses play a crucial role in shaping perceptions of products and interfaces [18]. Researchers and authors often propose frameworks for incorporating emotions into the design process. These frameworks guide designers in considering emotional aspects systematically [19]. They may include stages for emotional elicitation, evaluation, and implementation into design decisions [8].

The previous literature on affective design also explores the aesthetics of products and interfaces [14]. This includes discussions on the impact of visual elements such as color, typography, and imagery on emotional responses. Designers are encouraged to use aesthetics deliberately to evoke specific emotions [15]. Some literature delves into the cross-cultural aspects of affective design, recognizing that emotions can be expressed and interpreted differently across cultures [8]. Designers are encouraged to consider cultural nuances to create universally appealing and emotionally resonant designs [9]. There are also researchers who often propose methods and tools for measuring emotional responses to designs. This involves both subjective measures (user surveys, interviews) and objective measures (physiological responses, eye-tracking) [9].

Understanding how users emotionally engage with a product informs design decisions. Affective design extends into creating a personality for products or interfaces. This involves aligning design elements with a specific brand identity or infusing products with traits that users can relate to emotionally. This leads to the concept of anthropomorphism which means treating products as entities with personalities [10]. The concept of emotionally intelligent interfaces is also often discussed, where systems can recognize and respond to users' emotions. This may involve adaptive interfaces that adjust content or interactions based on users' emotional states, creating more personalized and empathetic experiences. A growing focus within affective design literature is on creating inclusive designs that cater to users with diverse abilities [12]. This includes discussions on designing for users with visual impairments, cognitive disabilities, and other conditions, ensuring that emotional experiences are accessible to all [11]. Besides, some literature addresses the ethical implications of designing for emotions. This includes discussions on the responsibility of designers in influencing users' emotions and potential manipulations and ensuring that emotional design practices align with ethical standards [13]. As the field evolves, the previous works of literature also explore emerging trends and challenges in affective design [11]. This includes discussions on incorporating emerging technologies (such as virtual reality or artificial intelligence) into emotionally intelligent design and addressing ethical dilemmas associated with these advancements. In accordance, the literature on affective design is diverse and multidisciplinary, incorporating insights from design, psychology, human-computer interaction, and other fields [11]. It offers a rich tapestry of theories, frameworks, case studies, and methodologies aimed at enhancing the emotional aspects of user experiences. Exploring this literature can provide designers with a deeper understanding of how to create products and interfaces that not only function well but also resonate emotionally with users.

However, it was found that visually impaired people are lacking in terms of positive interactions that promote two-way interaction between people, technologies, and objects. The scarcity of this aspect must be challenging for the visually impaired because of their limitation in eyesight. Designing for users with visual impairments requires a thoughtful and inclusive approach to ensure that the product or interface is not only accessible but also considers the emotional well-being of the users. Therefore, this research has proposed an affective design model that is specifically designed to cater to the needs of visually impaired individuals, particularly in their interaction. The following section discusses the methodology involved in developing and evaluating the proposed model.

2. Research Methodology

This study encompasses three main phases which are theoretical, construction, and evaluation, requiring an iterative approach for comprehensive exploration. To address challenges and achieve the objectives, a variety of iterated data sources, methods, theories, and analyses have been employed. In alignment with these requirements, the iterative triangulation methodology (ITM) has been adopted, as depicted in Figure 1. Triangulation methods play a pivotal role in design research, facilitating the attainment of research objectives. ITM, applied in numerous prior studies for thorough triangulation across phases. It involves a third component; theory which is situated between construction and empirical testing. This theoretical phase encompasses communication with experts and content analysis, enriching the overall research methodology.

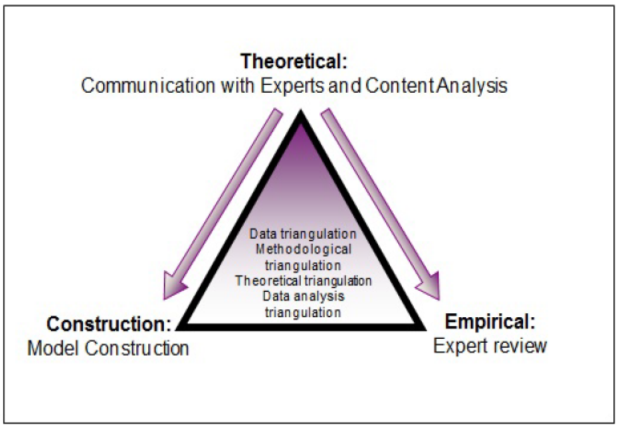

Figure 1. Iterative triangulation methodology

Rather than directly constructing the intended model, this study has undertaken a comprehensive understanding of the contextual phenomenon. This involved soliciting input from experts and delving into existing theories, models, and relevant technologies to provide a robust foundation for both model construction and empirical testing. Throughout these activities, triangulation has been systematically applied, encompassing data sources, methods, theories, and data analyses in an iterative manner. Study [16] elucidates the foundation of the ITM, which inherently involves these triangulation types throughout the entirety of the research process. Each phase involves specific activities, representing methods to achieve the respective sub-objective. There are discusses as the following:

(i) Theoretical Phase

The initial phase commences with a preliminary investigation, utilizing observation and interview methods involving targeted users. In defining the research problem, objectives, and gaps, the study conducts literature elicitation and content analysis of theories, approaches, and existing models. Each valuable input is critically analyzed, leading to the identification of the main research gap. The outcome of this phase encompasses the problem, needs, and available concepts in the context of interaction experience.

(ii) Construction Phase

In the construction phase, the study extracts the appropriate components and elements of the affective design model for visually impaired people based on literature study, expert consultation, and the user-centered design (UCD) approach. A UCD seminar is conducted with them. The outcome comprises specific components and elements to deliver the intended model, marking the achievement of the first and second objectives of the study.

(iii) Evaluation Phase

In the evaluation phase, the proposed model undergoes validation. Data verification with academicians and industrial authorities is conducted through the expert review method. Results from the expert review are analyzed and explained. The final iteration of the proposed model is performed to visualize it, and the third objective is achieved at this stage.Upon the last iteration, signifying the completion of the proposed design model, the study revisits the research questions and objectives. The direction and future research initiatives to enhance the study are elaborated as part of the conclusion phase.

The next section discusses and analyzes the gathered results.

3. Results and Discussion

The expert review method was conducted to review and validate the model. A total of 13 experts from various backgrounds were invited to contribute to the research findings. Below are the criteria for selecting an expert reviewer for the research:

(i) Qualification either in Software Engineering or HCI or Multimedia or Educational Technology or Computer Science or Psychology or Mathematics areas, and/or,

(ii) The Experts have been studying/researching/teaching/practicing Software Engineering, or HCI or Multimedia or Educational Technology or Computer Science or Psychology or Mathematics areas for at least 5 years.

10 experts agreed to participate in the research. The communication and review processes with all the experts were carried out through electronic mail (email) and telephone messaging. A formal email invitation that consists of an Appointment Letter, Consent Form, Instrument Form, Operational Definition, and Affective Design Model was sent to the experts. The experts were given ample time to complete the review. While waiting for the experts to complete the review, a formal follow-up message was given to them as a friendly reminder. The experts took about two to three weeks to finish the review task.

The instrument comprises 5 sections. The first section is demographic profiles, the second section is all about the components and elements, the third section highlights the affective items, the fourth section is on the relationships and flows of all the components, elements, and items and finally, the last part is about the overall look of the affective design model. The demographic profiles collected data on age, gender, education level, years of experience, and areas of expertise. For the second section, experts need to answer the instrument based on three options namely “some are not relevant”, “some may not be relevant” and “all are relevant”. The third section also has three options to be chosen from, but this section is more to the terms that are being used in the model. The options are “need a very detailed explanation”, “need some explanation” and “easy to understand”. The fourth and the last section just include two options which are “Yes” and “No”. Table 1 highlights the demographic profile of each of the experts.

Table 1. Demographic profile of the experts

Expert	Gender	Education	Field of Expertise	Year of Experience
A	Male	PhD	Game Technology Multimedia Technology Extended Reality Persuasive Computing	15
B	Female	PhD	Multimedia	17
C	Male	PhD	Information Technology Software Engineering Multimedia Technology Digital Audio Technology	10
D	Female	PhD	Multimedia Learning Persuasive Technology Interface	>5
E	Female	PhD	CCI HCI UX	18
F	Female	PhD	Game-based Application Developmen t Instructional Multimedia Assistive Multimedia	16
G	Female	PhD	Multimedia System, Web Information System HCI UX	>5
H	Female	Degree	Mathematics in Special Education	19
I	Male	Degree	Mathematics in Special Education	12
J	Male	Degree	Mathematics in Special Education	16

The gathered data from the expert review process are tabulated in Table 2, Table 3, and Table 4. The tables show the frequency of responses, and the result is also plotted in the clustered column charts (Figure 1, Figure 2, Figure 3) for a clear representation.

Table 2. Frequency of responses from expert review for the model's components and elements

Items			Frequency (n=10)		
1	The proposed components and elements are relevant		NOT relevant	May be NOT relevant	All are relevant
	Component	Element			
a	Content	Content Structure	0	0	10
		Content Composition	0	0	10
	User	Instructor	0	0	10
		Learner	0	0	10
	Design	Interface Design	0	0	10
		Multimedia Design	0	0	10
		Navigational Design	0	0	10
	Multimedia and Learning	Multimedia Theory	0	0	10
		Learning Approach	0	0	10
	Affective	Thought	0	1	9
		Emotion	0	2	8
		Feeling	0	1	9
		Action	0	0	10
	Technology	Hardware	0	1	9
		Software	0	1	9

Table 3. Frequency of responses from expert review for the model's affective elements and items

Items			Frequency (n=10)		
2	The terms used for the proposed elements and items of the conceptual design model are understood		Need detailed explanatin	Need some explanation	Easy to understand
	Element	Item			
a	Thought	Engagement	2	4	4
		Confidence	2	3	5
b	Emotion	Arousal	4	2	4
		Valence	4	2	4
c	Feeling	Positive	2	3	5
d	Action	Interaction	1	2	7
		Navigation	1	2	7

Table 4. Frequency of responses from expert review for the model's relationship, flows, and readability

Items		Frequency (n=10)	
		Yes	No
3	The relationships and flows of all the components, elements, and items are logical as illustrated in the conceptual design model	8	2
4	Overall, the conceptual design model is readable	8	2

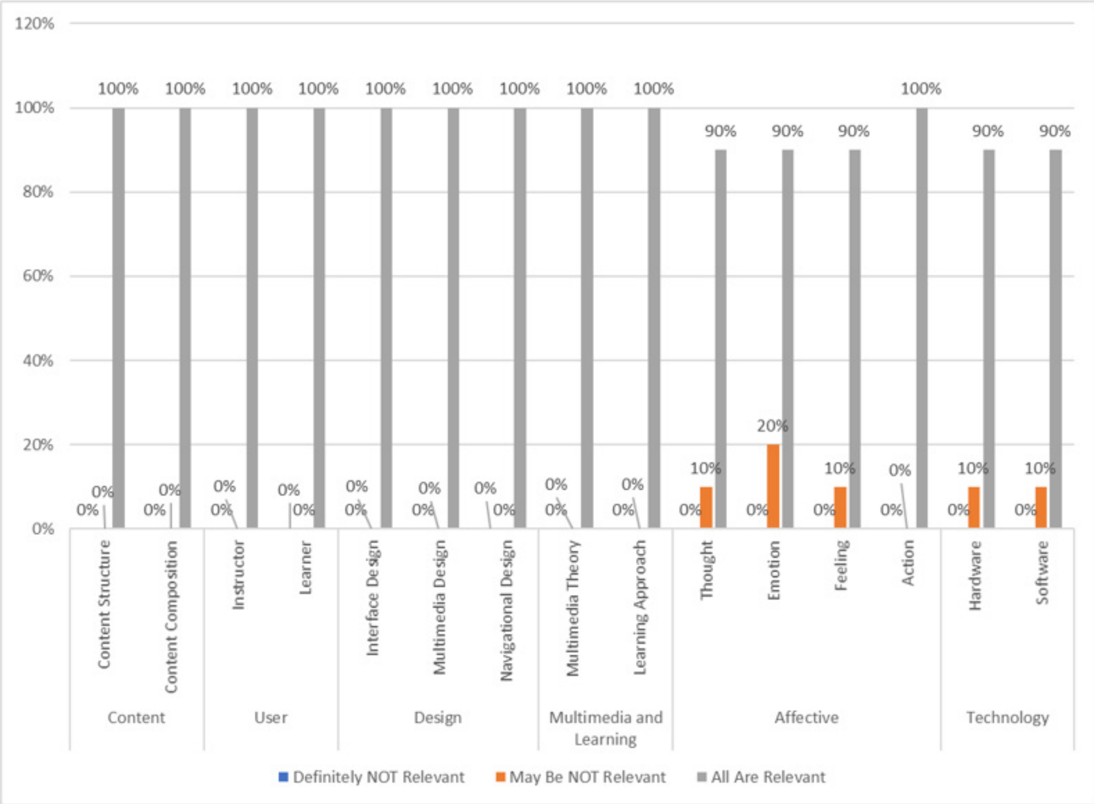

Figure 2. Relevancy of the components and elements of the model

Figure 2 displays the findings of the relevancy of the six components and their elements. All of the experts agree that the four components of the model namely content, user, design, multimedia, and learning are relevant.

However, for the affective and technology components, not all of the answers are relevant. For the affective and technology components, either one or two experts answered that the elements may not be relevant.

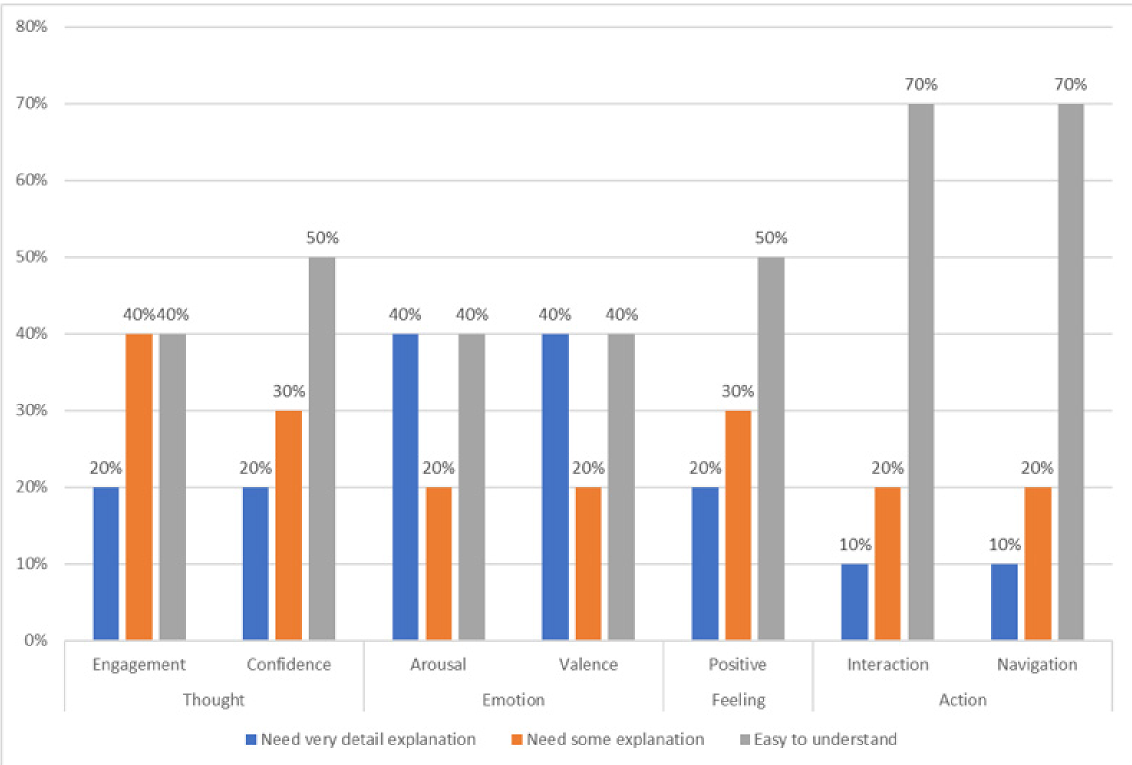

Figure 3. Terms used under affective's elements and items

Figure 3 highlights terms that are used for the affective's elements and items. Most of the experts agreed that items under the action element (interaction and navigation) are easy to understand. However, for the thought, emotion, and feeling elements, the findings were varied. Even though some of them responded that the items were easy to understand to conclude the experts stated that the items needed further explanation.

Figure 4 exhibits the relationship, flow, and readability of the model. The majority of them agreed that the relationships and flows of all the components, elements, and items are logical and the model is readable.

Moreover, further comments and suggestions from the experts were also documented for this research. Table 5 outlines all comments and suggestions from the experts.

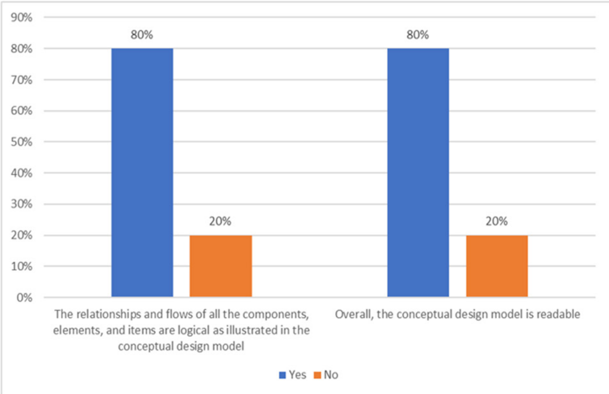

Figure 4. The Relationships, Flows, and Readability of the Model

Table 5. Frequency of responses from expert review for the model's relationship, flows, and readability

Expert	Comment
A	The operational aspects, detailing how a designer or developer intends to adapt and adopt the content structure during the development of a prototype, are crucial for the successful creation of an affective design model for visual impairments. These operational elements include the opening, instructional content, and closing phases. The model's purpose lies in describing the abstraction and processes preceding the actual development. As a researcher, careful attention must be given to crafting components 1, 2, 3, 4, and 6 to provide a robust foundation supporting the findings in component 5, which delves into the affective dimension. Each of these components should be meticulously developed:
B	The proposed research introduces an affective design model for the visually impaired, incorporating a multimedia approach. While the model delineates essential components, it appears to overlook the critical inclusion of a visually impaired component. The distinction between models for normal users and the visually impaired is not explicitly addressed. Furthermore, the use of the term 'relate to' is suggested for replacement with a more actionable keyword. Despite these minor revisions needed, the attached operational definition document proves valuable in ensuring the model's practical applicability.
C	The affective design model, while comprehensive, may not be easily grasped through visual examination alone. To facilitate understanding, it is essential to accompany it with the attached operational definition. Enhancing the model's clarity could be achieved by incorporating additional representations, as suggested in the comments for specific elements. Particularly, the technology component would benefit from the inclusion of more elements within the affective design model. For further elucidation, providing examples similar to those found in the operational definition, but presented in a more illustrative manner, would be beneficial. These refinements aim to improve the model's accessibility and comprehension for a broader audience.
D	The affective design model requires more detailed elaboration. Currently, it lacks crucial information regarding its objectives, intended users, their specific level or category, and the targeted platform (web/apps). There is also a notable absence of details highlighting what sets this model apart in terms of its special features catering to the visually impaired compared to their normal counterparts. The current description is overly general and challenging to anticipate. To enhance clarity and usability, it is imperative to provide explicit details on the model's purpose, target users, their characteristics, and the distinctive aspects designed to accommodate the visually impaired, as opposed to those without visual impairments.
E	It would be beneficial to include a clear title, legend, and concise information within the proposed conceptual model to enhance clarity and reference ability. The current discrepancy in numbering between the proposed model and operational definition (OD) confuses, and authors suggest adopting a consistent numbering format, such as using 1.1 for content structure and 1.2 for content composition. Additionally, the current model appears to be in its early stages and lacks comprehensive details. It is recommended to refine the model to ensure it applies to the research domain, is self-explanatory, and provides a more thorough representation of the concepts involved.

F	To mitigate bias, it is recommended to classify constructs as either positive or negative. The multimedia theory referenced in the model aligns with Mayer's and Moreno's Multimedia Learning Theory. To enhance clarity, explicitly term it as such. Recognize that learning approaches and strategies differ for normal learners and those with visual impairment; therefore, specify this in the model to prevent confusion. Omit the consideration of emotion, as its measurement involves special procedures. Feelings inherently imply emotion; thus, the term is sufficient for the model. Introduce a negative construct within the feeling dimension to ensure a balanced perspective and prevent bias in the findings. Without it, people lack a means to express negative sentiments towards the application. Expand the technology component by adding hardware and software constructs to provide a more comprehensive view. This refinement addresses potential oversights and contributes to a more detailed and accurate affective design model.
G	The upgraded affective design model has a detailed title, numbered components, and clear connections. Educational Environment branches into Classroom Settings and Inclusive Design. Multimedia Learning Theory specifies Mayer's Principles and Moreno's Cognitive Theory of Multimedia Learning. Learning Approaches covers both Normal Learners and the visually impaired. The Feeling Dimension includes Positive Feelings and Negative Feelings. Technology Component now has Hardware and Software. Arrows show the flow: Educational Environment influences Learning Approaches, Multimedia Learning Theory guides Multimedia Elements, Learning Approaches affect the Feeling Dimension, and the Technology Component supports Multimedia Implementation.
H	The model is strong, covering factors for multimedia learning in both normal and low-vision learners. The clear title, numbered components, and connections enhance clarity. Breaking down the Educational Environment into Classroom Settings and Inclusive Design considers diverse learning contexts. The Multimedia Learning Theory, including Mayer's Principles and Moreno's Cognitive Theory, adds theoretical precision. Distinguishing Learning Approaches for Normal and Low-Vision Learners shows an understanding of diverse strategies. Separating the Feeling Dimension into Positive and Negative Feelings reduces biases. Expanding the Technology Component to Hardware and Software provides a complete view. Directional arrows clarify the flow between components. Overall, it is a robust model for guiding research on multimedia learning.
I	The proposed model is well-suited for the visually impaired as it takes into account the unique learning needs and challenges associated with this group. By explicitly distinguishing Learning Approaches for Normal and Low-Vision Learners, the model demonstrates a targeted consideration for the diverse strategies required to accommodate individuals with low vision. The inclusion of Inclusive Design within the Educational Environment component further emphasizes the model's adaptability, acknowledging the importance of creating learning environments that cater to varying visual abilities. This tailored approach ensures that the conceptual framework not only recognizes the distinct needs of low-vision learners but also guides the development of inclusive educational strategies, making it a valuable tool for researchers and educators aiming to enhance multimedia learning experiences for this specific demographic.
J	The model is good overall. It combines different parts well to create a clear framework for understanding multimedia learning. The title, numbering, and connections between components make it easy to follow. Breaking down the Educational Environment into Classroom Settings and Inclusive Design shows an understanding of diverse learning contexts. Adding Multimedia Learning Theory, including Mayer's Principles and Moreno's Cognitive Theory, strengthens the model. The distinction between Learning Approaches for the Normal and visually impaired and separating the Feeling Dimension into Positive and Negative Feelings considers diversity and potential biases. Expanding the Technology Component with Hardware and Software gives a more complete view. The directional arrows improve the flow and clarity between components. In summary, it is a good and well-rounded framework ready for research and practice in multimedia learning.

3.1. Justification of Expert Feedback

(i) Overall Feedback

According to feedback from experts, a common concern was the perceived simplicity of the model, leading to difficulty in distinguishing whether it primarily caters to visually impaired or normal learners. To address this, they recommend a more nuanced breakdown of all elements to enhance the model's clarity. Additionally, experts expressed the need for a more detailed explanation of certain terms, even though operational definitions were provided. This refinement aims to ensure better understanding and transparency.

While the majority found the flow and connections in the model logical, expert G noted a lack of clarity due to brevity. To improve, the model should be expanded and provide a more explicit depiction of the relationships between components, elements, and items.

(ii) Content Component

Expert A emphasized the necessity for the content structure to encompass specific items such as opening, content, and closing. Furthermore, special attention was recommended for content composition, with a focus on addressing the study's direction.

Additionally, it was suggested that pedagogical aspects should be explicitly incorporated within the content composition.

(iii) User Component

Concerning the observation by expert D regarding the type of instructor, the study has clarified that the primary focus is on the unseen instructor. This unseen instructor comprises two types: an animated figure serving as the narrator and a normal child acting as their peer, featured in the educational courseware videos. Both expert D and G suggested considering two communication modes. The study acknowledges that the representation of interactive communication was not initially clear and has subsequently revised the arrow in the model to address this. Furthermore, in response to inquiries from experts E and G, the model specifies that the learner targeted in the study is a visually impaired individual aged between 9 to 12 years old, providing clarity on this crucial element.

(iv) Design Component

In response to feedback from experts D, E, and G regarding the design component, the study acknowledges that the elements were initially unclear, making it challenging to discern whether the model primarily caters to normal or visually impaired users. Receiving this feedback, the study has made modifications, refining the model to better suit visually impaired users. The revised model now explicitly includes elements related to (i) interface design, encompassing theme, typography, and color; (ii) multimedia design, covering formatting styles and the treatment of text, graphics, video, audio, animation, and transition; and (iii) navigational design, involving navigational instructions, user control, and navigational tools. This adjustment aims to enhance the clarity and appropriateness of the model for the targeted visually impaired audience.

(v) Multimedia and Learning Component

In response to feedback from experts D, E, F, and G regarding the multimedia and learning component, the study concurs with their arguments that these elements were not tailored for the visually impaired. Acknowledging this input, the study has identified relevant multimedia theories and learning approaches directly associated with the study's focus on visually impaired users. The chosen multimedia theories include the cognitive affective theory of learning with media and the cognitive theory of multimedia learning, primarily selected for their comprehensive coverage of affective and multimedia factors.

Regarding learning approaches, the study recommends the use of peer teaching and the mastery learning approach as they align well with the needs of low-vision learners. This revision aims to ensure that the multimedia and learning components are explicitly adapted to the unique requirements of the targeted audience.

(vi) Affective Component

In response to expert F's argument suggesting the removal of emotional elements from the model due to measurement concerns, the study respectfully disagrees. The study plans to employ facial expression analysis during observations as a viable method to measure the emotions of the visually impaired. Therefore, the emotional elements will be retained in the model as they are considered integral to the study's methodology for assessing the responses.

(vii) Technology Component

In alignment with the suggestions from experts C and F, the study acknowledges the importance of incorporating hardware and software as elements under the technology component in the model. Specifically, the study agrees to include desktops and laptops as suitable hardware options required for running the educational courseware in the context of the study. This revision ensures a more comprehensive representation of the technological aspects relevant to the research.

(viii) Interaction Method

To enhance accessibility for the visually impaired, the affective design model can be adapted by incorporating features like screen magnification, high contrast modes, and text-to-speech functions for better visibility. Customizable text size and font options, along with high-contrast color schemes, can improve readability. Providing multimodal feedback, clear navigation with audible cues, and tactile graphics for content can aid understanding. Voice-guided instructions and a responsive design adaptable to various devices ensure a more inclusive and affective interaction experience for visually impaired users. These adjustments aim to make the interaction method of the model more accommodating and accessible.

3.2. The Revised Model

Figure 5 depicts the revised affective design model for visually impaired users, incorporating valuable insights from comprehensive expert reviews.

The updated model offers improved clarity and readability, with a refined emphasis on addressing the unique needs of the visually impaired.

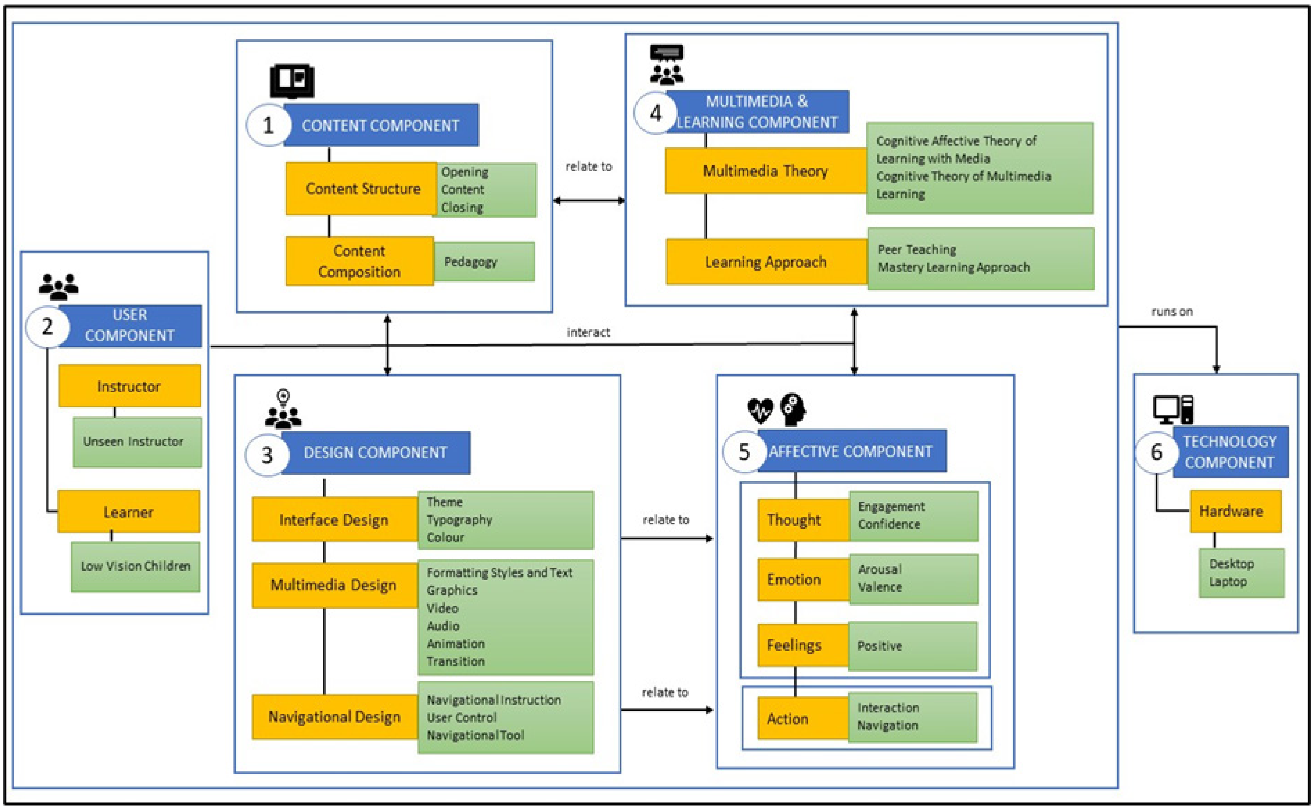

Figure 5. The revised affective design model

4. Conclusion

The development and evaluation of the affective design model for the visually impaired represent a significant step forward in addressing the challenges faced by the visually impaired in their interaction experience. The study, conducted through an iterative triangulation methodology, engaged experts from diverse fields and incorporated their valuable feedback to refine the initial model.

The findings from the expert review highlighted several important considerations for the model's enhancement. Experts emphasized the need for a more nuanced breakdown of elements, particularly in the content, user, design, multimedia and learning, affective, technology, and interaction components. The revision process aimed at improving clarity and appropriateness for the visually impaired, ensuring that the model aligns with their unique needs and challenges.

The model's adaptability for the visually impaired involves incorporating elements such as an unseen instructor, specific design components related to interface, multimedia, and navigation, as well as the utilization of multimedia theories and learning approaches tailored for this audience.

The inclusion of emotional elements, despite concerns raised, remains crucial to the study's methodology, with plans to employ facial expression analysis for measuring visually impaired responses.

Furthermore, the acknowledgment of hardware and software components under the technology aspect adds depth to the model, recognizing the importance of desktops and laptops for running educational courseware. The interaction method's adaptability through features like screen magnification, high contrast modes, and text-to-speech functions enhances accessibility for the visually impaired, making the learning experience more inclusive and effective.

The revised affective design model, presented in Figure 4, reflects a comprehensive synthesis of expert insights and addresses the research gap in existing models. The emphasis on affective interaction, emotion, meaningful delivery, confidence, social contact, cognitive engagement, and curiosity ensures a holistic approach to the visually impaired interaction experience.

This study contributes not only to the field of education but also to the broader goal of creating an inclusive interaction environment for individuals with visual impairments.

The refined model serves as a valuable resource for academicians, curriculum developers, and policymakers working towards fostering critical thinking skills and passion among visually impaired people. Ultimately, this research aligns with the overarching objective of promoting a knowledgeable and inclusive civil society where opportunities are accessible to all.

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