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Breastfeeding flashcards (BFC): An innovative tool for breastfeeding education using ADDIE model

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ABSTRACT

This study outlines the development and evaluation of Breastfeeding Flashcards (BFC) as a tool to support breastfeeding education for pregnant and postpartum mothers. The flashcards are intended for use by midwives, healthcare professionals, and community health workers or cadres. The development process followed the ADDIE model, which includes five stages: Analysis, Design, Development, Implementation, and Evaluation.

The BFC development process involved information gathering, storyboard creation, color coding, and card printing. The content and design were validated through consultations with breastfeeding and media experts. The flashcards were then pre-tested with mothers and community health cadres to assess their usability and effectiveness.

Post-implementation surveys and interviews revealed significant improvements in cadres' knowledge, as confirmed by the Wilcoxon signed-rank test. Cadres were able to effectively deliver breastfeeding education using BFC. Feedback from mothers, cadres, and midwives was highly positive. Cadres found the flashcards easy to use, citing the clear information, supportive images, and brief explanations on the back as helpful for communication. They expressed strong willingness to continue using the tool. Mothers appreciated the support from cadres and found the education beneficial.

Overall, BFC proved to be an effective tool in supporting cadres' breastfeeding education efforts. The involvement of trained cadres in delivering breastfeeding education is crucial for the successful integration of strategies aimed at improving breastfeeding practices and increasing breastfeeding coverage. Additionally, the BFC has potential for broader use, including by other health professionals and as an educational resource in health training programs.

1. Introduction

Breastfeeding is essential for the survival and health of children. It is a safe, natural, nutritious, and sustainable source of food for infants. Breast milk contains antibodies that help protect against many common childhood illnesses such as diarrhea and respiratory infections. It is estimated that inadequate breastfeeding contributes to 16% of child deaths each year. Children who are breastfed tend to perform better on intelligence tests and are less likely to become overweight or obese later in life. Women who breastfeed also have a lower risk of cancer and type II diabetes (UNICEF & WHO, 2023).

Although the WHO recommends exclusive breastfeeding for the first six months, in reality, less than half of infants under six months of age are exclusively breastfed worldwide (UNICEF, 2020). According to the 2023 Indonesian Health Survey (SKI), the proportion of children aged 6–23 months who were exclusively breastfed for six months is only 55.5%. While this meets the global target (50%), it still falls significantly short of the national target (80%) (Ministry of Health In Indonesia, 2021).

A lack of breastfeeding education is a significant factor contributing to unsuccessful breastfeeding practices. Mothers who lack knowledge about proper techniques, effective latching, and milk production are more likely to encounter difficulties and may resort to formula feeding. In contrast, breastfeeding education—especially when personalized to meet individual needs—has been shown to improve both breastfeeding initiation and duration rates (Sulasmi et al., 2021). Using educational media in breastfeeding education enhances mothers' knowledge of exclusive breastfeeding and supports the practice of exclusive breastfeeding (World Health Organization Regional Office for the Eastern Mediterranean, 2022).

To that end, the aim of this study was to develop Breastfeeding Flashcards (BFC) as a practical educational tool to support breastfeeding education that can be used by health professional and volunteers to provide breastfeeding education. The researchers sought to develop and validate the Breastfeeding Flashcards (BFC) based on the analysis, design, development, implementation, and evaluation (ADDIE) model.

2. Method

This study uses a Research and Development (R&D) approach with a development procedure based on the "Iterative ADDIE Instructional Design Framework" (Figure 1). The ADDIE framework consists of five stages: analysis, design, development, implementation, and evaluation. This model is iterative, allowing users or experts to provide feedback, and enabling the model developer to re-analyze and refine the product (Nordin et al., 2016).

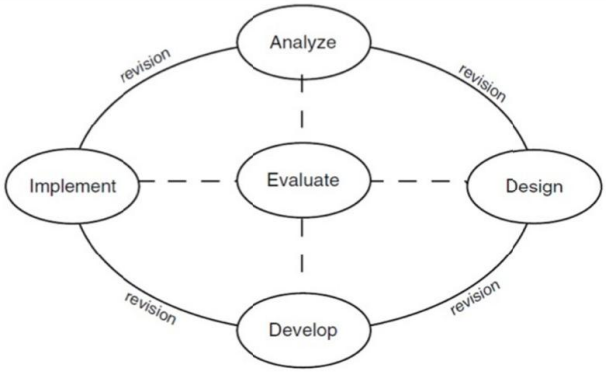

Fig. 1. ADDIE Framework (Alnajdi, 2018)

2.1 Analysis

In this stage, the researcher conducted field studies and literature reviews. The field study involved interviews with three cadres and one midwife in Sarirejo Village, Kaliwungu, Kendal District. The aspects explored included: how lactation education is conducted at the Posyandu, what media are used during lactation education, and how easy it is for cadres or midwives to use these media. The literature review focused on identifying essential components that should be included in flashcard media and collecting relevant content materials for developing the flashcards.

2.2 Design

The data obtained during the analysis stage served as the foundation for developing the educational media. The flashcard model was designed to be as attractive and concise as possible to facilitate ease of use and comprehension. A storyboard of the design was created and later realized using software

such as Ibis Paint X and Adobe Photoshop CC 2019. In addition to designing the visual model, the researcher also developed a user guide or systematic instructions for using the flashcards.

2.3 Development

Once the design was finalized, the researcher began assembling and developing the required flashcard components. The developed product was then validated by two content experts (lactation counselors) and two media experts (health promotion specialists). Validation covered aspects such as content completeness, ease of use, and visual aesthetics of the flashcards. If the product did not pass validation, it was revised to reduce any shortcomings.

2.4 Implementation

The validated flashcards were then tested with 10 Posyandu cadres in Sarirejo Village, Kaliwungu, Kendal District to assess the effectiveness of the lactation education media. The cadres who received training in breastfeeding education using the flashcards were assessed for their knowledge before and after the training using questionnaires. The cadres also tried using the flashcards while educating pregnant women or mothers with infants under six months of age. Their skills were measured through observation and a checklist during the education sessions.

2.5 Evaluation

After the training and practical sessions, an evaluation of the flashcard use was conducted by gathering feedback from the mothers, cadres, and midwives regarding the content, language, media, and usability.

Ethics approval for the study was granted by the Medicine Faculty of UNISSULA Ethics Committees, with approval number 400/XI/2021.

3. Results

3.1 Analysis Phase

In the analysis phase, several indicators were examined, including the implementation of lactation education, the use and effectiveness of educational media, and plans for developing lactation education media.

In practice, the Posyandu (integrated health service post) only consists of four stations: registration, anthropometric measurements (height, weight, head circumference, and mid-upper arm circumference), recording in the maternal and child health book (KIA), and distribution of supplementary food (PMT). Midwives only provide brief information when asked by mothers and remind mothers whose children show signs of stunting to visit the community health center (Puskesmas). No information or education regarding breastfeeding and exclusive breastfeeding is provided by either midwives or cadres during Posyandu.

Outside of Posyandu activities, some media are used, such as flipcharts and projectors. Flipcharts are typically used by midwives during antenatal classes, while projectors are often used by the Puskesmas during health education sessions for cadres at the village hall. Both midwives and cadres feel these media are not effective due to heavy and not easy to use. Observations confirmed that there is not only a lack of education during Posyandu, but also an absence of any educational materials or media. No posters were found anywhere at the Posyandu site.

Three cadres emphasized the need for educational media that is user-friendly, portable, and engaging. One cadre highlighted the importance of incorporating relevant, easy-to-understand visuals, noting that most mothers in the area have low to mid-level educational backgrounds. They also recommended including concise explanations to make the information easier to convey.

Cadres suggested that the material should cover general breastfeeding topics, while two others emphasized the importance of addressing local issues—such as formula feeding and the early introduction of complementary foods for infants who should still be exclusively breastfed, especially in cases involving working mothers. From the midwife's perspective, she expressed general support for the initiative and was open to the outcomes, provided the information is communicated effectively.

Based on the cadres' feedback, all the desired features of the educational media align with the characteristics of flashcards. Furthermore, information was gathered from books, research findings, and official government websites to compile content for the flashcards based on the identified problems. Key topics to include in the flashcards are basic information of breastfeeding, breastfeeding management for working mothers, impacts and indications of formula feeding. This content was compiled and structured to develop Breastfeeding Flashcards (BFC).

3.2 Design Phase

Several tools were used in this stage. The researcher used an ASUS E402Y series laptop with Windows 10 OS to design the flashcards. The design was created using Adobe Photoshop CC 2019 and www.canva.com. These tools were chosen for their accessibility and user-friendliness. Supporting Tools included a Wacom Intuos CTL-4100 drawing tablet was used to ease the illustration process.

The following steps were taken in designing the media including designing the cards, designing the packaging, creating user instructions, and designing the cover of BFC.

The flashcards were designed in A6 size (10.5 x 14.8 cm) and will be printed on 310 gsm Art Carton paper after expert validation. Designing the initial card concept manually in a storyboard as a reference.

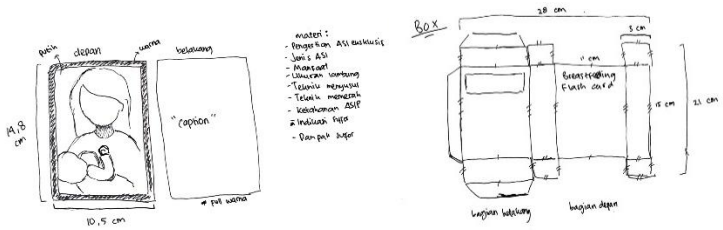

Fig. 2. Storyboard

The cards were designed one by one using the predetermined software. Before designing the front and back sides of the cards, a base color for each card was selected. The cards were designed to be colorful and grouped into 11 main content points, each represented by a different color. The content includes basics of breast milk and breastfeeding, baby's stomach size, benefits of breastfeeding, breastfeeding techniques, signs that baby is getting enough milk, expressed breast milk, breast milk storage, breastfeeding for working mothers, breastfeeding problems, indications for formula milk, and impact of formula milk.

At the final stage of the card design process, a total of 46 flashcards were produced and prepared for validation. On average, each subtopic group consists of 2 to 6 cards. The front of each flashcard features a picture illustration, while the back contains a brief explanation in Bahasa Indonesia.

Fig. 3. Example of Initial Flashcard Design (Front and Back View)

Fig. 4. Packaging, user instructions, and cover

3.3 Development Phase

In this phase, the researcher compiled all the flashcard designs into a single file for expert validation. The researcher recruited 2 content experts and 2 media experts based.

According to both content experts, the material in the flashcards was sufficiently comprehensive, but several points required revision or additions, such as emphasizing the distinct benefits of exclusive breastfeeding compared to formula, benefits for the country, mother, and baby, hand-expressing techniques, breastfeeding positions, signs of sufficient milk intake such as baby's bowel movements, examples of poor latch, and types of containers and methods for storing and giving expressed milk.

Some content was outdated or irrelevant, such as a card showing a pump with a red balloon, which should be removed due to its ineffectiveness and discomfort for mothers. The image showing the 'C' hand hold on the breast was also recommended for removal. A card indicating baby's weight gain as a sign of sufficient milk was questioned, as it is not a definitive indicator. The material was considered suitable for working breastfeeding mothers and was expected to help encourage them to choose exclusive breastfeeding over formula.

Content expert stated that the content was not only easy to understand, but the media was easy to use and adaptable. The accompanying module book would allow for joint discussions between the public and cadres. However, it was emphasized that cadres must first be trained to properly understand and deliver the content. Both content experts also suggested several refinements, such as ensuring the text and images on the cards are aligned and meaningful and avoiding brand names for formula milk—even disguised ones. A label simply stating "formula milk" was recommended.

From a creativity and attractiveness standpoint, both media experts agreed that the flashcards reflected creativity and appeal. Media experts noted it was their first time seeing breastfeeding flashcards, as such media are rare in the literature. The user guide was clear and covered essential points, although some language adjustments were suggested for clarity, such as using simpler sentences. The visuals were relevant, but some feedback included the suggestion to label images (e.g., name the objects) to help mothers more easily understand the content. Media experts also commented on the packaging, which was already appropriate, but suggested it be tested directly with the target audience.

In terms of ease and effectiveness, one media expert suggested these aspects would be more accurately measured after practical testing with the users. However, based on design structure, the media appeared easy to use and effective—grouping cards by topic allows flexibility in selecting only the relevant content for delivery. Both experts had no issues with the material type or size, but advised paying attention to color contrast to ensure text and images remain clear from a distance.

Media experts preferred realistic photographs over illustrations but acknowledged the ethical challenges of photographing mothers during breastfeeding. The use of consistent animated images was considered acceptable given these constraints, but it was recommended that cadres demonstrate

latching and positioning during implementation. Media experts focused more on images showing internal organs like the gastrointestinal tract and uterus, suggesting these be designed with clarity.

After several rounds of validation and revision, the media was deemed suitable by the experts, with no major revisions or only minor ones remaining. The flashcards were then printed, and a practical trial was planned with cadres as the target users.

Fig. 5. Final Validated and Printed Flashcard Design

3.4 Implementation Phase

The flashcards were trialed with 10 cadres (community health volunteers) through a breastfeeding education training. The responses from cadres were processed and analyzed using SPSS. Because the pre-training knowledge scores were not normally distributed, the Wilcoxon test was used.

Difference in cadres' knowledge scores before and after lactation education using the Breastfeeding Flashcards (BFC):

Table 1. Mean Change in the Results

Education with BFC	Mean	SD	P Value
Before	85,9	4,9	0.023
After	90	6,8	

This result indicates an increase in knowledge after the training using BFC, with a mean difference of 4.1. The Wilcoxon test produced a p-value of 0.023, which is less than 0.05, indicating a statistically significant difference in knowledge before and after the training. Meanwhile, skill assessment data showed that all cadres were able to deliver breastfeeding education using BFC very well.

3.5 Evaluation Phase

Cadres agreed that the material and information on exclusive breastfeeding and breastfeeding techniques in the flashcards were comprehensive. One cadre added that the number of cards was just right—not too many, not too few. Cadres stated that the material was deemed appropriate for mothers in their community, as many of them are working and tend to prefer formula milk. Additionally, there are mothers who lack knowledge of proper breastfeeding techniques. The cadres acknowledged that some information in the flashcards was new to them, despite having personal experience breastfeeding. For instance, they had just learned about the size of a baby's stomach and the correct latch and breastfeeding positions from these flashcards.

All three cadres stated that the language used was understandable. One cadre mentioned having difficulty pronouncing English terms such as foremilk and hindmilk, but said the explanations provided on the card made them easier to understand and explain.

In addition to the accessible language, the images were deemed appropriate and conveyed the intended message. One cadre commented that although the illustrations were relevant, a verbal explanation from the educator was still needed. Regarding the clarity of the user guide, all three cadres agreed that it was easy to understand and provided no further suggestions. The physical characteristics of the flashcards—including size, thickness, color, font type and size, and readability—received positive responses. The cadres said the cards were comfortable to hold, not too thin or thick. The color scheme was also considered suitable for mothers as the target audience.

Cadres said it was easy to use due to the short explanation on the back of each card. Another added that the combination of clear information and images made the cards even more effective. The cadres also expressed their willingness to use the flashcards for delivering breastfeeding education to mothers, provided they received prior training.

Feedback from mothers and midwives was also overwhelmingly positive regarding the effectiveness and usability of the Breastfeeding Flashcards (BFC). The tool was praised for its clear, concise content and engaging visual design, which made it easier to convey key breastfeeding concepts. Mothers especially recognized the important role of their local health cadres, viewing them as a trusted and accessible source of support. They expressed genuine appreciation for the breastfeeding education provided through the flashcards, noting that the tool helped them better understand proper techniques, the benefits of exclusive breastfeeding, and how to overcome common challenges. This positive reception highlights the potential of BFC to strengthen community-based health education efforts and empower both cadres and mothers in promoting optimal breastfeeding practices.

This flashcard has been officially registered with the Directorate General of Intellectual Property (HAKI) under the Ministry of Law and Human Rights of the Republic of Indonesia, with the Copyright Registration Number EC00202239326. The flashcards can also be translated into other languages, making them useful for improving breastfeeding practices around the world.

4. Discussion

Based on a literature review, no research was found on the development of flashcard media for breastfeeding education using the R&D method. The ADDIE model is a popular development model commonly used in R&D methods. This model is used as a research framework because, according to, it is suitable for undergraduate research with a duration of less than one year.

Exclusive breastfeeding requires the support and involvement of many parties to achieve optimal maternal and child health outcomes. Families, communities, healthcare providers, workplaces, and the government all play important roles in supporting exclusive breastfeeding (Tomori et al., 2022). Support that can be provided is breastfeeding education. According to previous studies, peer-supported breastfeeding education can increase a mother's chances of exclusively breastfeeding during the first 5 months by up to five times compared to mothers who receive no education at all (Ara et al., 2018).

Based on the characteristics of informants during the analysis stage, midwives and health cadres have different educational backgrounds and work experiences. According to research (Balakrishnan et al., 2016; Lecomte et al., 2017), education level affects one's ability to read, listen, and understand information. In addition, a person's experience also influences their knowledge of a particular subject (Yuniarti et al., 2019).

The data suggest that breastfeeding education, especially about exclusive breastfeeding at Sarirejo Village Posyandu, is not being implemented. Posyandu activities only include anthropometric measurements, data recording, and providing supplementary feeding. This does not align with the Posyandu service guidelines from the Indonesian Ministry of Health, which recommend implementing the 5-table service system. One of these tables—the fourth table—is meant for education, after measurement recording and before health services are provided (Govoni et al., 2019; World Health Organization, 2022).

Cadres' roles can be optimized in Posyandu activities, including assisting midwives in providing education on breastfeeding and other health topics. According to Indonesian Ministry of Health Regulation (PERMENKES) No. 4 of 2019, education is not only the responsibility of healthcare workers—trained health cadres can also be actively involved (Indonesian Ministry of Health, 2019). In PERMENKES No. 25 of 2014 concerning Child Health Efforts, cadres are mentioned as being able to provide Communication, Information, and Education (CIE) on exclusive breastfeeding using appropriate health media (Indonesian Ministry of Health, 2019). However, cadres have neither received breastfeeding education training nor been equipped with suitable educational media. Similar situations have been observed in Kedungwuni II Health Center in Pekalongan and Cepoko Village, Gunungpati, Semarang, where cadres are not provided with facilities or sufficient knowledge to deliver breastfeeding education (Tomori et al., 2022; Wicaksono et al., 2020; Yuniarti et al., 2019).

The characteristics of the educational media desired by cadres—such as portability and concise explanations—are fulfilled by flashcards. Flashcards are smaller than flip charts and are therefore easier and more practical to carry (Asmodilasti & Suparno, 2018). However, proper storage is needed to avoid misplacing or damaging them (Sharma, 2012).

The need for media that features visuals and information easily understood by people with lower education levels, like in Sarirejo Village, makes flashcards a suitable solution. According to (Chotimah, 2021), using flashcards one by one helps individuals focus more on the information and develop critical thinking skills. However, participants might miss out on the full picture since flashcards usually only contain key points (Sharma, 2012).

The flashcards designed from the analysis results passed validation by content experts. A total of 64 cards have been developed, covering materials appropriate for the target audience, including the basics of exclusive breastfeeding and breastfeeding, optimal techniques and latch, breastmilk management for working mothers, indications and impacts of formula milk, and more. Cadres agreed that the material was complete and highly needed by breastfeeding mothers in Sarirejo Village, who generally lacked knowledge in these areas. This is consistent with findings from a study on working mothers at Universitas Negeri Padang, which showed low knowledge about breastfeeding benefits, techniques, and breastmilk management (Balakrishnan et al., 2016; Lee et al., 2019).

After several revisions, the language and terminology on the cards were deemed acceptable by both content experts and positively received by cadres. Although there were minor issues with English terms, they were not a major problem since further explanations were provided on the cards. Similarly, in previous studies, mothers suggested that medical terms should be explained or translated, as not everyone understands them.

Regarding usability, a media expert suggested an evaluation would be necessary to confirm valid results. However, based on expert judgment, the grouped flashcards are easier to use and considered effective since the material can be selected based on specific needs. Both content experts agreed, with one adding that a guidebook would support better discussions between cadres and mothers. Practical testing also confirmed that the flashcards were easy to use due to the brief explanations provided on the back.

The final flashcards measure 10.5 x 13.3 cm, approximately the size of A6, printed on 310-gram Art Carton paper. This is consistent with previous research, where flashcards typically measured 10 x 12.5 cm or 25 x 30 cm (Baska et al., 2020). From a physical standpoint—size and material—both media experts and cadres found the cards appropriate. Regarding design, the flashcards use high-contrast colors as recommended, and the cartoon illustrations were well-received by media experts. According to theory, media should use contrasting colors to be more visually comfortable (Wulandari et al., 2023). The visuals were also well-received by cadres and considered suitable for educating mothers. Additional elements, like image captions, were included based on expert feedback.

Finally, the font type and size were adjusted following recommendations to ensure readability, especially for older cadres. The chosen font was Arial Rounded MT Bold, size 7. This aligns with recommendations that formal-looking fonts are best for adult audiences. Cadres responded positively, finding the text on the card backs easy to read.

The development of breastfeeding flashcards as an educational tool is grounded in evidence-based communication and learning theories that explain their effectiveness in enhancing maternal knowledge and confidence. One such framework is Cognitive Load Theory (Kirschner et al., 2018)

which emphasizes the limitations of working memory during learning. Flashcards, when designed appropriately, help minimize extraneous cognitive load by presenting essential information in small, digestible chunks. This focused approach enables learners to process and retain information more effectively than when confronted with dense textual content.

In addition, the design of these flashcards draws on dual coding theory, which posits that people learn better when information is presented both verbally and visually (Kanellopoulou et al., 2019). By combining simple, culturally appropriate images with concise, clear language, the flashcards leverage both verbal and visual cognitive pathways, thus enhancing comprehension and recall.

To further support learning, visual learning principles—such as the use of consistent icons, limited text per card, and clear visual hierarchy—were applied in the design. This aligns with research suggesting that visuals can improve understanding and retention, especially for health-related behaviors such as breastfeeding. However, care was taken to avoid visual overload. According to Mayer's Multimedia Learning Theory (Mayer, 2024). the use of visuals must be coherent and aligned with the instructional message to prevent cognitive overload. Accordingly, only essential information was included, and design elements were strategically selected to reinforce, rather than distract from, the core message.

By applying these principles, the breastfeeding flashcards aim to provide a low-cost, portable, and user-friendly educational intervention that supports mothers' learning needs. They are particularly valuable in settings with limited access to healthcare professionals or low literacy rates, where visual aids can bridge communication gaps and foster better health outcomes.

In conclusion, the flashcard media can be considered well-developed. It was rated as engaging and creative by both media experts. Unclear images were revised to enhance comprehension, and anatomical illustrations—although previously questioned—were retained due to their educational value. Cadres did not object to these images but noted that additional explanation would be helpful when used in education sessions. The usage instructions were also revised for clarity and brevity, making them easier for cadres to understand.

The cadres expressed willingness to use the flashcard media and conduct breastfeeding education or counseling with mothers. However, it is essential to first provide training to the cadres—not only in delivering education but also in using the media and in public speaking to boost their confidence. This aligns with previous research showing that training breastfeeding support cadres improves their knowledge and ability to provide exclusive breastfeeding education (Grover-Baltazar et al., 2021; Journal et al., 2022; Seyyedi et al., 2021).

5. Conclusion

Overall, the Breastfeeding Flashcards (BFC) demonstrated effectiveness in supporting cadres in delivering breastfeeding education within the community. The use of this tool enhanced the clarity, consistency, and confidence of cadres in communicating essential breastfeeding information. The involvement of trained cadres is critical to the successful implementation of strategies aimed at improving breastfeeding practices and increasing exclusive breastfeeding rates. Furthermore, the BFC shows strong potential for broader application, including use by other healthcare professionals and integration into educational curricula for midwifery and community health training programs. This adaptability underscores the BFC's value as a scalable and sustainable resource for strengthening breastfeeding promotion efforts at the community level.

6. Conflict of Interest

The authors declare that they have no affiliations with or involvement in any organization or entity with any financial interest in the subject matter or materials discussed in this manuscript.

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