Unleashing the Potential of Unsupervised Topic Modeling for Enhanced English Textbook Content Comprehension

Abstract

In this research Natural Language Processing (NLP) driven exploratory analysis is shown to depict various keywords related to subtle topic in context. Leveraged by Latent Dirichlet Allocation (LDA) and BERTopic, this research study identifies latent topics within textbook corpus by uncovering word, extract coherent themes from textual data, aims to improve the curriculum provided English textbook content synthesis and acquisition skill of learners. Our anticipation extracted topics from the English textbook, enabling readers to comprehend the curriculum material more efficiently. The unsupervised topic modeling application LDA and Transformer c-TFIDF based topic modeling model BERTopic is applied. Extensive analysis is conducted to determine dominant keywords, high impact terms, their similarities, co-occurrence patterns and correlation is visualized based on extracted topics. To observe impact of the topic modeling-based content representation prototype mobile app is developed and qualitative research survey is undertaken. The purpose of this survey was to evaluate the effectiveness and observe the impact on end-users specifically on course instructors. Survey is conducted on Bangladesh's higher secondary English education. The challenges, and future potential of integrating mobile app into the learning process powered by NLP extracted content is explored. After collecting feedback, word clouds were used to analyze the frequency of the participants' recommended terms, and the LIWC approach was used to estimate overall sentiment. The survey's findings LIWS and qualitative score showed that instructors are eager to use technology in teaching and learning, and there are tremendous opportunities adoption of mobile based digital technology in the context of learning English in Bangladesh.

**Introduction**

In Bangladesh there is lacking in effective acquisition, synthesis skill of English language from curriculum provided textbook by National Curriculum and Textbook Board (NCTB). Especially students from rural areas cannot perform well in English in the national board examinations (such as: PSC, SSC, HSC) [1]–[4]. Resource scarcity problems can be overcome by adoption of mobile app based learning [20]–[22] [9]–[13] for English language learning [5]-[8].

The purpose of this research is to determine whether higher secondary schools students can able to learn English better more convenient way. If mobile app is incorporated using NLP driven topic modeling techniques applied extracted keywords are presented within mobile app. Are the instructors prepared to accept technology in the classroom and app-based learning in the classroom?

This article presents the key findings and insights of qualitative survey, shedding light on the prospective of mobile app based learning in schools for higher secondary English in which contents are collected and presented using cutting edge NLP technology provided unsupervised topic modeling.

**Qualitative survey**

In the survey questions, it was indicated whether the students, teachers/instructors, and government organizations would find it acceptable and appreciated if textbook information were made available through a mobile app and presented in interactive format. To demonstrate the mobile app idea during the interrogation survey session a prototype is also prepared. Participants were asked for suggestions on how to make the app better and specify shortcomings. Presumably It provides an insight of teacher’s emotion about inclusion of mobile technology in higher secondary English education system.

Latent Dirichlet Allocation, a widely used probabilistic topic modeling technique, offers a means to automatically identify underlying themes or topics within a corpus of text. In Bangladesh there is deficiency in English subject as there is shortage of skilled teachers. Simplest solution could be use of technology introduce mobile app based learning. To grasp the English language knowledge from curriculum provided textbook we demonstrate a unique approach unsupervised Topic modeling using textbook corpus. It provides coherent topics, dominant keywords, latent combination of features that characterizes similarities between topics. Our anticipation is through this way student can able to extract meaningful information facilitates students to understand the correlated topics and important keywords related to that topics leads to understand the subtle meaning of the context. To determine it would be inevitable to the course instructor one prototype app is created. In this research scope, qualitative research is undertaken to evaluate the effectiveness of mobile-based digital learning with cutting edge NLP technology on Bangladesh's higher secondary English education. This article presents the key findings and insights from the survey, shedding light on the prospective of digital mobile-based learning in schools for higher secondary English subject with NLP. The purpose of this survey was to explore the challenges, and future potential of integrating mobile devices into the learning process powered by NLP extracted content. In the survey questions, it was indicated whether the students, teachers/instructors, and government organizations would find it acceptable and appreciated if textbook information were made available through a mobile app and presented in interactive format. To demonstrate the mobile app idea during the interrogation survey session a prototype is also prepared. Participants were asked for suggestions on how to make the app better and about any shortcomings. After collecting feedback, word clouds were used to analyze the frequency of the participants' recommended terms, and the LIWC approach was used to estimate overall sentiment. Presumably It provides an insight of teacher’s emotion about inclusion of mobile technology in higher secondary English education system. The survey's findings show that teachers are eager to use new technology in teaching and learning, and there are tremendous opportunities adoption of mobile based digital technology in the context of learning English in Bangladesh.

we anticipate that student will accept this type of technology for learning their textbook We are expecting teachers and students will be motivated, encouraged and enthusiastic to use the application. To observe the potentiality and acceptance of similar approach we conducted a survey with some teachers targeting teachers would be main user who will be using it during teaching in the classroom.

explain c-TFIDF in mathemetical expression

Term Frequency-Inverse Document Frequency (TF-IDF) is a numerical representation used to quantify the importance of terms in a collection of documents. It aims to highlight words that are both frequent within a specific document and rare across the entire document collection. While the concept of c-TFIDF (contextual TF-IDF) is not a standard term, I'll provide an explanation based on the idea of incorporating context into the TF-IDF calculation.

Let's define the terms used in the explanation:

- \( t \): A term (word) within a document.

- \( d \): A document within a collection of documents.

- \( D \): The entire collection of documents.

- \( \text{TF}(t, d) \): Term Frequency - the number of times term \( t \) appears in document \( d \).

- \( \text{DF}(t, D) \): Document Frequency - the number of documents in \( D \) that contain term \( t \).

- \( \text{IDF}(t, D) \): Inverse Document Frequency - \( \text{IDF}(t, D) = \log \left( \frac{|D|}{\text{DF}(t, D) + 1} \right) \), where \( |D| \) is the total number of documents in the collection.

- \( \text{TF-IDF}(t, d, D) \): The TF-IDF score of term \( t \) in document \( d \) with respect to document collection \( D \).

Now, to incorporate context into the TF-IDF calculation, let's consider a scenario where context is represented by a set of neighboring terms around \( t \) in the document \( d \). We'll call this context set \( C \).

One way to conceptualize c-TFIDF is by calculating the modified IDF based on the context set \( C \):

\[

\text{c-IDF}(t, C, D) = \log \left( \frac{|D|}{\text{DF}(t, D) + 1 + \sum\_{c \in C} \text{DF}(c, D)} \right)

\]

Where:

- \( |D| \) is the total number of documents in the collection.

- \( \text{DF}(t, D) \) is the Document Frequency of term \( t \) in the collection.

- \( \text{DF}(c, D) \) is the Document Frequency of context term \( c \) in the collection.

The c-TFIDF score for a term \( t \) in a specific document \( d \) can then be calculated using both the term frequency and the modified inverse document frequency:

\[

\text{c-TFIDF}(t, d, D, C) = \text{TF}(t, d) \times \text{c-IDF}(t, C, D)

\]

This formulation aims to capture the importance of a term within the context of its neighboring terms while considering its rarity in the entire document collection.

Please note that c-TFIDF is a hypothetical concept introduced here to illustrate the incorporation of context into the TF-IDF calculation. In practice, variations of TF-IDF and context-aware techniques can be used to enhance information retrieval and natural language processing tasks.

**Literature Review**

Mobile assisted language learning first appeared around 2005, when some USA universities began to give their students free mobile devices [14] for learning class lesson. It has been implemented in Turkey, Kuwait, Iran and neighbor country India positive attitude is found from the students [27], [28]. It came to appear more globally around 2009, when the British Council developed mobile applications (apps) for language learning. Major English language teaching (ELT) publishers producing standalone or coursebook-related apps accelerated the development and spread of this technology globally [15]. In [16] Yu, et.al (2023) designed a study to examine the mobile technology and effect of this technology in language learning, and they found that “students enjoyed to learn new words with the help of their mobile phone, motivation was significantly stronger compared to traditional English language learning; moreover, learning outcomes were significantly better than traditional English language learning.” In order to test the effectiveness of mobile games based English vocabulary test is conducted [17]. For reading comprehension, researchers designed content aware learning environments on mobile platforms. The results of these study showed students preferred the mobile learning approach way more than the conventional approach. From various literature review it is revealed, mobile language learning can be very beneficial if it is managed in a systematic way considering the context.

**Existing Apps. Strengths and weaknesses**

Mobile apps have revealed vividly that it can be used as a teaching learning assistive tool. Numerous English learning apps are available in Google play store and iOS store. There are many renowned publishers worldwide have their own app for English Language such as: Cambridge, Macmillan, Oxford University Press, Barrons, McGraw-Hill, Kaplan Publishing and many more. Apart from them based on user download and google rating some popular apps in Google play store are Duolingo, Busuu, Babel, Voxy etc [25].  Some Popular Apps:

Duolingo [26] Uses games for learning language. New words are taught based on a topic and skill points are awarded for completing lessons. Exercises are tailored to help the users learn and review vocabulary effectively. Another app Babbel Focuses more on helping English language learners to acquire the basic conversational skills. Babbel has a strong focus on vocabulary. The app has different approaches: Sound/Picture Recognition, Spelling and Fill in the blanks. It uses a custom goal system that allows users to set benchmarks and can monitor their progress. Voxy features news and stories on a variety of topics, Provides games for language practice, plus short quizzes to test comprehension. Mywordbook 2 Developed by the British Council in conjunction with Cambridge University Press Offers a wonderful, engaging way to learn new words through sets of interactive flashcards. Memrise Uses creative and easy way to remember words for learning English. It creates an association between the translation and words users are already familiar with.

Across all applications, 55% have activities for vocabulary learning and vocabulary applications are about 41% [18], [19]. The most frequently employed approaches are task-based (mostly cognitive problem-solving tasks). A few applications provide list of quizzes, tests, and game for enhancing learners’ comprehension and self-checks [17]. In terms of target learners’ profile age, interest, and proficiency level, difficulty level varies. Most dominant organization type is the word list with its definition and example sentences.

These apps can not able to attract a large population who are only depended on National Curriculum Board provided Textbook for learning English. In Bangladesh most of the primary, secondary level user uses Textbook for learning English. There is an App developed by National Curriculum & Textbook Board (NCTB) to provide ebook copy of NCTB approved books for free. This app is a onetime use only app for downloading e-copy of books accross the country. Some heavily used popular apps are emphasizing techniques for only toddlers whereas others assumed the users are adult. It has been seen that predominantly most the users of these applications are adults only. In Bangladesh apps users for learning English among school going students are nearly Zero percent. We anticipate to make an app useful among Bangladeshi pupil the app should contain the content of NCTB English Textbook’s course curriculum.

**Challenges [23], [24]**

1. Questions may arise from the pedagogue experts that the current education system is not yet prepared to offer this kind of education in all parts of the country.
2. Successful integration of mobile app based English learning depends to some degree on students’ and teachers’ acceptance and awareness
3. Not every student has a functional mobile device such as a smartphone or tablet. Since in Bangladesh most of the students are from under privileged family.
4. Beside sometimes mobile devices such as regular cellular phones distract students' attention engaging in different activities rather than study.

**Englisher Mobile App:**

A mobile application (Englisher) is being created with content from the NCTB English Textbook. We have gathered all the words and sentences from the "English for Today" textbook for class six using NLP data mining techniques (such as: Lemmatization) [29], [30]. The data list for words and sentences is then cleaned by eliminating extra characters like apostrophes, commas, semicolons, etc. The keywords are organized into a number of categories sections, chapters, lessons, exercises, and quizzes. Each sentence's and word's Bengali meaning is provided in accordance with the chapter or lesson. A quiz is used to ascertain word meaning. Students can take quizzes, and their results are recorded in the history so that history can be reviewed and performance can be improved by more practice in the future. Students can learn how to respond to questions from a variety of options by taking the quiz. This app uses a quiz game-based learning strategy. For the following version, synonyms antonyms were proposed. The terms' synonyms will be shown, providing a wide selection of answers to the various questions pertaining to that subject. The app will provide example phrases to demonstrate how to use synonyms. Gradually, either teachers or pupils will learn how to properly and efficiently use specific words.



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**Methodology:**

The methodology involves preprocessing textual data, training the LDA model on the preprocessed text, and subsequently interpreting and visualizing the generated topics.

**The methodology involves preprocessing textual data to remove noise and standardize text, followed by the application of LDA to identify underlying topics. By transforming dense textual information into a collection of interpretable topics, readers can navigate through complex subject matter more efficiently. Moreover, the study proposes an interactive interface that integrates LDA-derived topics with the textbook, facilitating an immersive learning experience. This interface allows readers to explore content through relevant themes, thereby promoting active engagement and a deeper understanding of the material.**

To evaluate the effectiveness of this approach, a series of experiments are conducted using a diverse range of textbooks from various disciplines. The results demonstrate that LDA-based topic modeling significantly enhances content comprehension by providing concise summaries of the material. Readers can grasp the main ideas and connections between topics, aiding in retention and knowledge acquisition. Additionally, the interactive interface receives positive feedback for its user-friendly design and utility in assisting readers' navigation through the textbook.

1. Identify some popular mobile apps on the basis of google playstore review, number of user download in google play store.
2. List all the the techniques used in those apps, to determine which technique may affect and could be promising or accepted by students.
3. Develop questionnaire for teacher to explore the viewpoints of using mobile app based learning technology incorporation for learning English. Involve teachers in an interrogation session.
4. Enlist all the results, observe it through rigorous analysis.
5. We are expecting through this way we can find out most effective technique for teachers and students how the app can be built. We have anticipated a dummy version and build to demonstrate it infront of the survey participants so that we could get vauable feedback.

**Exploratory analysis of Textbook content**

Extensive analysis is conducted in this research to understand the context of the English Textbook. In this experiment we have used NLP based exploratory analysis to visualize the content. Here whole book is segregated into Lessons and we wanted to explore the important topics within the content. Similar topics words will remain together. Therefore assumptions is, it helps students to understands the words, sentences and context of the book.

* 1. First NLP’s data processing or data mining techniques are applied for meaningful token or feature extraction is conducted. All text converted to Lowercased and Normalized to ensure consistent pre-processing
     1. Data cleaning (unwanted characters Punctuation and Special Character Removed and stop words (such as "and," "the," "is," etc) are removed) spacy’s English word model and NLTK’s stopwords list are used together. Also Words less than two characters are removed such as: I, Hi, Oh etc. Hence, Noise is Removed and irrelevant characters, symbols, or data artifacts that have been introduced during data collection or scraping from pdf file to text file generation are separated. Hence, we found a cleaned corpus.
     2. Lemmatization (Root words are collected words to their dictionary form (lemma) is extracted) using NLTK’s WordNetLemmatizer package. Stemming Reduce words to their base or root form is not used since sometimes it changes the expression of actual words.
     3. Part-of-Speech Tagging: Spacy’s English model ‘en\_core\_web\_sm’ is used to extract interested words (such as noun, verb, adjective) and excluded (CCONJ, AUX, DET, INTJ, PART etc which are Coordinating Conjunction, Auxiliary, Determinator, Interjection, Particle etc) thereby token is collected for only which are not punctuation, conjunction, symbol etc.

**Topic Modeling**

**Different techniques have been developed to perform topic modeling, each with its own strengths and limitations. Let's briefly discuss LDA, Mallet LDA, STM (Structural Topic Model), and HDP (Hierarchical Dirichlet Process) and why LDA is often considered one of the best choices.**

**Latent Dirichlet Allocation (LDA):**

LDA is a probabilistic model that assumes documents are mixtures of topics, and each topic is a distribution over words. The goal is to infer the hidden topic assignments and the topic-word distributions that best explain the observed documents. The joint distribution of LDA model can be expressed as

Where The word in document d, the topic assigned to the word in document d, are the Dirichlet LDA model parameters. controls per-document topic distribution, and per topic word distribution. represent the topic distribution. Dirichlet distribution representing the document-topic distribution, is the word topic assignment for the word in document , is the distribution representing the observed word given a topic

In this research LDA is used for latent topic modeling for NCTB’s English curriculum provided textbook. In this study Textbook corpus is divided into lessons which is a mixture of topics and using LDA expecting to determine which word in the lesson belong to Lesson's topics. Here how many topics are ideal need to determine and topic modeling quality depends on that.

Mallet LDA:

Mallet (MAchine Learning for LanguagE Toolkit) is a Java-based toolkit that provides an implementation of LDA and other topic modeling algorithms. Mallet LDA is a variation of the standard LDA algorithm and is known for its efficiency and scalability. It is often used for large corpora and offers additional features like parallel processing.

Structural Topic Model (STM):

STM is an extension of LDA that incorporates document-level covariates to model the relationship between topics and external variables. It allows researchers to examine how topics vary across different conditions, making it suitable for analyzing topics in the context of metadata or other structured data. STM is especially useful for social science research.

Hierarchical Dirichlet Process (HDP):

HDP is a Bayesian nonparametric topic model that can automatically determine the number of topics in a corpus. It's based on a hierarchical structure and allows topics to be shared across documents. HDP is useful when the number of topics is not known in advance, and it can discover a potentially unlimited number of topics.

Topic models comparative analysis

LDA is relatively simple and produces interpretable results. The identified topics are represented as distributions over words, making it easy to assign meaningful labels to topics. It is supported in various libraries and tools, making it easy to implement and integrate into existing workflows. While some variations of LDA, like Mallet LDA, focus on scalability, LDA in general can still be efficiently applied to moderately sized corpora. If large corpus needs to analyze, Mallet LDA might be more suitable. Analyzing topics within the context of metadata, STM could be a better fit. HDP can be useful when we cannot guess the number of topics in advance.

Baseline Model: LDA serves as a solid baseline for topic modeling tasks. It's a starting point for researchers to experiment with and compare against other techniques. Hence we have chosen LDA for baseline statistical topic modeling tool

**Determining Optimal Topics with Coherence**

Coherence score measure how coherent or interpretable the words in that topic and estimates number of topic clusters. Coherence score assess the quality of the topics produced by LDA and ensures that the topics generated are statistically significant. Coherence can be expressed as follows

Where, represent pointwise mutual information statistical association between two words occurring together. PMI score indicates that the two words are more closely related within a topic. can expressed as where is joint probability of occurrence of words and .

To calculate the coherence score genism library provides range of options such as . and These two methods are most popular. For given topic with words a fixed context window size is provided (default size 10 words) then coherence score is calculated using an equation which provides negative coherence score. can be expressed as in which represent the pairwise similarity between terms based on scores. provides a positive coherence score.

Higher coherence values indicate that the topics are more coherent and representative of meaningful themes within the text data. Coherence score 0.5 are fairly good, according to John McLevey (source: Doing Computational Social Science: A Practical Introduction By John McLevey).

**Coherence for LDA model**

To measure coherence in the context of LDA, following steps are followed:

1. Cleaned document samples are prepared using python’s NLP data mining techniques explain in detailed in data reprocessing section. Prepared set of tokens in Documents for document samples in corpus .
2. Doc to BOW corpus dictionary is prepared with Doc2Bow vector. This vector can be represented as where denotes the count of words for the document .
3. Trained LDA Model: During the training phase gensim’s MulticoreLDA model with four CPU worker thread is applied. Doc2Bow dictionary is applied along with 20 iterations is invoked. The rest of the parameters for LDA model training was default parameter settings of gensim library.
4. Calculate Coherence: To Calculate the coherence score for each LDA model for number of topics step 3 is iterated for times.
5. Iteration result coherence score for number of topics are saved in a list and plotted using seaborn.

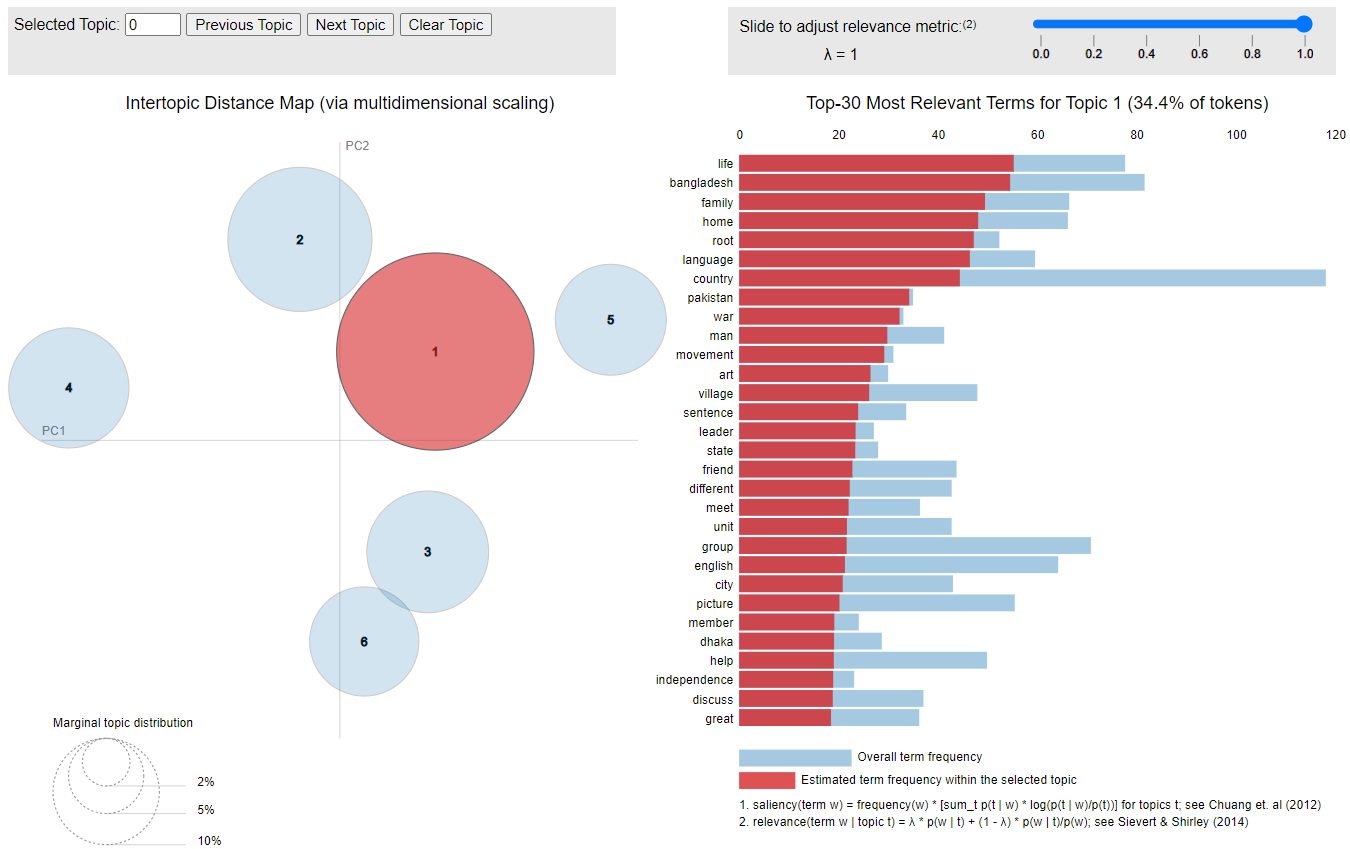
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| From the chart we can see that six topics are dominant in our provided corpus. The chart shown at the left shows the coherence score for and the right chart represents the score for for multiple iterations. Using 6 topics we can see the output of corresponding topic and top 10 words in a topic.  Topic: 01 ["energy" 0.060, "source" 0.029, "renewable" 0.018, "water" 0.016, "use" 0.013, "gas" 0.013, "produce" 0.013, "green" 0.013, "warm" 0.013, "cause" 0.012,]  Topic: 2 ["pastime" 0.024, "computer" 0.024, "social" 0.023, "user" 0.022, "network" 0.020, "student" 0.019, "class" 0.017, "change" 0.016, "book" 0.015, "survey" 0.013,]  Topic: 3 ["mother" 0.083, "buy" 0.021, "love" 0.018, "child" 0.014, "worker" 0.014, "begin" 0.013, "cultural" 0.012, "observe" 0.012, "thing" 0.012, "language" 0.011,]  Topic: 4 ["life" 0.016, "Bangladesh" 0.016, "family" 0.015, "home" 0.014, "root" 0.014, "language" 0.014, "country" 0.013, "Pakistan" 0.010, "war" 0.010, "man" 0.009,]  Topic: 5 ["country" 0.031, "river" 0.022, "India" 0.022, "land" 0.021, "boat" 0.015, "small" 0.015, "population" 0.015, "lake" 0.013, "group" 0.012, "house" 0.011,]  Topic: 6 ["job" 0.064, "English" 0.023, "learn" 0.021, "teacher" 0.017, "use" 0.016, "dream" 0.016, "think" 0.016, "thing" 0.015, "school" 0.014, "education" 0.013]  **Word count vs Relative Importance measurement**  Word frequency in each document is measured and plotted inclined with LDA provided weights. It identifies the most frequent words within each document and across the entire corpus we can visualize relative importance of any keywords in terms of frequency. | |
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**Dominant topic and contribution**

In LDA models, each document is composed of multiple topics. But, typically some specific topics are dominant. The following experiment extracts this dominant topic for each sentence and shows the relative weight of the topic and the keywords. It estimated which document belongs predominantly to which topic. How frequently the words have appeared in the documents and the weights of each keyword in the same chart, words that occur in multiple topics and the ones whose relative frequency is more than the weight.

**Topic-Term Matrix Visualization and Inter-Topic Distance Map**

We trained a LDA model using library pyLDAvis, Gensim and Scikit-Learn parameters was provided four CPU core, 100 passes, 20 iterations and corpus’s token frequency’s enumerated data dictionary. pyLDAvis facilitates us to extract the necessary information from the trained LDA model, such as topic-term distributions and topic-document assignments. The pyLDAvis library depict visualization and interpret the results by interactive web-based visualization. It combines various visualizations to understand the underlying topics, their relationships, and the distribution of words within each topic. pyLDAvis creates a scatter plot where each circle represents a topic. The distance between circles indicates the similarity between topics. pyLDAvis displays a bar chart histogram that represents the top terms contributing to that topic. This visualization helps understand the most salient words associated with each topic. The visualization also includes a heatmap that shows the similarity between topics. Topics that are closer together in the map are more similar in terms of the distribution of words. This helps you understand the spread of word probabilities within a topic.



pyLDAvis library generated interactive chart is represented above shows four different topics in four circles. PCA dimensionality reduction technique is applied here to embed the LDA result into a 2D plain scale. Project the data onto the lower-dimensional subspace by computing eigenvectors and eigenvalues of the covariance matrix, reduced the circle overlapping. This interactive chart provides the opportunity of hovering effect over a circle. It displays different words on the right, showing word frequency (blue) and estimated term frequency within the selected topic (red). The visualization on the right side shows the top 30 most relevant words per topic the blue shaded bar represents the occurrence of the word in all topics and the red bar represents the occurrence of the word within the selected topic. Topics closer to each other are more related. The distance between bubbles represents the semantic distance between topics, and in case bubbles are overlapping that means there are a lot of common words. In our case topics are well separated and do not overlap. In addition, the area of the topic bubbles represents coverage of each topic, and topic 1~4 are equally significant. On top of it, you can see a slide to adjust the relevance metric λ (where 0 ≤ λ ≤ 1) and λ = 1 tunes the visualization for the words most likely to occur in each topic, and λ = 0 tunes for the words only specific for the selected topic.

**Survey Planning**

The survey was conducted over a period of four weeks, with 50 High schools in Dhaka and Bogura district of Bangladesh. It encompasses only English subject areas Teachers who teaches in high schools from class six to class Ten and teaches regularly in the school. A questionnaire was distributed to teachers allowing us to gather a well-rounded perspective on the utilization of digital mobile-based learning. The questions focused on aspects such as frequency of technology usage among students for learning daily class tutorials, preferred learning activities related to specific apps, perceived advantages, and areas for improvement for a proposed solution.

**Survey Questionnaires**

* School or Organization Details (name, School or Organization Location (full address), School Type (Secondary/High School etc)
* School Infrastructural Condition, Number of Students Estimated, Number of Students in Each Class or Section)
* Teachers Details (Name, Phone Number, Year of Teaching Experience)
* Teachers' Social Sites address (e.g. FB, Linkedin, instagram etc)
* Graduation major was not English but currently teaching English subject
* English Teaching class or level
* Frequency of using digital content for teaching or digital medium for teaching and learning
* Internet or Mobile app to teach students or asked students to find solutions or learning materials from 16. Having experience of using mobile app for teaching and learning? Used internet or Mobile App such as (e.g. Youtube Tutorials)
* Do you think teacher will use a customized proposed mobile app for teaching
* Do you think students will use customized app for learning?
* Do you agree with the concept that mobile App and mobile based technology motivates students for learning English
* Do you agree with the concept that mobile App and mobile based technology App can replace guide book
* Do you think mobile app-based learning can improve English proficiency of students
* Any specific ideas How customized app can be improved specially for learning English for the context of Bangladesh
* Do you think Govt should promote these types of innovation for education sector

**Survey Results:**

We have done extensive analysis with the survey data collected. In our data collection highest priority is given for the secondary class student teachers who teach between 6-10th class about 46%. High school, KG college and KG High school. Details about the statistics are depicted in the following figure. Adjacent chart explains the percentage of teachers who teach in which class. Hence, from these two figures we can get a vivid image of collected dataset resources about the participating teachers.

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| Forms response chart. Question title: 3. School Type. Number of responses: 50 responses. | Forms response chart. Question title: 13. English Teaching class or level. Number of responses: 50 responses. |

The infrastructure's overall quality and condition, which is generally above average (76% good and 26% considered as average), are shown in the following statistics. The majority of school owners are privately held 45%, yet there are some of variable quality. 32% of which are MPO institutes—non-government educational institutions that receive funding from the government nonetheless—and 22% of which are government institutes. There are quite a few students overall. Over 1000 students attend almost 40% of the institutions. A sizable number of pupils are present in each section and class. A significant percentage of classes—38%—have a size greater than 50. So, we can presume that the participating teachers have quite a bit of experience teaching a lot of children.

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| Forms response chart. Question title: 6. Total Number of Students Estimated. Number of responses: 50 responses. | Forms response chart. Question title: 7. Number of Students in Each Class or Section. Number of responses: 50 responses. |

For the data privacy and security issues Teachers were reluctant to provide their social website address to the surveyor. Among 50 participants only 12 has, that means 24% attendees provided their social sites address to use them for research purpose.

The following graphs give an overview of the English teaching experiences of the teachers as well as the general consensus regarding the use of digital content and mobile apps in everyday teaching and learning. Almost 62% of teachers have been teaching for more than 8 to 10 years, and some of them have been teaching for decades in higher secondary education. 32% of teachers have three to eight years of experience, while just 6% are fresh to the profession. Around 83.7% of teachers the language of instruction during their graduation was English, and their major was also English. Very few teachers 13.3% graduation major is something other than English yet teaching English in secondary schools probably have sufficient English language proficiency.

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| Forms response chart. Question title: 11. Experience of Teaching English (years). Number of responses: 50 responses. |  |
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**Analysis Facts:**

More than half of teachers, or 58%, have no prior experience utilizing mobile apps or technology for teaching, but 90% of them agree, and more than 45% strongly agree, that it encourages pupils to engage actively in their learning. However, they (almost 60%) also hold the opinion that a notebook cannot be completely replaced, despite the fact that mobile apps may solve many problems and provide technological support for teaching and learning. Promisingly optimistic approximately 40%, although thinking that the notebook-based content memorizing learning method can be replaced, feel that mobile app-based learning can replace it permanently.

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| **Questions** | **yes** | **No** |
| Do you use digital content for teaching or digital medium for teaching and learning | 84% | 16% |
| Have you ever used Internet or Mobile app to teach students or asked students to find solutions or learning materials from internet or Mobile App such as (e.g. Youtube Tutorials) | 76% | 24% |
| Education during graduation was English and English was used for learning | 83.70% | 16.30% |
| **Customized mobile app for Learning and Teaching English** | | |
| Do you think teacher will use this mobile app for teaching | 92% | 8% |
| Do you think students will use this app for learning? | 80% | 20% |
| Do you think mobile app based learning can improve English proficiency of students | 86% | 14% |
| Do you think Govt should promote these types of innovation for education sector | 98% | 2% |

This study proposes the Englisher mobile app and presents it to the participating teachers to gather their insightful feedback. 92% of teachers reported that they would use this type of mobile app for teaching if it were made available after using the trial version of the offered customized Englisher app. Teachers anticipate that 80% of students will utilize this app during class. 86% of respondents believed it may help students' English proficiency, and 98% agreed that the government should support this kind of innovation in the education sector.

**Linguistic Inquiry and Word Count (LIWC) for Qualitative sentiment**

Linguistic Inquiry and Word Count (LIWC) [31], [32] is a text analysis tool to measure psychological or emotional characteristics. It aims to quantify sentiment by examining the frequencies of different linguistic terms within given text based on predefined dictionary of words associated with various categories.

Let’s assume text as a sequence of words: and M different linguistic categories: . Proportion of words in each category where T is the total number of Text. Now, a matrix can be formed, where represents the frequency of the word in the linguistic category . LIWC vector containing the proportions of words in each linguistic category can be expressed as .

In this research LIWC is used to ascertain the general sentiment of the responses given by the survey participants.

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Traditional LIWC Dimension | Answer Text | Standard Commercial Language | Answer Text | Standard for Formal Language | Answer Text | Standard for story language |
| Positive Tone | 2.54 | 3.96 | 3.91 | 2.33 | 3.22 | 2.18 |
| Negative Tone | 0 | 1.1 | 0 | 1.38 | 0 | 1.75 |
| Social Words | 2.54 | 6.87 | 5.65 | 6.54 | 4.08 | 10.5 |
| Cognitive Processes | 13.56 | 9.35 | 18.26 | 7.95 | 15.88 | 8.7 |
| Allure | 2.54 | 7.79 | 3.04 | 3.58 | 2.79 | 5.48 |
| Moralization | 0 | 0.2 | 0 | 0.3 | 0 | 0.21 |

From this LIWC table higher proportion of words related to positive emotions indicate a positive emotional tone in the text in the answer for the questions related to “How this app can be improved” and “How English learning can be improved using Mobile App”. LIWC is applied for three different categories “commercial writing”, “Formal language”, and “story language” and in all the categories answer text showed highly positive sentiment from the survey user. Though respondents had a mix of optimism and skepticism regarding the use of mobile apps in teaching and learning. During the interrogation session, their tone was positive and enticed participants.

**Visualize participants response with Word cloud:**

LIWC involves linguistic analysis using mathematical expression but using word cloud survey answers can be visualized vividly in interpretable interactive format. Word cloud consider a set of words extracted from Text document and associated frequencies , represent the proportional size of the word in the cloud can be expressed as where normalized frequency .

|  |  |
| --- | --- |
|  |  |

The word cloud is generated from the answers provided question “how the app can be improved” and followed by more generalized question “how English learning can be improved using an App”. The participants narrated varieties of viewpoints for the questions. From the word cloud it is inferred adding graphical content would enhance the apps' usefulness and make them more visually appealing to users. More practice resources for listening and exercise would be helpful. Another suggestion is to include synonym, and syllabus-related instances as well as audiovisual engagement with the app. Add additional vocabulary and involve more experience teachers who have greater experience in digital learning and teaching.

A qualitative model for survey results typically involves categorizing responses into different qualitative categories or themes. While mathematical equations may not directly capture the richness of qualitative analysis, you can use a simplified mathematical representation to illustrate the concept. Let's assume you have a survey question with qualitative responses that fall into three categories: "Positive," "Neutral," and "Negative." Here's how you might represent this qualitatively using mathematical notation:

Let:

- \( N \): Total number of survey respondents.

- \( P \): Number of respondents with positive responses.

- \( Ne \): Number of respondents with neutral responses.

- \( Neg \): Number of respondents with negative responses.

You can express the proportions of responses in each category as follows:

- \( p\_p = \frac{P}{N} \): Proportion of positive responses.

- \( p\_ne = \frac{Ne}{N} \): Proportion of neutral responses.

- \( p\_neg = \frac{Neg}{N} \): Proportion of negative responses.

To illustrate a simple qualitative model, you can create an abstract qualitative score based on these proportions. Let's call this qualitative score \( Q \):

\[ Q = p\_p - p\_neg \]

In this simplified representation, \( Q \) captures a basic qualitative assessment of survey sentiment, where positive responses contribute positively to the score and negative responses contribute negatively. Neutral responses do not affect the score.

Please note that this representation is just an abstraction and simplification of qualitative analysis. In real-world qualitative analysis, researchers use various methods like coding, theme identification, and narrative interpretation to derive meaningful insights from survey responses. Qualitative analysis is more focused on understanding the context, meaning, and nuances of textual data rather than using mathematical equations.

Special Remarks:

For the data privacy and security issues many Teachers were reluctant to provide their social website address to the surveyor. Among all the participants only 24% attendees provided their social sites address to use them publicly for research purposes.

General Discussion and outcomes:

The study concludes apps seem effective as they provide a personal and learner-centered learning opportunity ubiquitously. However, apps need to be improved by including collaborative form of learning. Their recommendation is to make it specific. In our case we will make the app specific for NCTB Books only for particular class. This approach is also our goal considering NCTB Books.

The survey revealed that digital mobile-based learning significantly improved learning flexibility for the context of Bangladesh. Most of the participating teachers are enthusiastic about diverse Learning resources related to technology incorporating into pedagogy. Participants appreciated the diverse range of learning resources available through mobile devices, including interactive e-books, dictionary, educational apps, and multimedia content. Teachers admitted that available digital resources facilitated a deeper understanding of topics and catered to different learning styles, nurturing more engaging learning environment. This will positively impacted student motivation and overall engagement and hence boost overall learning. Some crucial suggestions were improving the graphics of the app so that it becomes interactive and guardian involvement can be introduced. Based on the survey results, it is revealed the potential for digital mobile-based learning in school is immense. Government should take initiatives to incorporate it into course curriculum syllabus and could impose ordinance to adopt mobile app based learning teaching in the school.

Conclusion:

The school survey on digital mobile-based learning reaffirmed its potential to revolutionize education, promoting flexibility, engagement, and personalized learning experiences. In the survey questions, it was revealed teachers/instructors would find it acceptable and appreciated if textbook information were made available through a mobile app and presented in interactive format. The study concludes apps seem effective as they provide a personal and learner-centered learning opportunity ubiquitously. Reveal to user as a complementary essential material to learn English Textbook quickly and effectively. However, apps need to be improved by including collaborative form of learning.

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