# Exploring Students' Perceptions of Learning Medical Terminology With Teacher-Made Flashcards Used Electronically

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**Abstract-** Although the production and use of educational materials have been accelerated, their quality and usability for students might have been overshadowed by the urgency to maintain the continuity of education at universities. Concerned with the provision of quality education, this study aimed to discover medical sciences students' perceptions of the quality of teacher-made medical terminology flashcards used in university courses electronically. To do so, the students in the fields of laboratory sciences, radiology, anesthesia, operating room, nursing, medicine, and midwifery used the teacher-made flashcards in medical terminology and specialized English courses, and their perceptions of the quality of the flashcards were elicited in terms of appearance, content of information, and potential contribution to learning. The results showed that overall, the students evaluated the flashcards positively; they, however, indicated that the color choices, adequacy of information, and potential effects on students' motivation for studying medical terms were three aspects of the flashcards that warranted more detailed consideration. Moreover, the students' perceptions of the appearance of the flashcards and the potential contribution of the flashcards to learning did not differ across the disciplines; the students, however, had different perceptions of the content of information on the flashcards due to the type, degree, and specificity of the information they needed. The study concludes that how the flashcards are developed aesthetically, how exhaustively they embrace the students' needs for information, and how potentially efficaciously they contribute to learning mattered to the students. The study recommends that although teacher-made materials can support the delivery of knowledge and continuity of education, considering students' feedback on and perceptions of the materials can help secure the quality and usability of the materials and ensure quality teaching and learning.



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**Keywords:** Educational materials; Medical terms; Flashcards; Medical sciences students

## Introduction

Despite the importance of medical terminology courses in medical education programs (1,2), teaching and learning materials for such courses are scarce; the recent COVID-19 pandemic also intensified the need for such materials. The shortage of medical terminology materials provided the impetus for the development of teaching and/or learning materials in the form of medical terminology flashcards which have the potential to be used electronically. The materials can be used in medical terminology, English for medical purposes, anatomy, and other similar courses in which visual features matter to learners. Despite the challenges of using electronic learning in different contexts (3), there is abundant research recommending the employment of technological tools for educational purposes (4-8). Technological developments aid learners in acquiring language by receiving rich input even when they are isolated at home and teachers should provide rich input for the students (7). Medical terminology flashcards are one of the technological developments that can afford learners a lot

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of comprehensive input on medical terms. The use of flashcards has been recommended in the literature on educational technology as well. It would be beneficial if institutions could provide educational resources such as flashcards, which deliver a variety of quality learning content, for learners (8). The use of flashcards can serve not only to promote the autonomous work of students but also to improve their learning techniques (5).

**Challenges of medical terminology programs**

A review of the ways medical terminology programs are offered in different contexts attests to potential shortcomings in the programs. Medical terminology programs in Germany are offered in the form of a mandatory course for the preclinical part of the curriculum. There is no national curriculum for teaching medical terminology at German universities, the terminology courses "are purely self-study or e-learning courses combined with tutorials and/or consultation hours with lecturers and seminars with tutorials or lectures" and "textbooks or lecture notes are currently mainly used as teaching aids" (9). The lack of teaching materials, teaching aids, and limitations in teaching methods and techniques have been also reported in other contexts and studies. Medical terminology courses in Turkey are "mostly taught as a two-hour-per-week, single-semester course during the first year" of the programs. The shortcomings in the medical terminology courses are "the lack of sufficient teaching staff for Greek and Latin medical terminology, the lack of teaching methods other than traditional ways and methods, and the availability of limited Turkish language printed resources" (10). In Iran, the Ministry of Health, Treatment, and Medical Education offers an independent two-credit medical terminology course and incorporates concepts on medical terminology into the curriculum of specialized English courses for all medical sciences programs in the country. In certain fields of medical sciences such as operating room, radiology, and anesthesia, medical terminology is offered as an independent two-credit course, and in other disciplines, it is part of the specialized language course. The curriculum of the course prescribes that a medical terminology dictionary, for example, Medical Terminology: An Illustrated Guide by Cohen and DePetris, be used as the main resource for the course (11). The curriculum also underscores that the students learn the suffixes, prefixes, and roots of medical terms. Like many other countries, in Iran, book-style teaching is the dominant teaching method of medical terms. A dictionary in which medical terms, roots, prefixes, and suffixes are taught in English is used to teach medical terms in medical terminology and specialized English courses. Most Iranian educational institutes prefer to use textbooks and take up wordlists as a technique for teaching words (12) through PowerPoint. There is a demand for alternatives to textbooks as students' preferences for learning materials have changed (9). One of the techniques to enhance learning, "especially in difficult topics like anatomy and physiology, learning about bones, medical terminology or indeed any subject where there are a lot of new words and terms to learn, is making use of an old technique brought up to date with new technologies called flashcards" (13).

Because of the restrictions and quarantine during the COVID-19 pandemic, a variety of electronic educational materials, whose quality and usability for students might have been overshadowed by the urgency to maintain the continuity of education at universities, were used. Given the existing lack of the resources required for teaching medical terms in the Iranian context, medical terminology flashcards were electronically produced and used in medical terminology and specialized English language courses. A significant point in this regard, however, is that whether educational materials like flashcards are used in response to a lack, or a sudden unpredicted situation, they need to be appraised for quality evaluation during and after the use of educational materials helping us understand how successful these tools are in practice (14). This study aimed to discover medical and health sciences students' perceptions of the quality of teacher-made medical terminology flashcards used electronically in university courses. It also investigated whether students of laboratory sciences, radiology, anesthesia, operating room, nursing, medicine, and midwifery had different perceptions of the quality of the flashcards. Discovering students' perceptions of the flashcards in terms of appearance, content of information, and potential contribution to learning can help remove potential defects in the appearance of the flashcards and inadequacies and ambiguities in the content of the flashcards and similar materials with visual features. It will also help educators to fine-tune their expectations from the learning effects that using flashcards can bring about for the students. Furthermore, modifying flashcards based on the results from the students' evaluations can help educators trust and use flashcards as a teaching and learning aid.

Therefore, to address the objectives of the study, the medical sciences students' perceptions of the appearance and content of information of the medical terminology flashcards as well as their contribution to learning were investigated. Moreover, the study probed whether the students of different medical fields have different

perceptions of the appearance, content of information and potential contribution of the flashcards to learning.

**Review of literature**

Flashcards have been widely investigated as a teaching aid or a form of educational technology. The review of the literature on flashcards attests that the majority of the studies on using flashcards for educational purposes have been on issues such as the comparison of different types of flashcards (15), the effect of flashcards on learning (16), and the students' perceptions of using flashcards (17). There are a few studies that have targeted the development and evaluation of flashcards for educational purposes in the medical fields and English learning purposes (5,18-20).

**Studies on the benefits of flashcards**

Studies on the advantages of using flashcards for educational purposes in general and learning words, in particular, are abundant. Flashcards provide learners with a fast and effective way to improve their vocabulary knowledge and help learners acquire words more effectively (21). They are also the most common tools that learners use to study facts and ''perhaps no memorization technique is more widely used than flashcards'' (22). The teaching materials can enhance students' language learning, improve their learning attitudes (23) and aid learners in reviewing and recalling the learned words (24). The cards which contain both the learners' mother language and the second language can provide the initial form-meaning link for students to learn and review the words (25). Research has also shown that the visual input of flashcards can positively affect the recognition, differentiation, and memorization of words (26). Flashcards used for teaching vocabulary can enhance the link between form and meaning and make teaching and learning exciting (27). A study on the perceptions of two Mexican immigrant children in the United States who used flashcards to speak Spanish showed that the children had a positive view of using the flashcards; they loved the colors of the flashcards, and the flashcards helped them learn different ways of greetings and presentations in Spanish. (28). Likewise, a study using a mobile flashcard application in a course for the vocabulary development and motivation of students in Turkey showed that the students gained a higher level of vocabulary knowledge and were more motivated to learn words. It was also found that the application of the mobile flashcard in the teaching and learning processes was perceived positively by the students and their teachers (29). Digital flashcards also create short-term and long-term improvements in the learners' vocabulary knowledge (30). Research has also shown that digital flashcards help pharmacy students learn more technical vocabulary, and the students had positive perceptions of using flashcards to study technical vocabulary (31).

Despite the rich body of literature on the advantages of using flashcards for educational purposes (26,29,31), there is a paucity of research on the students' perceptions of flashcards. Little is known about how the appearance of the flashcards, the content of information on the flashcards, and the potential contribution of flashcards to learning are perceived by target students. In most studies, students are commonly provided with a stack of flashcards, and the effect of the flashcards on their learning is studied. Although discovering the effects of flashcards on students' overall learning is important, considering their aesthetic and organization, adequacy of information, and contribution to learning can help provide quality educational materials. Moreover, given the fact that students are the users of flashcards, discovering how they perceive their appearance, content of information and contribution to learning can prepare the grounds for a more purposeful use of them.

**Studies on the use and evaluation of flashcards in medical education**

There is a paucity of research in the area of developing and evaluating medical term flashcards in English for specific purposes and medical terminology courses. There are, however, studies that have targeted the use of flashcards for learning medical words in other courses. In a case in point, flashcards were designed for use in the gross anatomy course to address students' needs. To design the flashcards, schematic diagrams of individual muscles of the upper limb and lower limb and the details of the muscles were collected under specific headings. Next, senior faculty members in the Department of Anatomy were asked to validate the text material along with the images. Afterward, the printouts were taken in such a manner that the image of a particular muscle was matched with its details on the reverse. Finally, stacks of flashcards were created by fixing them on a metal ring. Subsequently, occupational therapy and physiotherapy students were provided with flashcards for self-study and their perceptions of using flashcards were investigated using a pre-validated questionnaire comprised of closed-ended and open-ended questions. Such items as "the content of the flashcards used was adequate", "flashcards were an effective method of learning the subject of Anatomy" and "the flashcards helped them in answering in the examination" were used to evaluate the flashcards.

The results showed that the students had positive views of the flashcards, reporting that "the flashcards helped them to do a quick revision, memorize the content easily and thus perform better in the exams". The results also indicated that almost half of the students did not know that flashcards could be one of the methods of learning, all students felt that flashcards were an effective method of learning the subject of Anatomy, almost all of the students thought that the content of the flashcards used was adequate and helped them in revising the subject of anatomy, the majority of them felt that flashcards helped them in answering in the examination, all of them felt that they should use this method of self-study for other practical sessions and a few of the students suggested modifications/ changes in the flashcards (20).

Educational flashcards were also designed to teach skull radiography techniques. The flashcards contained information on the patient's specific position and special radiation conditions. The flashcards were used for a semester and were asked to evaluate their effect on learning and items like "flashcards are written rationally", "content, color, and flashcard design are appropriate", "the classification of the content is presented in great form", "content, color, and flashcard design are appropriate", "are there any suitable images in flashcards?", "can flashcards be understood?", "the use of flashcards is an innovative way of learning', and "flashcards are not boring to learn skull radiography techniques" were used to evaluate the flashcards. The majority of the students believed that the flashcards were understandable, the content of the scientific and practical information on the flashcards was brief and helpful, appropriate pictures were used, the content of information of the flashcards facilitated and accelerated learning, learning with the flashcards was not boring, reviewing the flashcards were effective in long- term memorization of the information, the content, color, and design of flashcards were appropriate, and the size of the flashcards was appropriate(18).

Another study investigated how flashcards produced by students facilitated the learning of drugs. To do so, the materials and the template on which the students would work were designed. Next, the students produced their flashcards containing information on advice on healthy lifestyles, recommendations of a hygienic-dietary type, rational use, and the correct administration of drugs and medications. Afterward, the professors corrected the flashcards and uploaded them onto the web. Then, the students evaluated the created flashcards, indicating that the flashcards aided them in the study, memorization, participation, and motivation. The study concludes that the use of flashcards can serve not only to promote the autonomous work of the student but also to make it better to improve their learning techniques by adopting information and communication technologies (5).

Hypermedia flashcards (h-cards) were also designed, used, and evaluated as a teaching tool. To do so, three scripts in JavaScript were written and the flashcards were used in botany and biology classes. It was reported, "In every course in which we have used h-cards, the most common recommendation [from students] was to include additional sets of h-cards." Test results for students under conditions when h-cards were available, and when they were not available showed that the students using the flashcards outperformed the other group (19).

In another study, flashcards and a manual book were developed as teaching media for teaching English vocabulary to young learners. To develop the flashcards, first, the topics of the content of the flashcards were identified by conducting a syllabus analysis. Next, the flashcards were designed using the free version of Adobe Photoshop Cs3 Intended, where the flashcards were divided into the front side and the backside. On the front side of the flashcards, a picture and a target word were used and on the backside of the flashcards, the meaning of the word in the students' native language was given. The manual book guided the teachers on how to use the flashcards in various activities in English teaching. The flashcards were used by English teachers. The quality of the flashcards was evaluated as excellent by experts in media studies and teachers at elementary schools. The media experts suggested that the background color of the flashcards be changed from dark blue to a brighter color for readability purposes (32).

As the review of the literature showed, the flashcards used in the medical fields have followed different development procedures, and few of them have involved the evaluation of the flashcards. Moreover, flashcards have been used for basic sciences and clinical courses; none of the studies have targeted the evaluation of flashcards in medical terminology and specialized English courses for medical sciences students. Additionally, previous studies have been conducted in normal conditions when universities were open. None of the studies have used electronic flashcards in pandemics. Therefore, the present study can bridge the existing gaps in research on the evaluation of teacher-made flashcards in medical terminology specialized English courses. Moreover, the study can provide evidence for the usability and/or efficacy of using flashcards in the face of pandemics.

Digital flashcards duplicate the functions of paper

flashcards and provide such extra affordances as high-quality images, digital animations (on the card itself or when moving to the next card in the deck), embedded audio, embedded links to additional content and/or evaluations, the possibility of studying words anytime and anywhere, individualized study plan, instant feedback, and adaptive sequencing features (15,19,33). They do not get lost, torn, or stained (19). Studies have attested to learners' positive attitudes toward using digital flashcards (26,34) and the positive changes and differences digital flashcards cause in learning language skills compared to paper flashcards (34-36), emphasizing that flashcards should be available in a multitude of formats (15). The effects of using a digital flashcard application called the New Academic Word List (NAWL) builder, paper flashcards, and a list of target words with their definitions on learning academic vocabulary were compared. The results showed that the students using the digital flashcards outperformed the other groups (36). The effects of e-flashcards and paper flashcards on Chinese vocabulary learning and learning attitudes among students learning Chinese as a foreign language were examined. The e-flashcards incorporate multimedia resources with comprehensive visual, verbal, and audio inputs while the paper flashcards provide only visual and verbal inputs. The results revealed that the students who used the e-flashcards statistically outperformed those who used paper flashcards on immediate post-tests of Chinese word reading and listening, as well as on a 1-week delayed listening test. In addition, the students who used e-flashcards demonstrated more positive learning attitudes toward Chinese word learning than those who used paper flashcards (37).

The evaluation of flashcards has been performed differently in different studies. The evaluation of digital flashcards or paper flashcards has been case-specific; that is, based on the type (paper or digital) of the flashcards and their features, different evaluation tools have been used. A review of the literature shows that questionnaires comprised of closed-ended questions and open-ended questions (20), questionnaires based on a five-point Likert scale on the content, structure, user-friendliness and structure of the flashcards (18), surveys of both professors and students to know their opinion on the design and adequacy of the flashcards (5), surveys of students (19) and interviews, questionnaires for teachers and students, and evaluation sheets (32) have been used for the evaluation of flashcards.

From the arguments above it can be concluded that although some studies above have targeted the development and evaluation of flashcards, they have not evaluated the flashcards multi-dimensionally. The present study attempted to address the gap by exploring students' perceptions of the quality of the flashcards in terms of their appearance, content of information, and potential contribution to learning. Moreover, the participants in previous studies have been mainly a single group of students, for instance, in the fields of anatomy or physiotherapy; the present study expanded the spectrum of the target group by recruiting participants from different fields of medicine and health studies, which contributes to the generalizability of the findings. Furthermore, unlike previous studies which have been conducted in ordinary situations and conditions, this study was conducted at the time of restrictions and closures during the Covid-19 pandemic when the production, use, quality, and usability of electronic educational materials might have been overshadowed by the urgency to maintain the continuity of education at universities. Emphasizing the need for the continuity of education at times of urgency, this study raised concerns for securing quality education and advanced a procedure for developing, using, and evaluating the quality of medical terminology flashcards used in university courses electronically from the perspective of medical and health studies students. By doing so, the present study can provide help and guidance for teachers and material developers on how to aid in the continuity of education, provision of quality education, and the inclusion of students' perspectives in the development of materials during emergencies, restrictions, and closures.

## Materials and Methods

The design of the study was based on the purpose of the study; therefore, educational design research, commonly used in education development studies, was employed. Educational design research is defined as "the systematic analysis, design, and evaluation of educational interventions" such as programs, learning processes, learning environments, teaching-learning materials, products, and systems. Moreover, to describe how medical sciences students evaluate medical terminology flashcards in terms of appearance, content of information, and potential contribution to learning, this study used descriptive research design (38).

### Instrument

To discover medical sciences students' evaluation of the quality of the teacher-made medical terminology flashcards and to investigate whether students of laboratory sciences, radiology, anesthesia, operating

room, nursing, medicine, and midwifery have different perceptions of the quality of the flashcards, a researcher-developed questionnaire was used. The questionnaire consisted of 24 items on the appearance of the flashcards (7 items), the content of information of the flashcards (7 items), and the potential contribution of the flashcard to learning (10 items). The construction of a questionnaire is a "stepwise process" and the quality of the developed questionnaire hinges on the "cumulative quality of each sub-process" (39). As a result, to develop the questionnaire for the current study, the related literature on educational technology tools and the quality of the tools (5,18-20), (to name but a few) was examined and interviews were conducted with five experts in the field of educational technology and teaching. Then, to identify key underlying concepts in the review of the literature phase and the interview phase, the findings in the two phases were triangulated. Based on the identified key concepts, which constituted the framework for formulating the items of the questionnaire, an "item pool" (39) was developed. The initial sets of the key underlying concepts were refined in terms of their relation to the organization of the information on the front and back, aesthetic features, the adequacy of information on the flashcards and the potential contribution of the flashcard to learning. Next, the refined concepts were formulated into statements, which constituted the items pool. From the items pool, some items were excluded due to overlap with others and ambiguity. The items on the questionnaire were developed based on a four-point Likert Scale in Persian (the students' mother language). Then, the formulated items were checked for wording, format, face validity, and intelligibility. To check the face validity of the questionnaire, five experts in the field reviewed the questionnaire and provided their subjective judgment on whether it appeared to be measuring perceptions about the appearance of the flashcards, their content of information and their contribution to learning. As a result of the face validity check, the wording of three items was modified and the order of two items was changed. The questionnaire was then piloted and, as a result, some items were modified. To pilot the questionnaire, it was distributed among 50 medical students taking medical terminology and specialized English courses at the university. The sample size was large enough to provide meaningful feedback and detect potential problems; moreover, as they were taking medical terminology and specialized courses, they reflected the diversity and characteristics of the target population The students were also provided with the developed flashcards. They used the flashcards and evaluated them based on the items on the questionnaire subsequently. The questionnaires were then collected. To calculate the reliability of the questionnaire, the results of the pilot study were fed into the Statistical Package for the Social Sciences (SPSS), and a Cronbach Alpha reliability test was run. The results for Cronbach's Alpha were calculated at 0.81 which is an acceptable measure for the reliability of a questionnaire (40). Experts in the field of English language teaching also reviewed, confirmed the content validity of the questionnaire, and provided feedback on improving some items. The items were then modified based on the experts' feedback and the questionnaire was finalized. To check the content validity of the questionnaire, five experts in the field commented on the sufficiency of the items to measure the three aspects of the flashcards, the appropriateness of the syntax and semantics of the items on the questionnaire, the logical relationship between the items and the dimension of the flashcards it measured, and the necessity and importance of incorporating the items on the questionnaire. Based on the experts' comments, the structure of some items was changed, some items were fine-tuned to match the constructs they measured, and a redundant item was removed. The final questionnaire contained a demographic section, an appearance section with seven items, a content of information section with seven items, and a potential contribution to learning section with 10 items.

**Participants**

The participants in the study were 351 students of laboratory sciences, radiology, anesthesia, operation room, nursing, medicine, and midwifery who used and evaluated the flashcards. They were taking medical terminology or specialized English courses at the colleges of Guilan University of Medical Sciences, Iran. They were male and female students and were in the 20-22 age bracket. The reviewers of the flashcards were two English language teaching professors, a nursing professor, a biochemistry professor, a microbiology professor, a physiology professor, and an anatomy professor. The professors all held a Ph.D. in their relevant fields and had at least three years of teaching experience at the university.

**Procedure**

The decision to produce and use the flashcards had been made before the coronavirus pandemic in 2019; the flashcards were, however, used, and evaluated in medical terminology courses and specialized English courses for medical students in the second semester (January 2020 to

July 2020) and first semester (September 2020 to January 2020) of the Iranian academic year. The impetus for producing the flashcards was a lack of medical terminology materials in the market. With the outbreak of COVID-19, the need for materials for teaching the medical terminology course electronically became necessary. Below, samples of the medical terminology flashcards are given. The medical terminology flashcards pertain to the cardiovascular system, nervous system, respiratory system, and blood and immunity system.

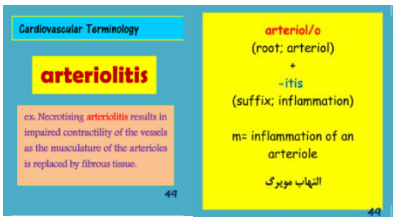


**Figure 1.** The front and back of a flashcard on the cardiovascular system

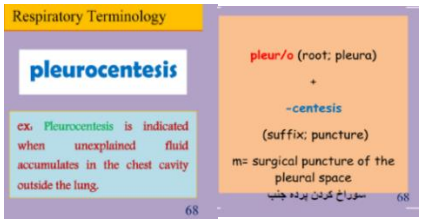


**Figure 2.** The front and back of a flashcard one respiratory system

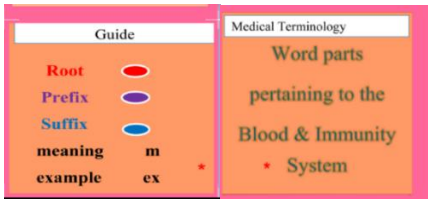


**Figure 3.** The front and back of the Guide flashcard on blood and immunity

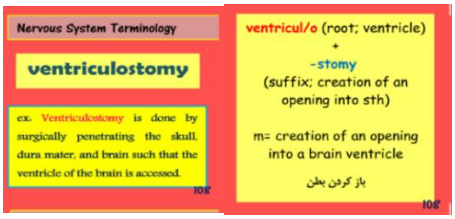


**Figure 4.** The front and back of a flashcard on the nervous system


**Figure 5.** The front and back of a flashcard on the respiratory system


**Figure 6.** The front and back of a flashcard one nervous system

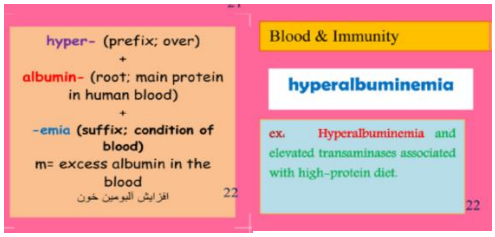


**Figure 7.** The front and back of a flashcard on the blood and immunity system

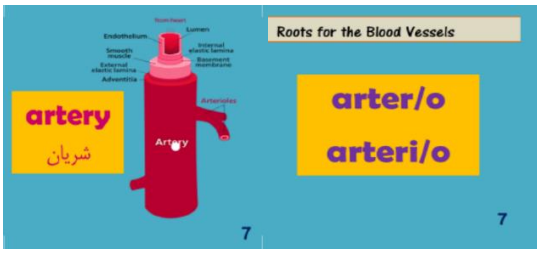


**Figure 8.** The front and back of a flashcard on the cardiovascular system

After designing the flashcards, a group of reviewers examined the flashcards in terms of the content of information, wording, readability, the organization of the information on the front and back, and the aesthetic features. They were asked to scrutinize the flashcards, comment on different parts of the flashcards, and give their suggestions for improving the flashcards. The reviews were collected, and a panel session was organized in which the examiners discussed the ways to improve the quality of the flashcards. Based on the reviewers' corrections, comments, and suggestions, and the results of the panel session, the flashcards were modified and finalized.

The flashcards were then given to the students who used them to study the medical terms of four body systems: cardiovascular system, nervous system, blood and immune system, and respiratory system. They used the flashcards for eight sessions. The flashcards were used in the electronic specialized English courses and Medical terminology courses which were offered both online and offline via a Learning Management System (LMS) developed by the university for teaching and

learning purposes. The teacher, however, did not teach the terms covered in them. Instead, the teacher uploaded the flashcards onto the LMS, and the students could download and study them; that is to say, in the online courses, the teacher covered subjects and contents other than the terms covered on the flashcards. The flashcards were uploaded onto the LMS, and the students were asked to study the terms on the flashcards without the teacher's help. The students were then asked to use the questionnaire to evaluate the flashcards in terms of 1) appearance, 2) content of information, and 3) potential contribution to learning.

One of the objectives of the study was to discover the students' perceptions of the appearance of the flashcards, the content of information of the flashcards, and the potential contribution of the flashcards to learning medical terms. To explore the students' perceptions of the three aforementioned aspects of the flashcards, they were provided with the flashcards, used them, and evaluated them based on relevant items on the questionnaire. Next, to discover the students' perceptions of each of the three aspects of the flashcards, the Minimum, Maximum, Mean, and Standard Deviation of the students' answers were calculated. Table 1 below shows the mean score of the flashcards in each of the three areas.

## Results

**Table 1. The mean score of the three aspects of the flashcards**

| | N | Missing | Min | Max | Mean | SD |
|---|---|---|---|---|---|---|
| **Potential contribution to learning** | 347 | 4 | 1.00 | 5.00 | 4.1503 | .54942 |
| **Content of information** | 347 | 4 | 1.57 | 5.00 | 4.2386 | .49421 |
| **Appearance** | 348 | 3 | 2.71 | 5.00 | 4.2892 | .50936 |

As the table shows, the students' mean score on the appearance of the flashcards was the highest (4.2892) which was followed by the content of information (4.2386) and contribution to learning (4.1503). The analysis of the data on the appearance of the information on the flashcards on each of the items of the questionnaire is given in Table 2 below.

**Table 2. Descriptive analysis of the students' evaluation of the appearance of the flashcards**

| Appearance | | Item 1 | Item 2 | Item 3 | Item 4 | Item 5 | Item 6 | Item 7 |
|---|---|---|---|---|---|---|---|---|
| **N** | **Valid** | 348 | 348 | 348 | 348 | 347 | 348 | 348 |
| | **Missing** | 3 | 3 | 3 | 3 | 4 | 3 | 3 |
| **Mean** | | 4.2328 | 4.3017 | 4.4511 | 4.4339 | 4.2795 | 4.2155 | 4.1063 |
| **Std. Deviation** | | .83536 | .69853 | .64457 | .71517 | .83956 | .91864 | .81955 |
| **Minimum** | | 1.00 | 2.00 | 2.00 | 1.00 | 2.00 | 1.00 | 1.00 |
| **Maximum** | | 5.00 | 5.00 | 5.00 | 5.00 | 5.00 | 5.00 | 5.00 |

As the table shows, the mean score of the students' evaluation of all items on the appearance of the information on the flashcards is high. Among the items, item number three, which was "The positioning of a medical term together with a sentence containing the term on the front side of the flashcards and positioning the components constituting the medical terms (prefix, root, and suffix) on the backside of the flashcards are done suitably", had the highest mean score and item number seven, which was "The medical terms are suitable in terms of positioning and organizing the information and color codes for different body systems", had the lowest mean score. Table 3 below shows the analysis of the data on the items on the content of information on the flashcards.

**Table 3. The descriptive analysis of the students' evaluation of the content of the flashcard**

| Flash cards' Content of information | | Item 1 | Item 2 | Item 3 | Item 4 | Item 5 | Item 6 | Item 7 |
|---|---|---|---|---|---|---|---|---|
| N | **Valid** | 347 | 347 | 347 | 347 | 346 | 346 | 347 |
| | **Missing** | 4 | 4 | 4 | 4 | 5 | 5 | 4 |
| **Mean** | | 4.2017 | 4.3372 | 4.0922 | 4.2680 | 4.2168 | 4.2977 | 4.2536 |
| **Std. Deviation** | | .77512 | .67906 | .82070 | .71336 | .72380 | .71493 | .67935 |
| **Minimum** | | 1.00 | 2.00 | 1.00 | 1.00 | 1.00 | 1.00 | 2.00 |
| **Maximum** | | 5.00 | 5.00 | 5.00 | 5.00 | 5.00 | 5.00 | 5.00 |

The table shows that the students have a positive evaluation of the content of the information contained on the flashcards. They particularly had the highest evaluation of item two, which was *"Prefixes, suffixes, and roots of medical terms are included meaningfully and comprehensibly on the backside of the flashcards".* The students, however, had the weakest evaluation of the adequacy of the information contained on each flashcard (item 3). The results of the students' evaluation of the effect of the flashcards on learning are given in Table 4 below.

**Table 4. The students' perception of the potential contribution of flashcards to learning**

| Potential contribution to learning | | Item 1 | Item 2 | Item 3 | Item 4 | Item 5 | Item 6 | Item 7 | Item 8 | Item 9 | Item 10 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| N | Valid | 346 | 347 | 344 | 344 | 343 | 344 | 343 | 344 | 344 | 343 |
| | Missing | 5 | 4 | 7 | 7 | 8 | 7 | 8 | 7 | 7 | 8 |
| Mean | | 4.1185 | 4.2421 | 4.0872 | 4.2209 | 4.1895 | 3.9826 | 4.1050 | 4.0698 | 4.2384 | 4.2478 |
| Std. Deviation | | .73058 | .76722 | .79243 | .79578 | .73485 | .86036 | .79880 | .87119 | .72533 | .74130 |
| Minimum | | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 |
| Maximum | | 5.00 | 5.00 | 5.00 | 5.00 | 5.00 | 5.00 | 5.00 | 5.00 | 5.00 | 5.00 |

From the table, it can be understood that the students believed that the flashcards had the potential to contribute learning. Item 9, which is on cognitive and affective contribution of the flashcards to learning, had the highest mean score and item 8, which was on the extent the flashcards motivate the students to study medical terms, had the lowest mean score.

The study also aimed to discover how students majoring in different medical fields evaluated the flashcards. Table 5 below shows discipline-specific descriptive statistics of the medical sciences students' evaluations of the appearance, content of information and potential contribution of the flashcards to learning.

As the table shows, the students of the Operating Room have the highest mean (4.5260) in the evaluation of the appearance of the flashcards while the students of Anesthesia had the lowest mean (4.1731). As for the content of the flashcards, the students of Medicine had the highest mean (4.4273), and the students of Anesthesia had the lowest mean (4.0448). Moreover, the students of medicine had the highest mean (4.2634) while the students on Anesthesia had the lowest mean score (4.0313) on the evaluation of the potential contribution of the flashcards to learning. From the table, it can be said that the students of medicine had the most positive view of the flashcards, whereas the students of anesthesia evaluated the flashcards the lowest of all.

To compare the mean variance of the perceptions of the students of different medical and health fields in the three aspects of appearance, the content of information, and potential contribution to learning, the ANOVA test was used. The results of the major-specific evaluation of the flashcards are given in Table 6 below.

The table shows that the students' evaluations of the content of the flashcards (Sig. of 0.000) differs significantly, while their evaluation of the appearance (Sig. of 0.113) and potential contribution to learning (Sig. of 0.058) of the flashcards does not differ.

**Table 5. Discipline-specific statistics of the students' perceptions of the flashcards**

| | | N | Mean | Std. Deviation | 95% Confidence interval for Mean | | Minimum | Maximum |
|---|---|---|---|---|---|---|---|---|
| | | | | | Lower bound | Upper bound | | |
| Appearance | Laboratory sciences | 52 | 4.1978 | .58810 | 4.0341 | 4.3615 | 3.14 | 5.00 |
| | Radiology | 43 | 4.3339 | .46987 | 4.1893 | 4.4785 | 3.29 | 5.00 |
| | Anesthesia | 59 | 4.1731 | .50876 | 4.0405 | 4.3057 | 2.71 | 5.00 |
| | Operation room | 22 | 4.5260 | .36458 | 4.3643 | 4.6876 | 3.86 | 5.00 |
| | Nursing | 43 | 4.2965 | .54390 | 4.1291 | 4.4638 | 3.14 | 5.00 |
| | Medicine | 93 | 4.3212 | .45304 | 4.2284 | 4.4140 | 3.14 | 5.00 |
| | Midwifery | 35 | 4.3224 | .57179 | 4.1260 | 4.5189 | 2.71 | 5.00 |
| | Total | 347 | 4.2892 | .50936 | 4.2355 | 4.3429 | 2.71 | 5.00 |
| Content of information | Laboratory sciences | 52 | 4.1488 | .61539 | 3.9775 | 4.3201 | 1.57 | 5.00 |
| | Radiology | 43 | 4.3023 | .54462 | 4.1347 | 4.4699 | 3.14 | 5.00 |
| | Anesthesia | 59 | 4.0448 | .41879 | 3.9357 | 4.1539 | 3.14 | 5.00 |
| | Operation room | 22 | 4.2532 | .33556 | 4.1045 | 4.4020 | 3.71 | 5.00 |
| | Nursing | 43 | 4.1362 | .43861 | 4.0012 | 4.2712 | 3.14 | 5.00 |
| | Medicine | 93 | 4.4173 | .43249 | 4.3282 | 4.5064 | 3.29 | 5.00 |
| | Midwifery | 35 | 4.2619 | .50458 | 4.0886 | 4.4352 | 2.71 | 5.00 |
| | Total | 347 | 4.2386 | .49421 | 4.1864 | 4.2908 | 1.57 | 5.00 |
| Potential contribution to learning | Laboratory sciences | 52 | 4.1731 | .57364 | 4.0134 | 4.3328 | 2.20 | 5.00 |
| | Radiology | 43 | 4.2326 | .55150 | 4.0628 | 4.4023 | 3.00 | 5.00 |
| | Anesthesia | 59 | 4.0313 | .45701 | 3.9122 | 4.1504 | 3.10 | 5.00 |
| | Operation room | 22 | 4.2136 | .33423 | 4.0654 | 4.3618 | 3.80 | 5.00 |
| | Nursing | 43 | 4.0442 | .57167 | 3.8683 | 4.2201 | 1.80 | 5.00 |
| | Medicine | 93 | 4.2634 | .47840 | 4.1649 | 4.3620 | 2.70 | 5.00 |
| | Midwifery | 35 | 4.0057 | .80438 | 3.7294 | 4.2820 | 1.00 | 5.00 |
| | Total | 347 | 4.1503 | .54942 | 4.0923 | 4.2083 | 1.00 | 5.00 |

**Table 6. ANOVA test to compare students' major-specific evaluation of the flashcards**

| | | Sum of squares | df | Mean square | F | Sig. |
|---|---|---|---|---|---|---|
| Appearance | Between groups | 2.661 | 6 | .443 | 1.729 | .113 |
| | Within groups | 87.188 | 340 | .256 | | |
| | Total | 89.848 | 346 | | | |
| Content of information | Between groups | 6.255 | 6 | 1.042 | 4.529 | .000 |
| | Within groups | 78.253 | 340 | .230 | | |
| | Total | 84.5 | 346 | | | |
| Potential contribution to learning | Between groups | 3.649 | 6 | .608 | 2.051 | .058 |
| | Within groups | 100.797 | 340 | .296 | | |
| | Total | 104.446 | 346 | | | |

## Discussion

The study aimed to explore medical sciences students' perceptions of the quality of the medical terminology flashcards used electronically in the medical terminology and specialized English courses in terms of appearance, content of information, and potential contribution to learning. The results reflected the students' overall positive perception of the flashcards. One of the reasons for the students' positive perception of the flashcards could be the role of the flashcards in filling the gap between the need for medical terminology in medical education and the existing lack of such educational material as flashcards for medical terminology at the time

of the COVID-19 restrictions and closures. Learning medical terms is among the prerequisites and prime needs of medical sciences studies and competency in the use of medical terminology can significantly contribute to patient safety and effective workflows (41). The students in the present study, based on their field of study, had to pass from two to six credits in medical terminology and specialized language courses. Therefore, the students' need for medical terms could also have played a role in their positive evaluation of the flashcards. It is argued that medical students are strongly motivated to learn medical terms as they know that the terms can help them get a better job and participate actively in the exchange of scientific knowledge (1). Along the same line of discussion, proficiency in medical terminology has been described as an "essential competence of physicians", noting that such competency in medical terminology makes communication in clinical practice clear and reliable (9).

The students' positive perception of the flashcards could also be created by the affordances of electronic flashcards. The flashcards in the present study were produced in various colors which associated with different body systems, contained images of the medial roots and terms, had the meaning of the medical terms in the students' mother tongue, had example sentences in which the target medical term is used, and had information on the part of speech of the term and its phonetics. The affordances of digital flashcards compared to paper flashcards such as high-quality images, and the possibility of studying words anytime and anywhere help the creation of positive perceptions of and attitudes towards the flashcards (34,42), render them effective vocabulary learning tools (15,33) and do not get lost, torn, or stained (19). Moreover, electronic flashcards can facilitate students' technical vocabulary learning (31) and take less time to review compared to paper flashcards (15). Additionally, the care and precision in the designing stage and the involvement of the students in the production phase of the flashcards could have shaped the students' overall positive perception of the flashcards. As was explained in the methods sections, the flashcards in the present study were designed and reviewed by medical students, and experts in the fields of medical teaching and English language teaching. The acceptance of teaching aids like flashcards among students increases if the students are involved in the designing of the flashcards (20).

Another point in the present study that merits consideration refers to the way flashcards as a form of educational materials were evaluated. Educational materials like flashcards need evaluation (43) because they can differ in terms of attractiveness, preferences, and potential effect on learning (44). In the evaluations of teaching aids, scales like contents, the formal characteristics, technicalities, and the learning process should be considered as the students' perceptions of the flashcards may affect their perception of the effectiveness of the program (45). Flashcards should be evaluated in terms of flashcard creation and editing as well as learning. In the present study, three perception elicitation components of the appearance of the flashcards, the content of information of the flashcards, and the potential contribution of the flashcard to learning were used and the students' evaluations of the flashcards in terms of each of the components were investigated. Although the components used in the present study shared commonalities with those used in other studies, they differed in certain ways (23). The present study used a 24-item questionnaire containing seven items on the appearance, seven items on the content of the information, and 10 items on the potential contribution of flashcards to learning. Moreover, the present study, unlike other similar studies on the evaluation of flashcards, compartmentalized the evaluation components so that any ambiguity could be avoided, and a more precise and clear evaluation of each component could be made. Moreover, compared to other studies (18,20), more items were developed on each of the components so that a comprehensive, rich, and detailed evaluation could be made of the flashcards. Dashti *et al*., for example, used a 13-item checklist to discover the students' evaluation of the flashcards; the items like "content, color, and flashcard design" in their study, however, were not compartmentalized and mixed concepts on content and appearance (18). Moreover, in the study by Patil and Iyer, there was no item for the evaluation of the appearance and structure of the flashcards and the items they used for evaluating the flashcards mainly focused on the effect of the flashcards on learning. Gaining insights from other studies, this study attempted to evaluate the flashcards from the perspective of the students in terms of compartmentalized and comprehensive components (20).

Another finding of the study was that the students' perceptions of the appearance and the potential contribution of the flashcards to learning did not differ, whereas their evaluations of the content of the flashcards differed significantly. The findings of the present study in terms of students' perceptions about the appearance of the flashcards and their effect on learning correspond with the findings in the study by Vargas (2022) where the

students had a positive view of the colors of the flashcards noted that the flashcards helped them learn different ways of greetings and presentations (28). The findings of the present study are also in keeping with the results of the study by Dashti *et al*., where appropriate pictures were used on the flashcards, the content of information of the flashcards facilitated and accelerated learning, learning with the flashcards was not boring, and the content, color, size, and design of flashcards were appropriate (18).

The study also discovered that the students of different fields of medical and health studies had different perceptions of the content of information of the flashcards. Unlike the findings of the present study, the students in the study by Patil and Iyer, perceived that the content of the flashcards they used was adequate (20). In the same vein, the students in the study by Dashti *et al*., believed that the content of the scientific and practical information on the flashcards was brief and helpful. The reason for the marginal difference in the students' views on the content of the flashcards could relate to their needs for information (18). The students in the present study could have needed more content of information on the flashcards compared to the students in previous studies. Moreover, as for language learning, learners have different needs and motivations, develop their routes to learning and progress at different rates. Additionally, the marginal difference in students' evaluation of the content of information on the flashcards could be due to the type and degree of need for medical terms (46). Although all students need to know common core medical terms (common medical roots, prefixes, suffixes, plural forms, etc.) for communication and patient safety purposes within the limits of their specialization, not all students may need detailed comprehensive knowledge of medical terms in all or various specialties. They would rather gain more content of information on medical terms of their field of specialization. This is where comes the concept of priorities of needs, i.e. medical students have priorities of needs for medical terms ranging from common core medical terms required for communication and patient safety purposes to detailed specialized needs for medical terms required for field-specific purposes and services. All students of health studies and medical sciences need to know the meaning of a term like "CARDI" (meaning heart in English) as a medical root and how it is pronounced or combined with prefixes and suffixes; however, knowing the meaning of "ANTITACHYCARDIA PACING or CARDIOMYOPATHY" may be a top priority for the students of Medicine and only a peripheral need, if any, for the students of such health studies as Radiology technology.

## Limitations

As the students were in intact university classes where there were different proportions of female and male students with different proficiency levels in English, student variables like gender and level of English language proficiency were not investigated. Moreover, because of the closures and restrictions, only a questionnaire was used in collecting data on the students' evaluation of the flashcards. In normal conditions and situations, interviews can also be performed with students, to collect richer data on the usability of the flashcards.

Concerned with securing quality education, this study explored medical and health studies students' perceptions of the quality of teacher-made medical terminology flashcards produced and used electronically in university courses. To do so, students of medicine, radiology, anesthesia, midwifery, nursing, operating room, and laboratory sciences used the flashcards and evaluated them in terms of appearance, content of information, and potential contribution to learning. The results showed that the students had an overall positive perception of the appearance of the flashcards, the content of information of the flashcards, and the potential contribution of the flashcards to learning. Despite the overall positive evaluation, the students' perceptions of the color choices, the adequacy of the information contained on each flashcard, and the contribution of the flashcards to the students' motivation for studying the terms did not match up with other evaluation criteria of the flashcards. From the results, it can be concluded that the colors used on the flashcards need to be more varied to attract a larger population of students, and the size and type of the information contained on the flashcards are required to be modified to meet the needs of a larger spectrum of students, which can, in turn, influence the students' motivation for learning medical terms. Another finding of the study was that, though not significantly different, the students' evaluation of the appearance of the flashcards was marginally better than their evaluation of the content of information on the flashcards; moreover, the appearance and content of information of the flashcards were evaluated slightly more positively than the potential contribution of the flashcards to learning. From the results, it can be concluded that the beauty, information, and potential efficacy of the flashcards shaped the students' positive perceptions of the flashcards in a subtle order of priority. It mattered to the students how the

flashcards are developed aesthetically, how exhaustively the flashcards embrace the needed content of information, and, last but not least, how efficaciously the flashcards potentially contribute to learning. The study also showed that the perceptions of the students of different medical and health fields about the appearance and contribution to the learning of the flashcards did not differ significantly; however, their evaluation of the content of the flashcards differed significantly; From the findings, it can be said that, although all students of health studies need medical terms for securing patient safety and accurate communication in medical fields, there could be degrees of need for medical terminology flashcards and other teaching materials, which can, in turn, appeal differently to the students majoring in different medical fields; the finding has practical implications for developing medical terminology materials and flashcards based on the needs of the students. The study concludes that although teacher-made materials could support the delivery of knowledge and continuity of education, securing the quality of the materials and the usability of the materials for the target students by eliciting the students' perceptions of the materials in terms of the appearance, content of the information and potential contribution to learning can improve quality education.

**Future study**

This study aimed to explore medical and health studies students' perceptions of learning with medical terminology flashcards. To this end, the students used flashcards in the medical terminology and specialized English courses and evaluated the quality thereof in terms of appearance, content of information, and potential contribution to learning. Future studies can investigate the effect of using the same flashcards on students' learning of medical terminology using pre-test and post-test research designs. The study recommends that similar electronic teaching and learning aids be developed, used, and evaluated in other courses to check the practical effect of flashcards on the student's academic achievements. Future studies can also compare the effect of teaching medical terms with the help of electronic flashcards with other teaching methods using wordlists, and paper flashcards.

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