

Development and Perceived Usability Evaluation of a Mobile application for Notetaking

H. Demirelli¹, Y. Isler² and Y.K. Yuce^{1,*}

¹Department of Computer Engineering, Alanya Alaaddin Keykubat University, Kestel Mah. 07425 Alanya, Antalya, Turkey

²Department of Biomedical Engineering, İzmir Katip Çelebi University, Balatçık Mah. 35620 Çiğli, İzmir, Turkey

Abstract

INTRODUCTION: Notetaking is considered, by many educators, as one of the critical actions of learning. There are several note-taking methods and approaches. Based on these methods and approaches, various applications, whether mobile, desktop or -Web-based, were developed.

OBJECTIVES: In this paper, a novel note-taking application based on Cornell Technique, is presented. Its development process and user acceptance trend are exhibited and results for user evaluation based on user satisfaction are presented.

METHODS: For the software development process, Incremental Model was adopted. Requirement Analysis included, aside from examining principles and related note-taking structure of Cornell Technique, investigating (i) how to perform notetaking as an activity of learning, (ii) its product and (iii) relationship of notes for the purpose of storage. Models containing sub-activities, such as reviewing note have been identified and some were selectively adopted and related functions such as review alert (tickler) and collaboration on notetaking have been implemented. To the purpose of storage, a tree-based scheme called collection was modelled. User interfaces were first designed as mockups and click-through prototype using Adobe XD. The mobile application was implemented in Dart programming language. Google's Firebase Service and Flutter Framework was adopted. The mobile application was compared with its equivalents in the Google Play Store and user statistics were investigated. To evaluate perceived usability, the System Usability Scale is adopted and applied to 14 university students conforming to determined persona.

RESULTS: The application has been published in Google Play Store for users to install for free on 18th March 2022. As of 10th September 2023, total number of downloads is 5K and the Cornell Note mobile app is currently installed on 1108 devices. For the last three-month period (from 11th June to 10th September 2023), the active users per month changed in an increasing trend from 450 to 589. The average engagement time on 11th of April 2023 was 28 minutes 00 seconds. As the number of monthly active users increased, the average engagement time measured on 10th September 2023 decreased to 23 minutes 31 seconds. However, engagement rates measured were 76.91% and 77.19%, respectively. The mean SUS score was found to be equal to 79.5.

CONCLUSION: The user statistics and comparison with equivalent mobile applications reveal that Cornell Note has potential to grow as a mobile application for notetaking since it has a good perceived usability, however, there is room for improvement. Considering any extra marketing effort was not spent for the application such as application store optimization, the statistics are another evidence for user appeal and acceptance. However, it is important to add new functionality without complicating the user experience so that user appeal and acceptance boosts.

Keywords: notetaking, Cornell Technique, e-learning, mobile application

Received on 14 October 2023, accepted on 29 November 2023, published on 05 December 2023

Copyright © 2023 H. Demirelli *et al.*, licensed to EAI. This is an open access article distributed under the terms of the [CC BY-NC-SA 4.0](https://creativecommons.org/licenses/by-nc-sa/4.0/), which permits copying, redistributing, remixing, transformation, and building upon the material in any medium so long as the original work is properly cited.

doi: 10.4108/eetel.4538

*Corresponding author. Email: yilmazkemalyuce@gmail.com

1. Introduction

Note taking is an information-processing approach that is efficacious and commonly used both in daily life and in many professions [1]. In this regard, it is an action taken as a routine of productive thought processes such as learning, decision making and problem solving as well as practicing.

Due to its relationship with learning, note taking can be accepted as an academic skill, too. During any period of their education, whether it be primary school or university, students are presented either no or very little information regarding the approaches or techniques of note taking. However, notetaking is one of the most common activities performed by students. Research has shown that taking notes is a type of writing task that undergraduates perform during lectures. Brobst reported that 98% of college students take lecture notes [2].

1.1. Impact of notetaking on learning

From a cognitive point view, notetaking does not simply refer to writing down what one listens to or reads as shortened text. Learning is comprised of a few integral cognitive processes such as attention, encoding, storage and retrieval. According to Di Vesta and Gray [3], notetaking serves primarily for two cognitive functions, encoding and storage, since during notetaking students encode information by transcribing, selecting, and summarizing relevant information and organize it for later retrieval. In their study Craik and Tulving [4] presented that notetaking demonstrates significant impact on retention and recall by activating some cognitive processes. In his research Kiewra shows that notetaking significantly raises attention during lesson compared to simply listening to the lesson without notetaking [5,6]. In another study, students asserted the same result regarding notetaking by referring to the fact that taking notes helps them remain attentive [7]. A study by Carrier et.al. found out that one's perception of confidence in notetaking skill is a predictor of course achievement [8]. Affirmatively, a study reported that students who take more notes during lectures are high achievers in their courses [9]. In accordance with this finding, two different studies concluded that notetaking is positively correlated with test and course performance [10,11]. The product of notetaking, i.e., the set of notes taken, is essential and critical for review; since evidence shows that students who review notes outperform students who do not review notes [12,13]. Kılıçkaya and Çokal-Karadaş studied the effect of notetaking in listening comprehension performances of students from Foreign Language Education in Middle East Technical University. They concluded that the experimental group, which was allowed to take notes, performed statistically better than the control group, which was not allowed to take notes [14].

1.2. Problems related to notetaking

Many studies focused on problems that would occur related to notetaking and whether these problems cause negative consequences in learning and education [15-25]. Some of these confirmed that university students apply weak strategies and techniques during lectures and while studying, such as organizing ideas linearly and poor or incomplete notetaking [15,16]. Another study similarly concluded that students have poor notetaking skills (e.g., organizing ideas linearly) during lecture or reading. Consequently, lecture note takers omit around 70% of critical lecture points [17,18]. Incomplete notetaking is considered as a major issue since studies show that number of points recorded in notes is positively correlated with academic success [20-24].

In relation to students' poor notetaking skills supported by evidence, a research set reveals that students' own study notes are less complete and less effective than ones provided by the instructor [17-19, 24-25].

1.3. Notetaking techniques and methods

In literature, there exists a body of research regarding notetaking techniques and strategies. Basically, they are classified as (i) Linear Notetaking Techniques and (ii) Non-linear Notetaking Techniques. Linear notetaking is defined as organization of information in a linear fashion as lists or outlines. Research depicts that linear organization of notes restricts learning, in particular; relational learning [13, 26-27].

Any notetaking approach should have validated strategies to activate cognitive processes mentioned. The main objective of these techniques is to guide students through a standardized and effective method or a step-by-step procedure of processing lecture or similar context material. They dictate and make students walk through certain instructions and employ certain principles. Some even propose their own structures, and formats. These methods include but not limited to Buzan Method, Verbatim Split Method, SOAR Method, Bartush Active Method, and Cornell Method [28-33]. Among them, Cornell Method has a long history [32].

1.4. Mobile applications for notetaking

Digital notetaking has recently become an alternative format of notetaking. There are many mobile applications for notetaking available in application marketplaces. A search in application marketplaces reveal many options offering features and functionalities. Using latest versions of some applications users can insert multimedia into their notes (pictures, voice recordings, video recordings), take voice-recorded speech-to-text notes or take handwritten notes using a stylus pen. Two popular ones are Samsung Notes [34] and Google Keep [35], both of which are downloaded more than one billion times in Google Play

Store. There are others such as Microsoft One-Note [36] (more than 500 million downloads), ColorNote NotePad Notes [37] (more than 100 million downloads) and Evernote [38] (more than 100 million downloads).

In literature, research evidence concerning the use of mobile applications for educational purposes is scarce [39-41]. In their study, [39] Pyörälä, et.al. investigated students' perceptions of notetaking with iPads in 2019. The study was conducted at University of Helsinki, which has given iPads to its freshman students in medical and dental schools since 2013. The study concluded that both medical and dental school students considered digital notetaking as the most important use of mobile devices during their first two years. In addition, the authors discovered that students had developed refined digital notetaking strategies and always had their notes ready for retrieval [39]. Shen and Reily developed a mobile application called GroupNotes that allows students to form groups and take digital notes during a lecture collaboratively [40]. In a similar effort, a mobile application called EduNotes for collaborative notetaking during lectures was introduced by Popescu et. al [41]. The authors investigated 25 students' perceptions of using the application in a lecture session through a survey regarding their experience with EduNotes. Students were positive about and welcomed the idea of taking notes and sharing them with peers. They also reported notetaking by EduNotes as relatively quick.

1.4. Aim of the study and organization

In this paper, we report on the development, user statistics and perceived usability of a mobile application that makes a notetaking system, called Cornell Technique, possible to experience with many features to help users in their learning processes. An electronic model that is a version of the original technique with some essential and additional functions (facilities) were designed and implemented. The application is available on Google Play Store to download.

The next section introduces an overview of Cornell Technique, the electronic notetaking model designed to implement, the system architecture and tools that we utilized for the development. In addition, basic features through user interface of the application are presented. Results section provides user statistics regarding user acceptance and potential of mobile application for notetaking. In the Discussion, possible increments (i.e., possible functionality features that are planned to be added in next versions) and possible design of a study on measuring the impact of use of our application on academic performance will be discussed. Finally, in the last section, the mobile application is evaluated based on the findings of user statistics per user acceptance. It must be noted that this is an extended version of our paper in ICMTEL 2023.

2. Materials and methods

2.1. The Cornell Notetaking Technique

The Cornell Notetaking Technique had its name after Cornell University. It was developed by Walter Pauk in 1949. Pauk states that his sole purpose was to present his students with a simple and effective notetaking technique to reach high comprehension and retention in relation to what they listen to or read regarding their studies in university. In his book titled "How to Study in College", Walter Pauk later has extended his effort's scope and presented Cornell Technique as part of a methodological study approach for college education [32].

In his book [32], Pauk proposes "retaining information" as the third stage of his four-staged studying and learning approach. He divides retaining information into three sub-stages and offers Cornell Notetaking System as a technique consisting of a collection of algorithms, principles, and a documentation template to use in two sub-stages, i.e., "Taking effective notes" and "Turning notes into knowledge".

In detail, the Cornell Notetaking System is established on:

- Classification of notetaking depending on context of learning activity performed, i.e., event (how to take notes during e.g., lecture, discussion, meeting, or reading session)
- A notetaking sheet with a specific structural format
- Algorithms having steps with five relevant routines to be performed using the notetaking sheet(-s), and
- Timing of these algorithms (i.e., during event or after or before event, e.g., lecture)

The Five routines/actions of CT are defined as follows; Record, Reduce, Recite, Reflect, Review [30]. The notetaking documentation format is presented in Figure 1.

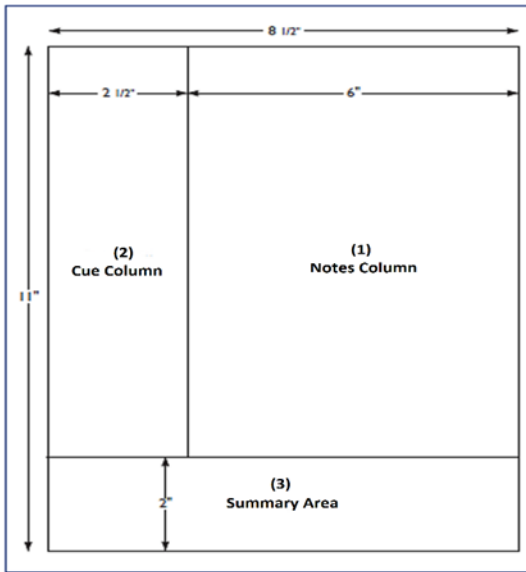


Figure 1. Structure of a Cornell Notetaking sheet [30].

Basically, it is divided into 3 partitions. In his methodology, Pauk relates each partition in format with a different combination of routines, learning context and timing. The first partition, called Notes, is as shown in white in Figure 1. For using Notes partition, considering the categorization of notetaking mentioned above (relative to data source and learning context, i.e., listening to lecture or reading from textbook), Pauk offers two different algorithms [32] both to be carried out during related learning activity. One of these algorithms, i.e., the algorithm for note taking during lecture, discussion, or meeting, is shown in Figure 2.

Pauk relates Notes partition to ‘R’ecording action. Regardless of the type of the source or context for learning activity (lecture, book reading, discussion) Notes partition is for recording as many facts and ideas from source activity (e.g., listening to lecture, reading textbook) as possible. Pauk also proposes some methods to take meaningful notes in a quick and timely fashion for application in this partition during an event such as taking notes telegraphically [32].

The second partition is called Cue Column. This column is related to ‘R’eviewing, ‘R’educing and ‘R’eciting routines. While taking notes in Notes partition, Cue Column should remain empty. Hence, timing for use of this column is defined correspondingly as after initial learning activity or event (e.g., lecture, class, discussion, etc.) in general. When it’s time for user to review, recite and/or reduce what s/he has jotted down in Notes Column, user ought to type down questions and pivotal phrases to help clarify meanings, reveal relationships by filtering out essential points in text. Thus, Cue partition is designed for connecting key concepts and finding out relationships between them by investigating the text in

Notes partition. Thereby, through a learning session consisting of three ‘R’s, user shall fill this partition.

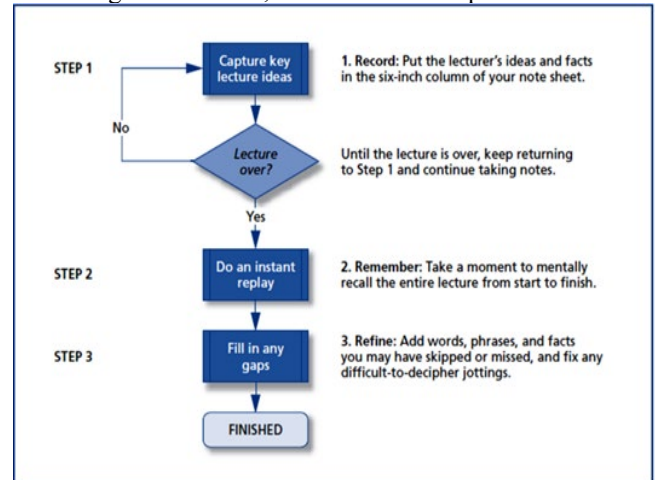


Figure 2. Pauk’s Algorithm for taking notes in Notes partition during lecture, discussion, or meeting [30].

The second partition is called Cue Column. This column is related to ‘R’eviewing, ‘R’educing and ‘R’eciting routines. While taking notes in Notes partition, Cue Column should remain empty. Hence, timing for use of this column is defined correspondingly as after initial learning activity or event (e.g., lecture, class, discussion, etc.) in general. When it’s time for user to review, recite and/or reduce what s/he has jotted down in Notes Column, user ought to type down questions and pivotal phrases to help clarify meanings, reveal relationships by filtering out essential points in text. Thus, Cue partition is designed for connecting key concepts and finding out relationships between them by investigating the text in Notes partition. Thereby, through a learning session consisting of three ‘R’s, user shall fill this partition,

- (i) First, user shall make a ‘r’evue through Notes Partition,
- (ii) Then, user shall ‘r’educer [reviewed] notes to essential facts and concepts, and established relationships between them,
- (iii) Finally, user shall ‘r’ecite.

The last partition, called Summary, is reserved for ‘R’evue and ‘R’eflect activities. Pauk refers to this partition as “the area that will be used to distill a page’s worth of notes down to a sentence or two” [32]. By exploiting the Summary partition for the first time after reviewing Notes and Cue partitions, user synthesizes, reasons and draw conclusions and writes them with her/his own words. This partition is useful for quick reference, especially before exams of type quizzes.

The impact of Cornell Technique was investigated by many studies. For instance, Şahin et. al. aimed whether applying Cornell Technique has impact on understanding

and retention of the text dictated [42]. They concluded that there was a statistically significant difference between experimental group that applied Cornell Technique and control group that applied traditional linear notetaking technique.

2.2. Proposed model for electronic notetaking

The proposed model consolidates and equips the original Cornell Technique together with some functionalities based on facts in reference to scientific findings.

The first functionality is collaborative notetaking. In their study regarding a Web-based collaborative notetaking application, Valtonen et.al. reported that students showed acceptance towards the idea of sharing their lecture notes and were interested in reading other students' notes [43]. Considering these findings, the proposed model in our study, enables users to form teams and work collaboratively for taking notes. This functionality offers users much more than sharing notes and/or completing missing parts of shared/team notes. It simply makes it possible for users with different learning styles to come together and combine and reflect their learning strengths on notes. In their book dated 1971, Kolb, Rubin and McIntyre proposed a categorization of learning style [44-46]. They conceptualized and described four different learning styles, i.e., Converger, Diverger, Assimilator and Accommodator [44] and they also designed and validated a self-examining inventory for individuals to discover their learning mode, called Learning Style Inventory. Later in 2013, Kolb and Kolb refined and extended the categorization and introduced Learning Style Topology with nine learning styles [45]. Users with different learning styles will have the opportunity to collaborate on notes.

To the purpose of storing and accessing notes, the "Folder-File" model, which is a typical abstraction currently in use in modern operating systems, is adopted. In our abstraction, notes are represented and stored as files with a specific format (technically speaking, as entries in database). For storing logically related notes, a logical storage structure called "Collection", which is equivalent to a "Folder", is designed. For each user's storage space, a root collection is created by default. Users can create and store notes as separate files under their root collection. Similarly, they can create a hierarchy of collections under root collection (i.e., users can create new collection under an existing collection) to store their interrelated notes.

A reminder module was integrated as part of application of Cornell Technique's learning routines (i.e., Recording, Reciting, Reducing, Reviewing and Reflecting). The module simply allows user to set a notification-based tickler for any note. For each tickler, user sets date and time. A reminder is thought to be useful since studies show that notes are valuable when they are reviewed. It is experimentally discovered that reviewing

notes is more important than recording them for learning [47]. Hence, ticklers will help users act proactively for reviewing, reducing, and reciting.

Another function in our electronic model is called Note History. This function allows users to do versioning on their notes. In other words, whenever a user makes some changes in (i.e., manipulates) and saves an existing note, that note's previous version is also saved and stored as an old version of it. The expected efficacy and benefit of note history for users is to be able to rephrase and observe their progress on the matter of respective note. However, there is a limit to versioning a note. Each version of a note is stored for 30 days. Any 30-day old version of a note is deleted implicitly by the application.

2.3. Development approach and tools

As the software development process model, Incremental Model [48-49] was adopted. Major reasons behind choosing the Incremental Model are twofold; to develop a version with core functionality and have a quick release, and since we know the requirements up-front and already had the note template defined as an interface.

We analysed and prioritized the requirements and decided on core/essential functionality set. Next, we used Adobe XD v21 (released July 2021) software to design user interface based on core functionality set [48]. To this purpose, we modeled the functions and prepared a medium fidelity click-through prototype to test product flows of the application [51-52].

For implementation, two integrated development environments (IDEs) Android Studio v2020.3.1 and IntelliJ Idea v2021.2.3 were used [53-54]. In these IDEs, system is implemented using Dart programming language with Flutter Framework from Google and respective plugin for Dart programming language for the IDEs. As the database management system infrastructure, one of Google's cloud services called Firestore is employed. Firestore is a NoSQL type of database management system (DBMS) [55].

2.4. System architecture

The system architecture is presented in Fig 3. It is a two-tier architecture, however, for some services such as login, it acts as a three-tier architecture [56]. Basic system operation at the data tier and parts of business/application tier are realized using dedicated Google Services. For operations at data tier, such as database operations and file hosting, Google's Firebase Service is adopted, which is an instance of Google Cloud Services with advanced capabilities [57].

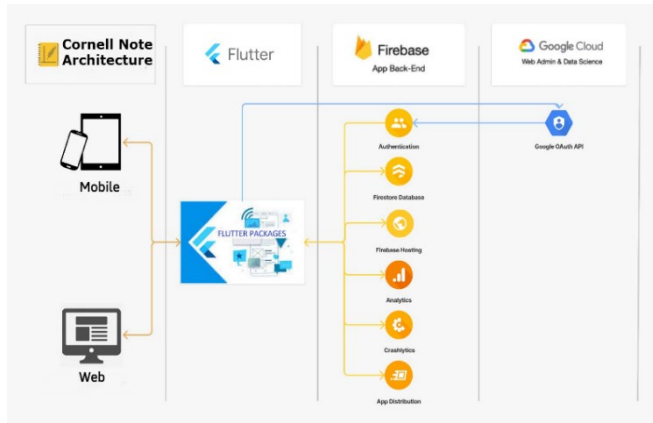


Figure 3. System architecture containing DBMS and other services for both Web and mobile applications of Cornell Note.

2.5. Data model

Google’s Firebase Service relies on Google’s Firestore Cloud Database Service. Fire-store is a NoSQL type of database management system and requires JSON notation-based data modelling. Therefore, for our system’s data tier operations, data model is designed using JSON [59]. The data model is shown in Figure 4.

In our data model, at the root are two types of arrays (collections) of objects, i.e., User and Group (Team), defining a user or a team. A user is defined by several fields, including but not limited to userId, displayName (a field cloned from Google OAuth API) and email address followed by an array of objects of type Document representing notes and note collections of user. Each Document has type field to indicate whether object is a note or note collection. In addition, parentId field is available as the track of note collection the object is stored. Finally, within each note of type Document is defined another type of array (collection) of objects called History, in which old versions of a note is stored with fields homogeneous to ones in object of type Document. In case notes and collections of notes belong not to a single user but to a team, an object of type Group with fields such as id, user (representing number of users in team), created at is defined.

In definition of a group are two arrays (collections) of objects of two types, User and Document. The array called User is designated to store members of a team (Group). An object of type Group can be created by any user, who is called Creator. Creator of a team can add members by their email addresses.

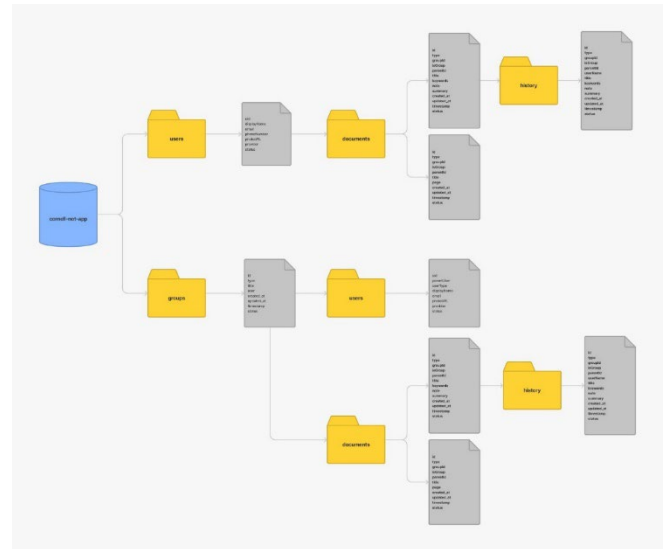


Figure 4. Data model implemented in Firestore Cloud Database Service with 7 collections.

While adding a member, creator must also assign a role to that team member. There are three roles represented by the field userType, Moderator, Editor and Viewer. Each role represents an authorization schema (set of permissions) per operations within group. Each Document type of object in first array is either a note or a note collection. Within each group note, an array of old versions of note is defined as History, which is an array of old versions of a note to be stored with fields homogeneous to ones in object of type Document.

2.1. Basic operation and user interface

To manifest basic operation and functionality of our application, we designed a use case diagram and used it through the rest of the development. The use case diagram is presented in Figure 5. It also allows users to image and get an idea of what they can do with the application. As seen in Figure 5, there are:

- 32 distinct use cases,
- between them are 17 different relationships of types <<include>> and <<extend>>,
- 17 distinct associations from user to use cases.
- 4 distinct <<invariants>> (column-wise).

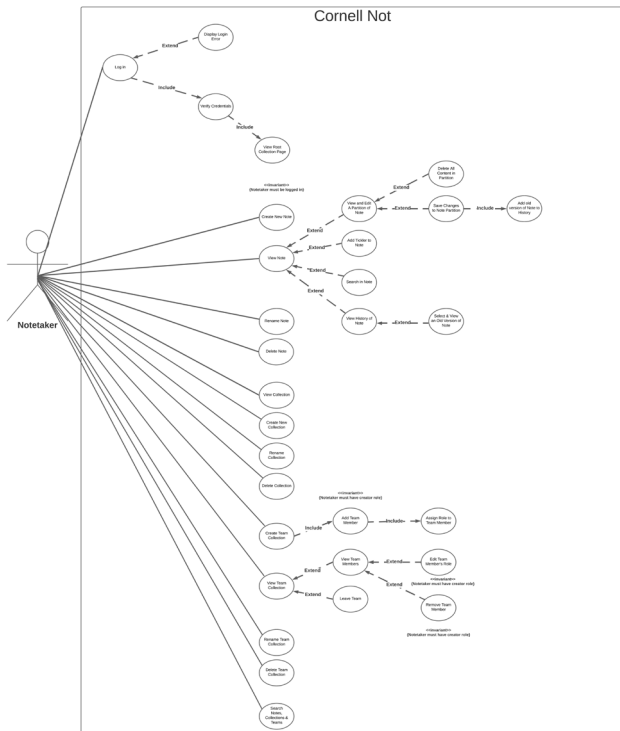


Figure 5. Use case model for Cornel Note application.

The user can start using Cornell Note after logging on. Log on operation requires user to have an active Google account. Hence, the first screen any user would face is shown in Figure 6 (a). First time logging on is considered as a registration and as part of the registration process, for each user, a root note collection is created. After logging on, user will be viewing her/his root collection screen showing all notes, note collections and teams (groups) user is a member of. By tapping on any note collection in her/his root collection, user can view notes and sub-collections of notes within. Included in this screen on the right bottom corner is a floating action button with three sub-actions to choose from, called create new note, create new note collection, and create new group. In addition, a search button with magnifier icon is available on the top right corner of this screen. By tapping this button, user can perform a search for those notes and note collections having names matching the text s/he would input into the search box that appears. A sample of this user interface is presented in Figure 6 (b). When viewing this UI, user can view the contents of a note in Cornell Note template simply by tapping that note. The sample of UI showing contents of a note is available in Figure 6 (c). Within the Cornell Note Template UI, three partitions are created with default dimensions. However, users can adjust the dimensions of partitions by tapping on and dragging the bars between partitions. This functionality allows users to adapt the partitions' area to their content when and where necessary. On top right corner of this screen are

three buttons represented with icons for search, tickler, and action overflow menu (also known as “more menu”), respectively. The search function enables user to search for a text in note. User can add a tickler for the note s/he currently is viewing through a two-stepped interface, the first one for date and the second one for time. A snapshot of UI for viewing a note in Cornell Technique’s template is in Figure 6 (c).

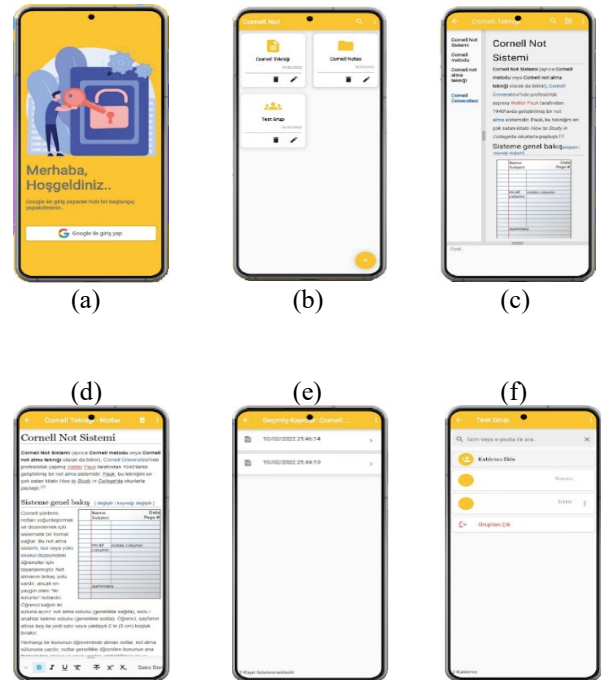


Figure 6. User interface screenshots for login, root collection, template, and editing.

Whenever user double-taps on one of the partitions of note that is currently viewed on the Cornell Note Template UI, that partition would be viewed in Editor UI. Double-tap for viewing and editing partition of a note is a design choice related to Midas Touch Phenomenon in interface design [60-61]. In the Editor UI, at the top is the note’s name concatenated with respective partition’s name as the title. Below the title is the editing area showing the content of the respective partition.

At the bottom is a sliding bar with various functional buttons for formatting and adding multimedia (e.g., pictures, audio, etc.) into content of partition that is currently viewed. In case user makes changes in content of partition of a note, regardless of availability of Internet connection, changes are saved (if user confirms). In clear terms, the application saves changes in a note or a newly created note locally (i.e., in mobile device) if it cannot connect to Firebase service. Whenever the connection is established, the changes are committed in Firebase implicitly without further user interaction and saving changes transaction is completed.

While viewing/editing a note on Cornell Note Template UI, users can also check old versions of that note. To this purpose, user should tap on overflow action menu at the top right corner and tap History action. If there exists one or more old versions of note, they are listed in Note History screen. In this screen, each old version gets listed with the date it would become an old version. The capacity of the system to cache old versions of notes is defined as the last 30-days, i.e., all versions of all notes within the last 30-days are stored. A sample of Note History screen is presented at Figure 6 (e).

Users can also form teams to take notes collaboratively. The application provides this functionality through the floating action button at bottom right of the root collection screen as shown in Figure 6 (b). After tapping the floating action button, by simply tapping “New team” option, user shall view team creation screen shown in Figure 6 (f). On this screen, user can add members to her/his new team by typing each user’s e-mail address after tapping “Add New Team Member” button. All functionalities for notes (e.g., tickler, history) are available for team notes, too.

3. Results

In this section, we present user statistics of Cornell Note after it has been published in Google Play Store in March 2022, compare it with equivalent mobile applications based on features and users’ thoughts and feelings about our mobile application based on System Usability Scale (SUS). The user satisfaction, statistics and feature based comparison are important indicators for future releases of application software as they can help reflect and discover application’s current potential for user preference and acceptance for the purpose of notetaking.

3.1. User statistics as an indicator of acceptance

Many different user statistics are available for analysis, including but not limited to user engagement rate (last 28 days), engaged sessions per user (last 28 days), average engagement time (last 28 days), event count (last 28 days), and number of active users for today, last 7 days and last 30 days.

Below, number of active users on 10th September 2023, for the week between 4th September 2023 and 10th September 2023, and finally, for the last 30 days before 10th September 2023. A 25.9% increase in number of daily active users is achieved. As for the number of monthly active users, 39.2% increase draws attention. In Figure 8, all statics are monthly and statistics such as the number of active users, new users, engaged sessions per user, average engagement time and event count per user language are presented for the period of 10th of August

and 10th of September 2023. A total of 575 users were active in our application for the mentioned 28-day period.

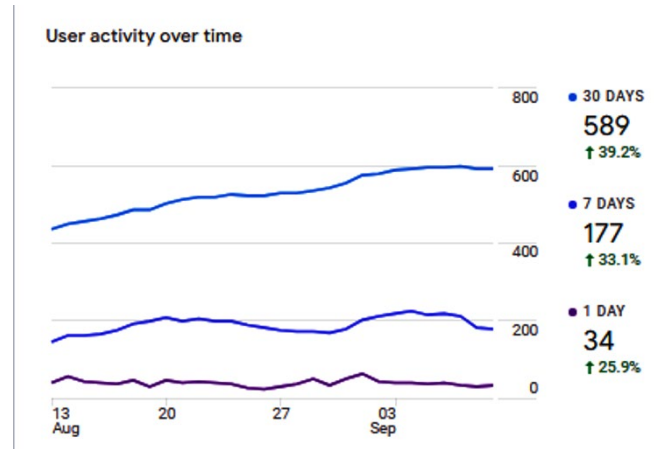


Figure 7. Number of monthly active user change between Aug 10 and Sep 11 of 2023.

The average engagement time is 23 minutes and 31 seconds, which is a strong indicator of users interacting with the application for the intended purpose. An interesting statistic is that the number of Spanish speaking monthly active users (186) was almost equal to number of English speaking monthly active users (189). Portuguese speaking monthly active users (33) appear to have used our application heavily and had the highest engagement rate (87%), engaged sessions per user (3.88), and average engagement time (39 minutes 4 seconds).

Language	Users	New users	Engaged sessions	Engagement rate	Engaged sessions per user	Average engagement time	Event count All events
	575	583	1,269	76.91%	2.21	23m 31s	11,016
	100% of total	100% of total	100% of total	Avg 6%	Avg 6%	Avg 0%	100% of total
1 English	195	193	595	74.80%	2.10	21m 58s	3,073
2 Spanish	186	122	483	78.25%	2.60	35m 35s	4,554
3 Turkish	88	90	109	72.87%	1.60	4m 20s	745
4 Portuguese	33	21	128	87.07%	3.88	39m 04s	1,334
5 French	18	12	27	75%	1.50	27m 10s	309
6 Indonesian	17	12	22	52.86%	1.29	2m 12s	182
7 Chinese	10	7	13	81.25%	1.30	4m 48s	107
8 Italian	9	7	11	73.33%	1.22	4m 53s	76
9 Russian	8	6	23	92%	2.88	11m 16s	178
10 Total	7	2	13	66%	1.86	17m 32s	101

Figure 8. User and usage statistics for the period between Aug 10 and Sep 10 of 2023.

As of 10th September 2023, total number of downloads was between 1K and 10K and the Cornell Note mobile app was installed on 1108 devices. For the last three-month period (from 11th June to 10th September 2023), the active users per month changed in an increasing trend, from 450 to 589. The number of monthly active users recorded on 11th of April 2023 was 256 as shown in Figure 9. The average engagement time on 11th of April 2023 was 28 minutes 00 seconds. As the number of monthly active users increased, the average engagement

time measured on 10th September 2023 decreased to 23 minutes 31 seconds. However, engagement rates measured were 76.91% and 77.19%, respectively, hence, remained constant.

Language	# Users 100% of total	New users 100% of total	Engaged sessions 100% of total	Engagement rate Avg. %	Engaged sessions per user Avg. %	Average engagement time Avg. %	Event count All events 100% of total
1 English	92	67	173	73.31%	1.88	14m 30s	1,488
2 Spanish	91	71	229	77.89%	2.52	46m 50s	2,235
3 Turkish	18	5	31	97.41%	1.72	10m 39s	245
4 Portuguese	13	7	61	91.04%	4.69	1h 00m	420
5 French	6	4	12	85.71%	2.00	7m 39s	76
6 Italian	6	5	16	84.21%	2.67	12m 28s	92
7 Chinese	5	2	9	60%	1.80	4m 05s	53
8 Russian	5	5	16	84.21%	3.20	21m 46s	101

Figure 9. Number of monthly active users on 11th of April 2023 for the last 28 days.

The performance of Cornell Note mobile application with respect to gaining monthly active users is shown on Figure 10. Five measurements are available for five different months. It is possible to say that the monthly active user trend behaves almost linear.

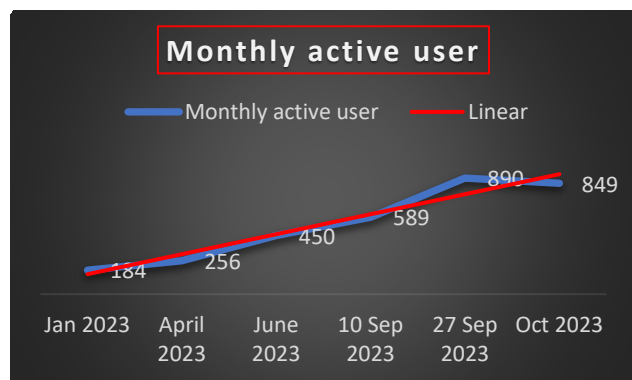


Figure 10. Monthly active user trend between Jan 2023 and Oct 2023.

3.2. Comparison to similar applications

There are three similar mobile applications implementing Cornell Note Technique available in application marketplaces such as Google Play Store and AppStore of Apple. A comparison of these mobile applications to our application with respect to some functions and features is presented at Table 1 [62-64]. Obviously, our application is superior to other applications with respect to features and functions available and UI design. Our application (named Cornell Note) can be downloaded from [65].

Table 1. Functionality comparison of Cornell Note Technique based mobile applications to our mobile application.

	Columns	Speech to Text CN	Cornell Notes	Our App
Collaboration	✗	✗	✗	✓
Collection	✓	✗	✗	✓
Tickler	✗	✗	✗	✓
Formatting	✓	✗	✗	✓
Multimedia	✗	✗	✗	✓
Search Within Notes	✓	✗	✗	✓
Search Within Collections and Note Names	✗	✗	✗	✓
Template Frame Adjustment	Partial	✗	✗	✓
Note History	✗	✗	✗	✓
Web	✗	✗	✗	✓
Speech-to-Text	✗	✓	✗	✓

3.3. User satisfaction

International Standards Organization (ISO) defines user satisfaction as one of the three dimensions of usability [66]. Basically, user satisfaction represents users' thoughts and feelings regarding a system depending on their experience with that system. In other words, user satisfaction refers to perceived usability of a system [66-67]. For measuring user satisfaction with distinct dimensions, many different scales are available [67-70]. The System Usability Scale (SUS) is one of them. SUS was developed by Brooke [67] in 1986. It consists of 10 items. Each item comprises of a sentence and a 5-point Likert scale where a score of 1 indicates "strongly agree" and a score of 5 indicates "strongly disagree" with the opinion expressed in that item's sentence. SUS has its own scoring technique and the acceptable score for SUS starts from 68. Although a SUS score can be in the interval of [0, 100], it is not a percentage [71-72]. Lewis and Sauro showed that SUS has two dimensions (i.e., usability and learning) [73]. Borsci et.al. [74] and Lewis and Sauro [73] confirmed that those factors (usability and learnability) are correlated. Therefore, SUS can provide a score for perceived learnability of a system, too.

Since the year it was presented, several studies showed that SUS is a reliable and valid scale for capturing users' opinions about any system [72,73,75] even with relatively low sample size [76-77]. The minimum

reliability goal for such scales is accepted as 0.70 [78]. For SUS, Bangor et.al. calculated the coefficient alpha as 0.91 [79]. Considering the sample size, in their studies, Orfanou et.al. provided scientific evidence that SUS can provide reliable evaluation of perceived usability even with a sample size between 6-14 participants [76]. In another study, Tullis and Stetson demonstrated that even with a very small sample of 8-12 people, the System Usability Scale (SUS) could provide robust measurements of what people think about the usability of a particular system or product [77]. They showed that SUS yielded highly reliable results regarding the perceived usability of the relevant system or product. Hence, it was adapted in several different languages, as well as adopted for measuring perceived usability [80-89].

To measure the perceived usability through SUS for the Cornell Note mobile application, a persona was determined. Since Cornell Note Technique is originally developed for educational purposes in a university setting, we defined the persona as a university student, who is a user of a mobile phone with Android for at least 1 year and takes notes during lectures. A study protocol was developed and applied with the following steps for each participant:

1. Inform participant about the study and explain that s/he needs to install Cornell Note mobile application into her/his mobile device.
2. Ask participant whether s/he agrees to participate in the study.
3. Check if s/he matches the persona. If s/he matches, then provide the consent form to be signed.
4. Provide URL for installing the mobile application.
5. Provide her/him the scenarios one by one (a total of 3 scenarios were presented) and tell s/he can skip anytime to the next scenario.
6. As soon as a participant finishes with the scenarios, explain the structure of the SUS for self-administration and provide the link for administering it.

For the statistical analysis of the data collected, Sauro's SUS Calculator was used [90]. A total of 14 university students (6 female and 8 male) between the ages of 20 and 23 agreed and matched the persona to participate. The average age of participants was 21.5 years. The mean SUS score and standard deviation for the sample were calculated as 79.5 ± 11.1 , for which the mean for usability dimension score was equal to 75.9 and mean for learnability dimension score was 93.8. The Cronbach Alpha, which represents the internal reliability of the responses of participants, was calculated as 0.771 (>0.70). The statistical analyses show that with 95% confidence, the margin of error for the calculated SUS score is 6.41, therefore, the population SUS score is between 73.05 and 85.87 as shown in Figure 11. Besides, with 97.5% confidence, the population SUS score is greater than 73.05.

In 2009, Bangor et. al. collected and examined more than 3500 SUS results and they proposed an adjective rating scale for SUS scores, simply, by analysing the relationship between SUS scores and people's ratings of systems they were evaluating in terms of adjectives such as poor, excellent, good and three more [71]. They discovered a very close relation between these two. With respect to proposed adjective rating scale, our application's SUS score of 79.5 is classified as Good.

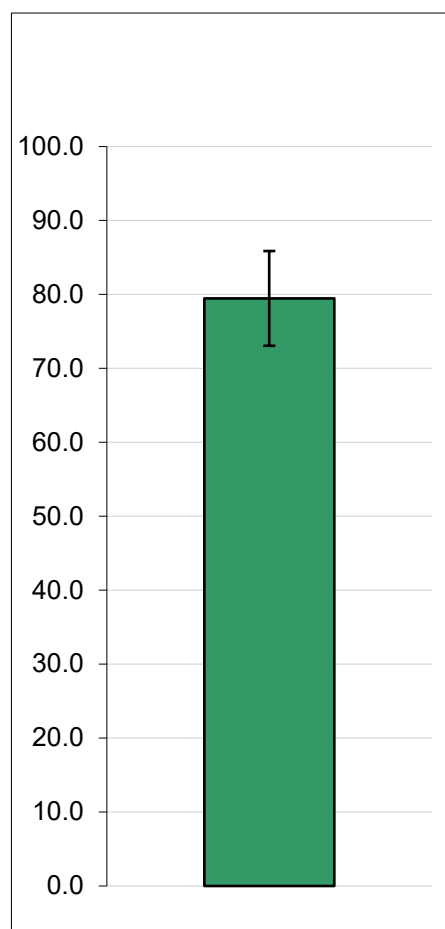


Figure 10. The SUS score interval for Cornell Note application with 95% confidence.

4. Discussion and future work

Considering the nature of notetaking and characteristics of Cornell Note Technique, some functions will be added to allow users to better experience notetaking and to increase effectiveness and efficiency of notetaking.

It is planned to add Kolb Learning Style Inventory as a self-examining tool to Cornell Note mobile application. Behind this decision lies the motivation to increase individuals' understanding of the process of learning from experience and enable users to realize their unique individual approach to learning as Kolb and Kolb phrases in their book [45]. Thus, users will be empowered to taste

and become aware of their own unique style with reference to generalized structure of process of learning. They can also realize how it is to study with people with different learning styles and experience how it results and yields for themselves in notetaking.

In the next version, while setting ticklers, our application will enable users to select relevant Cornell Technique routines (i.e., five 'R's) together with related partition[-s]. Such a functionality will allow users to easily remember relevant partition[-s] together with his/her next learning routine[-s]. From a user's point of view, associating partition[-s] of a specific note with learning routine[-s] user would plan to execute might offer a more precise learning activity management. Setting repeated or periodic ticklers will be available in the next version, too.

For the next version, another functionality we plan to add is linking notes. Basically, this is an identical function to linking documents in World Wide Web. To our knowledge, there are not any notetaking applications offering such a feature/function. The objectives of this feature are twofold:

- Connecting the notes based on conceptual relationship between them (e.g., order of or prerequisite subjects in notes).
- Connecting concepts within different notes that are related to each other for review and reduce routines.

In addition to user-set ticklers, there will be new type of tickler. This type of tickler is called Reduce in Cue. It is an implicit tickler that will remind user of those notes in which only Notes partition is used. Reduce in Cue is a characteristic reminder of Cornell Technique to help user take next necessary action, i.e., Reduce, to continue learning process on a specific note. User can choose to pass, to reduce and fill Cue and to delete related note.

Currently in our app, reminder module operates with local machine notifications and there is no functionality that allows users to list set ticklers. In addition, the functionality of Ticklers by Reminder Module will be migrated from local machine to Firebase. For this purpose, the data model shall be redesigned, and Firebase Cloud Messaging API will be used.

In the current version, system can store old versions of each note dating 30-days back, as a maximum. In the next version, users will be able to set their preferred cache length within an interval of months with a maximum of 12 months.

The current user statistics as of 10th October 2023 shows that without any marketing effort, such as Application Store Optimization (ASO) [91-92] for improving our application's visibility, our application achieved a maximum of 890 monthly active users on 27th of September 2023. Without any intervention for marketing, such a performance reflects application's appeal to users. Nevertheless, it must be remembered that fluctuations in user statistics (user acceptance) are inevitable, hence, are expected.

Certainly, user acceptance is also a matter of updates [67] and it has been more than 13 months that new version has not been released. Hence, a set of features constituting new increment is to be implemented and new version will be released soon. The set of features has been prepared based on the user reviews and previous requirement analysis.

Although there exists many studies investigating the impact of Cornell Technique in different learning contexts, to our knowledge, none of them were involving the use of Cornell Technique through a digital environment. We plan to investigate the impact of Cornell Technique on academic success in an engineering faculty of a university for different core courses.

The perceived usability of Cornell Note mobile application is rated as Good. This rate is a result of mean SUS score that is equal to 79.5. There is another grading by Lewis and Sauro [93]. In this proposed rating scale, the mean SUS score of 79.5 refers to A- which comes after A+ and A as the third grade out of eleven grades from A+ to F. The results of analyses on the mean SUS score reveal that users find Cornell Note mobile application's learnability very high (93.8). This is a good result although the mobile application has some interesting features such as double tap for editing for Midas Touch Problem.

A very important limitation of this study is that it does not aim to find out design errors in the user interface of Cornell Note mobile application. The instruments, such as System Usability Scale, are not diagnostic, either. Therefore, a heuristic evaluation of the application would be very beneficial. In fact, some participants reported about their experience of not being able to insert a picture into their notes and when they tried to, the application was aborted. This is due to an exception thrown in response to picture file size. There is a default file size limit, however, for files with larger sizes, the exception must be handled. We must, as developers, handle such exceptions in the code for better user experience and satisfaction. Obviously, such exceptions can easily be overlooked during testing stage.

To the best of our knowledge, this study is the first one in the literature regarding user satisfaction and acceptance of a mobile application for notetaking. It reveals that Cornell Note, the mobile notetaking application, has a good perceived usability level, which implies an acceptable user satisfaction that is in line with its user acceptance trend. However, there is room to further improve user satisfaction. To this purpose, after some improvements in the user interface and exception handling, a study with a larger sample size ought to be designed and conducted. Hence, a comparison would become possible.

References

- [1] Hartley, J., Note taking in non-academic settings: a review. *Applied Cognitive Psychology*. 2023; 16(5): 559-574.
- [2] Brobst, K.E., The process of integrating information from two sources, lecture and text. Dissertation (1996).
- [3] Di Vesta, F.J., Gray, G.S. Listening and note taking. *J Educ Psychol*. 1972; 63(1): 8–14.
- [4] Craik, F. I. M., Tulving, E. Depth of processing and the retention of words in episodic memory. *Journal of Experimental Psychology: General*. 1975; 104(3): 268–294. <https://doi.org/10.1037/0096-3445.104.3.268>
- [5] Kiewra, K.A. Note taking and review: The research and its implications, *Journal of Instructional Science*. 1987; 16, 233-249.
- [6] Kiewra, K.A. Cognitive Aspects of Autonomous Note Taking: Control Processes, Learning Strategies, and Prior Knowledge, *Educational Psychologist*. 1988; 23(1): 39-56. DOI: 10.1207/s15326985ep2301_3.
- [7] Van Meter, P. N., Yokoi, L., Pressley, M. College Students' Theory of Notetaking Derived from Their Perceptions of Notetaking. *Journal of Educational Psychology*. 1994; 86(3): 323-338. <https://doi.org/10.1037/0022-0663.86.3.323>.
- [8] Carrier, C. A., Williams, M. D., Dalgaard, B. R. College Students' Perceptions of Notetaking and Their Relationship to Selected Learner Characteristics and Course Achievement. *Research in Higher Education*. 1988; 28(3): 223–239. <http://www.jstor.org/stable/40195863>.
- [9] Kiewra, K.A. A Review of Note-taking: Encoding-Storage Paradigm and Beyond. *Educational Psychology Review*. 1989; 1(2): 147-173.
- [10] Kiewra, K. A. The process of review: A levels of processing approach, *Contemporary Educational Psychology*. 1983; 8(4): 366-374. [https://doi.org/10.1016/0361-476X\(83\)90023-1](https://doi.org/10.1016/0361-476X(83)90023-1).
- [11] Kiewra, K. A., Benton, S. L. The relationship between information-processing ability and notetaking. *Contemporary Educational Psychology*. 1988; 13: 33-44.
- [12] Kiewra, K. A. Investigating notetaking and review: A depth of processing alternative. *Educational Psychologist*. 1985; 20(1): 23-32.
- [13] Kiewra, K. A., DuBois, N. F., Christian, D., McShane, A., Meyerhoffer, M., Roskelley, D. Note-taking functions and techniques. *Journal of Educational Psychology*. 1991; 83(2): 240–245. <https://doi.org/10.1037/0022-0663.83.2.240>.
- [14] Kılıçkaya, F., Çokal-karadaş, D. The Effect Of Note-Taking On University Students' Listening Comprehension Of Lectures, *Kastamonu Eğitim Dergisi*. 2009; 17 (1): 47-56.
- [15] Kiewra, K. A. Aids to lecture learning. *Educational Psychologist*. 1991; 26(1): 37–54.
- [16] Pressley, M., Yokoi, L., van Meter, P. et al. Some of the Reasons Why Preparing for Exams Is So Hard: What Can Be Done to Make It Easier?, *Educational Psychology Review*. 1997 9: 1–38. <https://doi.org/10.1023/A:1024796622045>
- [17] Kiewra, K. A. Learning from a lecture: An investigation of notetaking, review and attendance at a lecture. *Human Learning: Journal of Practical Research & Applications*. 1985; 4(1): 73–77.
- [18] Kiewra, K.A. Students' note-taking behaviors and the efficacy of providing the instructor's notes for review, *Contemporary Educational Psychology*. 1985; 10(4): 378-386. ISSN 0361-476X. [https://doi.org/10.1016/0361-476X\(85\)90034-7](https://doi.org/10.1016/0361-476X(85)90034-7).
- [19] Baker, L., Lombardi B. R. Students' Lecture Notes and Their Relation to Test Performance. *Teaching of Psychology*. 1985; 12(1): 28-32.
- [20] Kiewra, K. A. Acquiring effective notetaking skills: An alternative to professional notetaking. *Journal of Reading*. 1984; 27(1): 299–302.
- [21] Kiewra, K. A. Implications for note taking based on relationships between note taking variables and achievement measures. *Reading Improvement*. 1984; 21: 145–149.
- [22] Kiewra, K. A., & Benton, S. L. The relationship between information-processing ability and notetaking. *Contemporary Educational Psychology*. 1988; 13(1): 33–44.
- [23] Kiewra, K. A., Benton, S. L., Lewis, L. B. Qualitative aspects of notetaking and their relationship with information-processing ability and academic achievement. *Journal of Instructional Psychology*. 1987; 14(3): 110–117.
- [24] Collingwood, V., Hughes, D. C. Effects of three types of university lecture notes on student achievement. *Journal of Educational Psychology*. 1978; 70(2): 175–179. <https://doi.org/10.1037/0022-0663.70.2.175>.
- [25] Morgan, C. H., Lilley, J. D., Boreham, N. C. Learning from lectures: The effect of varying the detail in lecture handouts on notetaking and recall. *Applied Cognitive Psychology*. 1988; 2(1): 115–122.
- [26] Kiewra, K. A., Kauffman, D. F., Robinson, D., DuBois, N., & Staley, R. K. Supplementing floundering text with adjunct displays. *Journal of Instructional Science*. 1999; 27(1): 373–401.
- [27] Robinson, D., & Kiewra, K. A. Visual argument: Graphic organizers are superior to outlines in improving learning from text. *Journal of Educational Psychology*. 1995; 87(1): 455–467.
- [28] Tee, T.K., Azman, M.N., Mohamed, S.B., Muhammad, Mohamad, M.M., Yunos, J.B., Yee, M.H., Othman, W. Buzan Mind Mapping: An Efficient Technique for Notetaking. *World Academy of Science, Engineering and Technology, International Journal of Social, Behavioral, Educational, Economic, Business and Industrial Engineering*. 2014; 8(1): 28-31.
- [29] Readence, J.E., Bean, T., Baldwin, R.S. *Content area reading: An integrated approach*, 4th Edition. Iowa, USA: Kendall-Hunt Publishing; 1989. 421 pages.
- [30] Jairam, D., Kiewra, K. A. An investigation of the SOAR study method. *Journal of Advanced Academics*. 2009; 20(4): 602–629. <https://doi.org/10.1177/1932202X0902000403>.
- [31] Daher, T.A., Kiewra, K.A. An investigation of SOAR study strategies for learning from multiple online resources, *Contemporary Educational Psychology*. 2016; 46, 10-21. ISSN 0361-476X <https://doi.org/10.1016/j.cedpsych.2015.12.004>.
- [32] Pauk, W., & Owens, R. J. Q. *How to study in college*. 10th Ed. Boston, USA: Wadsworth Cengage Learning; 2011. 406 pages. ISBN-13: 978-1-4390-8446-5.
- [33] Stacy, E.M., & Cain, J.J. Notetaking and Handouts in The Digital Age. *American Journal of Pharmaceutical Education*. 2015; 79(7): 107-112.
- [34] Samsung Notes. <https://play.google.com/store/apps/details?id=com.samsung.android.app.notes>, Last accessed 10.01.2023.

- [35] Google Keep, <https://play.google.com/store/apps/details?id=com.google.android.keep>, Last accessed 10.01.2023.
- [36] Microsoft OneNote, <https://play.google.com/store/apps/details?id=com.microsoft.office.onenote>, Last accessed 10.01.2023.
- [37] ColorNote Notepad Notes, <https://play.google.com/store/apps/details?id=com.socialn.mobile.dictapps.notepad.color.note&gl=TR>, Last accessed 10.01.2023.
- [38] Evernote, <https://play.google.com/store/apps/details?id=com.evernote>, Last accessed 10.01.2023.
- [39] Pyörälä, E., Mäenpää, S., Heinonen, L. et al. The art of note taking with mobile devices in medical education. *BMC Med Educ.* 2019; 19(1): 96-105. <https://doi.org/10.1186/s12909-019-1529-7>.
- [40] Shen, H., Reilly, M. Personalized Multi-User View and Content Synchronization and Retrieval in Real-Time Mobile Social Software Applications. *Journal of Computer and System Sciences.* 2012; 78(4): 1185-1203.
- [41] Popescu, E., Stefan, C., Ilie, S., Ivanović, M. (2016). EduNotes – A Mobile Learning Application for Collaborative Notetaking in Lecture Settings. In: Chiu, D., Marenzi, I., Nanni, U., Spaniol, M., Temperini, M. (eds): *Advances in Web-Based Learning – ICWL 2016*. ICWL 2016. Lecture Notes in Computer Science, 10013. Springer, Cham. https://doi.org/10.1007/978-3-319-47440-3_15
- [42] Şahin, A., Aydın, G., Sevim, O. The Effect of Cornell Method on Understanding and Retention of the Text Dictated. *Dumlupınar Üniversitesi Sosyal Bilimler Dergisi.* 2011; 29(1): 29-36.
- [43] Valtonen, T., Havu-Nuutinen, S., Dillon, P., Vesisenaho, M. Facilitating Collaboration in Lecture-based Learning through Shared Notes Using Wireless Technologies. *Journal of Computer Assisted Learning.* 2011; 27(6): 575 – 586.
- [44] Kolb, D.A., Rubin, I.M., & McIntyre, J. *Organizational psychology: An experiential approach.* 4th Ed. New Jersey, USA: Prentice Hall; 1984. 496 pages.
- [45] Kolb, A.Y., Kolb, D.A. *The Kolb Learning Style Inventory 4.0: A Comprehensive Guide to the Theory, Psychometrics, Research on Validity and Educational Applications.* Kaunakakai, Hawaii, USA: Experience Based Learning Systems Inc.; 2013. 233 pages.
- [46] Smith, D.M., Kolb, D.A. *User's Guide for the Learning Style Inventory.* Boston, USA: McBer and Company; 1986. 100 pages.
- [47] Kiewra, K.A. Providing the Instructor's Notes: An Effective Addition to Student Notetaking, *Educational Psychologist.* 1985; 20(1): 33-39. DOI: 10.1207/s15326985sep2001_5.
- [48] Link, J. *Software Engineering and Programming, Unit Testing in Java.* Massachusetts, USA: Morgan Kaufmann; 2003. Chapter 14, The Role of Unit Tests in the Software Process [291-312]. ISBN 9781558608689, <https://doi.org/10.1016/B978-155860868-9/50016-X>.
- [49] Arifoğlu, A., Dođru, A. *Yazılım Mühendisliği (Yöntemler, Metodolojiler, CASE Ortamları, Günün Teknolojisi),* Ankara, Turkey: SaS Publishing; 2001. 361 pages.
- [50] Adobe XD, <https://www.adobe.com/tr/products/xd.html>, Last Accessed 10.02.2023.
- [51] A Comprehensive Guide to Wireframing and Prototyping, <https://www.smashingmagazine.com/2018/03/guide-wireframing-prototyping/>, Christopher Murhpy, Last Accessed 10.01.2023.
- [52] McElroy, K. *Prototyping for Designers: Developing the Best Digital and Physical Products.* California, USA: O'Reilly; 2017. 324 pages. ISBN-13: 978-1491954089.
- [53] Android Studio. <https://developer.android.com/studio>. Last Accessed 10.01.2023.
- [54] IntelliJ Idea. <https://www.jetbrains.com/idea/>. Last Accessed 10.01.2023.
- [55] Google Firestore. https://firebase.google.com/products/firestore?gclid=CjwKCAjwjZmTBhB4EiwAynRmD0uFN9Kh-qQ_S3NSUmvuy4N9uEWtHT_QI2xOks59VnOvVICuN3C4qRoCxeAQAvD_BwE&gclid=aw.ds. Last Accessed 10.01.2023
- [56] What is Three-tier Architecture? <https://www.ibm.com/cloud/learn/three-tier-architecture>. IBM, Last Accessed 10.01.2023.
- [57] Google Firebase. <https://firebase.google.com/>. Last Accessed 10.01.2023.
- [58] Google OAuth API. <https://developers.google.com/identity/protocols/oauth2>. Last Accessed 10.01.2023.
- [59] JavaScript Object Notation (JSON). <https://www.json.org/json-en.html>. Last Accessed 10.01.2023.
- [60] The Midas Touch Effect. <https://uxdesign.cc/the-midas-touch-effect-the-most-unknown-phenomenon-in-ux-design-36827204edd>. Last Accessed 10.01.2023.
- [61] Haans A., Usselsteijn, W.A. The Virtual Midas Touch: Helping Behavior After a Mediated Social Touch. *IEEE Transactions on Haptics;* 2009; 2(3): 136-140. doi: 10.1109/TOH.2009.20.
- [62] Cornell Notes Mobile Application. https://play.google.com/store/apps/details?id=com.aipsoft.cornell_notes_mobile&hl=en_US&gl=US. Last Accessed 10.01.2023.
- [63] Columns – Mobile application for Cornell Note Technique. <https://apps.apple.com/us/app/columns-cornell-notes/id1493839821?mt=12>. Last Accessed 06.01.2023.
- [64] Speech-to-text Cornell Notes Mobile Application. https://play.google.com/store/apps/details?id=com.cornell.voice.notepad&pcampaignid=web_share. Last Accessed 10.01.2023.
- [65] Cornell Note Mobile Application. <https://play.google.com/store/apps/details?id=com.cornell.note&gl=TR>. Last Accessed 06.01.2023.
- [66] ISO 9241-11:1998. Ergonomic requirements for office work with visual display terminals (VDTs) - Part 11: Guidance on Usability.
- [67] Brooke, J. *Usability Evaluation in Industry.* London, UK: Taylor & Francis; 1996. Chapter 21, SUS: A quick and dirty usability scale [4-7].
- [68] Kirakowski, J., Corbett, M. “SUMI: the Software Usability Measurement Inventory”, *British Journal of Educational Technology,* 1993; 24(3): 210-212.
- [69] Lewis, J.R. “IBM Computer Usability Satisfaction Questionnaires: Psychometric Evaluation and Instructions for Use”, *International Journal of Human-Computer Interaction.* 1995; 7(1): 57-78.
- [70] Lewis, J.R. Psychometric Evaluation of the PSSUQ Using Data from Five Years of Usability Studies, *International Journal of Human-Computer Interaction.* 2002; 14(3): 463-488.

- [71] Bangor, A., Kortum, P., & Miller, J. Determining what individual SUS scores mean: Adding an adjective rating scale. *Journal of usability studies*. 2009; 4(3): 114-123.
- [72] Sauro, J. A practical guide to the System Usability Scale: Background, benchmarks, & best practices. Denver, USA: Measuring Usability LLC; 2011. 150 pages.
- [73] Lewis, J.R., Sauro, J. The Factor Structure of the System Usability Scale. In: Kurosu, M. (eds) *Human Centered Design. HCD 2009. Lecture Notes in Computer Science*, vol 5619. Springer, Berlin, Heidelberg.
- [74] Borsci, S., Federici, S., & Lauriola, M. On the dimensionality of the System Usability Scale: A test of alternative measurement models. *Cognitive Processing*. 2009; 10 (3): 193–197.
- [75] Bangor, A., Kortum, P. T., & Miller, J. T. An empirical evaluation of the System Usability Scale. *International Journal of Human-Computer Interaction*. 2008; 24(6): 574-594.
- [76] Orfanou, K., Tselios, N. & Katsanos, C. Perceived usability evaluation of learning management systems: Empirical evaluation of the System Usability Scale. *The International Review Of Research In Open And Distributed Learning*. 16
- [77] Tullis, T. S., Stetson, J. N.: A Comparison of Questionnaires for Assessing Website Usability (2004), unpublished presentation given at the UPA Annual Conference, <http://home.comcast.net/~tomtullis/publications/UPA2004TullisStetson.pdf>
- [78] Landauer, T. K. *Handbook of Human-Computer Interaction*. North-Holland: Elsevier; 1997. Chapter 9, Behavioral Research Methods in Human-Computer Interaction In: Helander, M., Landauer, T., Prabhu, P. (eds.) pp. 203--227. Elsevier, Amsterdam, Netherlands (1997)
- [79] Bangor, A., Kortum, P. T., & Miller, J. T. (2008). An empirical evaluation of the system usability scale. *Intl. Journal of Human-Computer Interaction*, 24(6), 574-594.
- [80] Demirkol, D., & Şeneler, Ç. A Turkish translation of the system usability scale: The SUS-TR. *Uşak Üniversitesi Sosyal Bilimler Dergisi*. 2018; 11(3): 237-253.
- [81] Martins, A. I., Rosa, A. F., Queirós, A., Silva, A., & Rocha, N. P. European Portuguese validation of the system usability scale (SUS). *Procedia computer science*. 2015; 67: 293-300.
- [82] Sevilla-Gonzalez, M. D. R., Loeza, L. M., Lazaro-Carrera, L. S., Ramirez, B. B., Rodríguez, A. V., Peralta-Pedrero, M. L., & Almeda-Valdes, P. (2020). Spanish version of the system usability scale for the assessment of electronic tools: development and validation. *JMIR Human Factors*, 7(4), e21161.
- [83] Katsanos, C., Tselios, N., & Xenos, M.N. (2012). Perceived Usability Evaluation of Learning Management Systems: A First Step towards Standardization of the System Usability Scale in Greek. 2012 16th Panhellenic Conference on Informatics, 302-307.
- [84] Blažica, B., & Lewis, J. R. A slovene translation of the system usability scale: The SUS-SI. *International Journal of Human-Computer Interaction*. 2015; 31(2): 112-117.
- [85] Condit F., J., Mandernach, M., Nelson, C. S., Paulo, J. R., & Saunders, G. Usability test results for a discovery tool in an academic library. *Information Technology & Libraries*. 2015; 31(1): 83–112.
- [86] Perrin, J. M., Clark, M., De-Leon, E., & Edgar, L. Usability testing for greater impact: A Primo case study. *Information Technology & Libraries*. 2014; 33(4): 57–66.
- [87] Yüce YK, Tezcan E, Uyguralp C, Yolcular BO, Akça M. On the usability of snapchat: what do users think about it. *Akıllı Sistemler ve Uygulamaları Dergisi (Journal of Intelligent Systems with Applications)*. 2019; 2(2): 148-156. DOI: 10.54856/jiswa.201912085
- [88] Kaya, A., Ozturk, R., Altin Gumussoy, C. Usability Measurement of Mobile Applications with System Usability Scale (SUS). In: Calisir, F., Cevikcan, E., Camgoz Akdag, H. (eds) *Industrial Engineering in the Big Data Era*. 2019. *Lecture Notes in Management and Industrial Engineering*. Springer, Cham. https://doi.org/10.1007/978-3-030-03317-0_32
- [89] Liang, J., Xian, D., Liu, X., Fu, J., Zhang, X., Tang, B., & Lei, J. Usability study of mainstream wearable fitness devices: feature analysis and system usability scale evaluation. *JMIR mHealth and uHealth*. 2018; 6(11): e11066.
- [90] SUS Calculator, <https://measuringu.com/product/suscalc/>. Measuring Usability. Last accessed 03.10.2023
- [91] Padilla-Piernas, J.M., Parra-Meroño, M.C., Beltrán-Bueno, M.Á. The Importance of App Store Optimization (ASO) for Hospitality Applications. In: Rana, N.P., et al. *Digital and Social Media Marketing*. 2020. *Advances in Theory and Practice of Emerging Markets*. Springer, Cham. https://doi.org/10.1007/978-3-030-24374-6_11
- [92] Karagiozidou, M., Ziakis, C., Vlachopoulou, M., Kyrkoudis, T. App Store Optimization Factors for Effective Mobile App Ranking. In: Kavoura, A., Kefallonitis, E., Giovanis, A. (eds) *Strategic Innovative Marketing and Tourism 2019*. *Springer Proceedings in Business and Economics*. Springer, Cham. https://doi.org/10.1007/978-3-030-12453-3_54.
- [93] Lewis, J.R. and Sauro, J. Item benchmarks for the system usability scale. *J. Usability Studies*. 2018; 13(3): 158–167.