
An empirical study on mobile-assisted civic and e-learning service through sentiment analysis

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Abstract: This paper aims to analyse the use of mobile phone assisted services in civic and academic learning. General and education-related learning applications useful to educate the users are considered as the input. This paper explores the literature into two different aspects: general and education-related mobile applications. The sentiment analysis is carried out to study users' emotions towards the mobile learning (mLearning) service. More than 30,000 tweets were collected. Through sentiment analysis, the users' awareness about mLearning application is analysed and compared. Fewer studies have reported the usefulness of civic learning apps introduced by government agencies. Moreover, the users' perceptions towards the mLearning apps in higher education are also less reported in the Indian context. The findings show the importance of improving mLearning services initiated by government agencies for civic and education-related learning. The suggestions are also provided for the improvement of mLearning services in India.

Keywords: mobile learning; mLearning; civic learning; social media; sentiment analysis; e-governance India.

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1 Introduction

The Government of India had launched the 'National e-Governance plan' campaign to empower digital technologies, improve digital infrastructure, and support internet connectivity in India. The main aim of these digital initiatives is to provide a stable digital infrastructure service to all citizens. As a result, many general and education-related e-learning apps were introduced as a part of this scheme. For example, the civic m-learning app promotes public transparency of e-service among citizens (Saxena, 2018).

In the present study, the Twitter sentiment analysis is carried especially on civic and education-related mobile apps introduced through the National e-Governance Plan. The user perception towards mobile assisted e-service is also analysed as a part of the study. The results of this study can be used to expand e-service in the mobile platform. The findings may help to improve the e-service and attract more mobile users to use these services. It will give an appropriate solution to bridge digital divide issues in India. The digital divide is often reported from India due to inadequate infrastructure and limited access to ICTs. Lower economic status and lack of digital awareness may also influence the digital divide issues (Couse and Chen, 2010). These digital initiatives aim to provide adequate infrastructure facilities and spread digital awareness among Indian citizens (Nedungadi et al., 2018).

This paper confirms that the mobile platform is a better choice to promote digital awareness. This is because smartphones and tablets are portable, economical and convenient for the citizens. As evidence, the internet and Mobile Association of India (IAMI) report (2019) stated that there is a high usage of mobile phones due to cheaper cost, faster connectivity and affordable service offered by the service provider in India (Nedungadi et al., 2018a). Furthermore, the government also introduced the 'Make in India' scheme to provide low-cost mobile phones to the citizens in their regional language (Make in India, 2021). Therefore, India is considered a suitable place to conduct this study.

This paper explores how these mobile apps improve civics and e-learning services and analysed digital awareness among citizens. It also enables an effective digital service to overcome digital literacy among Indian citizens. The aim of this study is to analyse digital awareness among the citizens through social media analytics. Therefore, the research question is framed as,

RQ How mobile platforms promote civic learning and e-learning service among Indian citizens? To answer this question, the objectives are developed as,

- RO1 To study the usage of mobile apps for civic learning and e-learning through sentiment analysis.
- RO2 Compare the awareness level of mobile apps among Indian users through sentiment analysis.

The above research objectives were achieved by analysing and comparing civic learning apps with e-learning apps through sentiment analysis. The mobile assisted civic learning apps like Cvigil, Divyang Sarathi, agrimarket were compared with the e-learning app like study webs of active learning for young aspiring minds (SWAYAM), ePathshala, and electronic-centre board of secondary education (E-CBSE). Under civic learning, three different categories of mobile apps are analysed. They are the election-bound app (cVIGIL), a mobile app for special needs (Divyang Sarathi) and an agriculture-related mobile app (agrimarket). All these applications are compared with e-learning apps. Furthermore, through social media analytics, e-service awareness and user emotions are analysed and compared. Finally, suggestions are provided for the improvement of the m-Learning service.

The paper is structured as follows: literature on civic and higher education e-service has been discussed in Section 2. Section 3 explains the research methodology adopted in the study. Section 4 discussed the results of the investigation. Finally, Section 5 discusses the findings and provides a conclusion about the users' awareness, followed by the future scope of the study.

2 Literature review

The previous studies confirm that m-learning platforms provide flexible and comfortable platforms to share knowledge among users (Hwang et al., 2017). Meanwhile, many government schemes promote m-learning apps for civic learning and academic learning among their citizens. For example, the Philippines Government enhances SMS learning programs among users to promote m-learning services (Shiratuddin and Zaibon, 2010). On the other hand, developing countries like Japan, Malaysia and Singapore also encourage m-learning services for the learning process (Khan et al., 2015). According to the Telecom Regulatory Authority of India (TRAI Annual Report 2017–2018, 2021), smartphone usage in India increased in urban and rural areas (Bharucha, 2018). Tata Consultancy Service (TCS, 2016) reported that students in India use mobile phones for their academic activities. It also states that the students use social media as a platform to learn and share knowledge. This report confirms that the usage of mobile phones will increase digital awareness among Indian citizens.

In 2008, the National Science Council of Taiwan introduced a four-year e-learning research project named 'mindtool-assisted in-field learning (MAIL)' to promote learning activity. This research aimed to motivate students learning activities and encourage e-learning through a mobile platform (Hwang et al., 2014). The Indian government has introduced many mobile apps to encourage civic and e-learning services among citizens. It also increases the interest of the citizens towards mobile apps. As evident, Sakibayev et al. (2019) conclude that the mobile application positively impacts the users. It is due to the penetration of smartphones in developing countries like India. These also create general awareness about government service, education, and entertainment (Katz et al.,

2014; Sivathanu, 2019). Therefore, mobile apps are considered an essential platform for improving civic and e-learning services (Hahn, 2014).

In general, mLearning apps has various advantages such as reachability, accessibility, and flexibility. Hence, many universities adopt the mLearning platform to promote e-learning services (Hinze et al., 2017). Furthermore, the mobile apps provide anytime and anywhere service to the learners through internet facilities. Moreover, the mobile platform is convenient for both learners and instructors for the teaching-learning process (Lai and Hwang, 2015). Thus, it enables the globalised learning platform through mobile applications. In recent years, the government also uses the mLearning platform to promote civic and e-learning services (Seidlhofer, 2005).

In developing countries like Taiwan, the teaching-learning process is encouraged through the mobile platform in high school. For this purpose, the teachers from selected high schools are trained to develop the mLearning service (Lai et al., 2016). The Indian government also launched the 'Pradhan Mantri Grameen Digital Saksharta Abhiyan' scheme to create digital awareness among Indian citizens. This scheme aims to improve rural citizens digital literacy rate and increase job opportunities for them. As a part of this scheme, the Central Service Centre is established to promote e-service in rural areas (Nedungadi et al., 2018b). Without proper awareness about the schemes, the actual benefits may not reach the target population. Therefore, social media like newspapers, television and online platforms are used to create awareness among citizens about these schemes (Hooda Nandal and Singla, 2019)

2.1 Mobile application download and usage

According to (Internet World Stats – Usage and Population Statistics, 2019), India holds second place in number of Internet users next to China because of the growth of smartphone users in India. More mobile apps are developed and downloaded worldwide with increased information technology and mobile phone users (Lim et al., 2014). According to the Yordan (2020), the total number of app downloads has increased between 2016–2019 (App Download and Usage Statistics, 2020). China led the market in app downloads and 45% of the global downloads among the 95 billion population. Next to China, India has 10% of global downloads among 20 billion people. The United States has 5% of global downloads among 12.3 billion people, followed by Brazil with 40% of global downloads among 3 billion people and Indonesia with 70% global downloads among 2 billion people (App Download and Usage Statistics, 2020). There are five countries, including China, India, US, Brazil, and Indonesia, with an emerging mobile app download and usage market.

According to App Annie stats report 2021, India is the second-largest mobile application user next to China. In 2017, the daily mobile usage hours were around 3 hours 40 minutes by Indian users, reflecting 25% among global usage. Even though India had a one billion population in 2017, it holds second place for worldwide app downloads. However, because 400 million hours were spent using education applications in 2019, the app download status gradually increased to 10% of all global mobile downloads in 2019. In India, 25% of users spend more daily time with their devices (App Annie, 2021). Therefore, India is considered as one of the emerging markets in mobile app usage.

Bharat broadband network limited provides digital infrastructure facilities and on-demand government service to the education sector and citizens (Digitalindia, 2021). It also facilitates the high-speed Internet connection in rural areas and improved the digital

literacy rate in India (Saxena, 2018). Similarly, 'Make in India' offered mobile phones and smartphones and increased mobile phone service availability within the country (Couse and Chen, 2010; Nedungadi and Raman, 2012). The previous studies reported that the mobile phone initiatives improved the socioeconomic status of Indian citizens (Rajan, 2015; Ghosh, 2017). Especially the mLearning apps attract citizens' attention and make them active participants in the e-service. Many social media, blogs, and posts reflect the students' satisfaction level towards the e-learning apps (Savitha and David, 2016). As a result, the growth of digital learning in India is increasing (Technopak and SimpliLearn, 2016).

2.2 Recent mLearning apps in civic learning

Civic learning app will help enlighten the citizen about new government schemes, policies, and benefits (Babu, 2017; Yamada, 2011). Furthermore, according to Meihui (2000), civic learning explains the nation-building process and the country's heritage to the citizens in Taiwan. This civic education apps are often important for the students and young people in an e-democracy environment. Therefore, to facilitate civic learning, mobile apps are launched by the government of India. Some of the mobile apps discussed in this study are cVIGIL, Divyang Sarathi, and Agrimarket. Three different domains were chosen for analysis of the awareness of civic learning. First, the mobile app cVIGIL related to election domain is considered. The main purpose of this app is to avoid violations during the election period. It also promotes awareness about the election procedures to the citizens (Gowda and Gupta, 2019). Second, the mobile app related to special education named 'Divyang Sarathi' has been selected for this study. This app provides valuable information for special needs persons. The familiarity of special users' mobile app and comfortableness are analysed (Balaji and Kuppusamy, 2016; Haridas et al., 2018). Third, the agriculture-related mobile app Agrimarket is considered to measure the awareness level of the citizens. The primary purpose of this app is to create awareness about the current market status and commodity prices. It also provides the overall market details to the farmers of all commodities (Inwood and Dale, 2019).

2.2.1 cVIGIL

The functionality of the cVIGIL mobile app is described as follows. This app is effective from the date of election announcement until the next day after polling (cVIGIL, 2019a). The complaints are registered through online photos or videos sent directly to the district control room. The 'cVIGIL dispatcher,' which is based on a (GIS), is turned on, and the complaint locations will be shared through navigation technology (Gowda and Gupta, 2019). The time-stamped evidence with auto location can be reported to flying squads, and action will be taken within 100 minutes. More than 10,000,000 users downloaded this app and used it during election time (ECI, 2019b).

2.2.2 Divyang Sarathi

Divyang Sarathi is 'an accessible and comprehensive mobile app specially designed for a person with special needs' (Enabled.in, 2019). This mobile app provides information about disability acts, rules and regulations, schemes and job opportunities for disabled persons. This mobile app is launched by the Department of Empowerment of Persons

with Disability as a part of the ‘Sugamya Bharat Abhiyan’ campaign. This mobile app have additional features to convert text to audio and adjust font size according to the users’ convenience. The size of this mobile app is 13MB, and more than 10,000 users download and use this app (Department of Empowerment of Persons with Disabilities, 2019).

2.2.3 *Agrimarket*

Ministry of Electronic and Information technology introduced Agrimarket mobile app under the scheme of ‘National Mobile Governance Initiatives’ (Agriculture Marketing, 2019). It gives information about the market price of crops within 50 km. Using global positioning system (GPS) technology, the location around 50 km is captured. The details of the market price of the different crops are displayed in the mobile app. It will help fetch some commodities’ market prices within a specific distance (Mohan Kumar et al., 2019). This app also provides information about the state- wise monthly analysis report about commodities. More than 12,000 farmers downloaded this app in India and used it to know the market price and other information (Agriculture Marketing, 2021).

2.2.4 *Recent mLearning app in the education sector*

The Global Competitiveness Report (2018) states that improving competitiveness depends on ‘infrastructure, higher education training, and technological readiness’. ‘Unified Mobile Application for New-age Governance’ (UMANG) program initiates many mobile apps to improve higher education (Saxena, 2018). The government also provides sufficient bandwidth, adequate mobile phones, broadband subscriptions and Internet access for users. In addition, the Indian government offers mobile phones and android tablets free of cost to rural citizens (Times of India, 2013; Das and Singha, 2012; Alajmi, 2014). Thus, the growth of ICTs decreases the digital divide and improves digital awareness among users. The mobile apps discussed in this study are SWAYAM, epathshala, and E-CBSE.

The mobile e-learning app considered in this study categories into two divisions. First, the mobile app suitable for higher education. SWAYAM and Epathshala are the two mobile apps that provide online courses to higher education students. These apps offer a well-structured and collaborative environment along with quality education. Many Indian universities provide online course content through this platform (Pathak, 2014; Dwivedi et al., 2019; Balaji and Kuppaswamy, 2016). Second, E-CBSE is specially designed for school students from 1 to 10 standards.

Therefore, the mobile app which supports both universities and schools are analysed in this study. The main aim of these mobile apps is to promote e-learning services to rural students. It also promotes awareness to the students about the e-learning service at the school level (National Council of Educational Research and Training, 2019).

2.2.5 *SWAYAM*

‘SWAYAM’ is an e-learning platform under the ‘e-education’ scheme. It enables an IT platform to host Massive Open Online Courses (MOOCs) in Indian universities. National Program on Technology Enhanced Learning (NPTEL) ((Nptel, 2019) is a part of SWAYAM (Swayam Central, 2021) initiatives to enhance e- learning among higher

education institutions. Several courses have been developed under the NPTEL platform. The Ministry of Human Resource Development (MHRD) supports e-learning through DTH channels with 24X7 facilities. SWAYAM plays a vital role to provide an adequate e-learning platform for online education.

This program aims to provide learning resources to all students and bridge the digital gap in India. Through education policies, it tries to enhance quality education, equality and access to digital resources. There are 203 partnering institutes involved in completing 2748 courses and 12,541,992 students enrolled in this program. The total number of students who completed the online course successfully is 6, 54, 664 (Swayam, 2021).

2.2.6 Epathshala

In India, the Union MHRD and the National Mission on Education through ICTs (Ministry of Education, 2019) launched the 'epathshala' mobile app. The quality and content of the e-learning courses are considered as a key component of this app. It provides open education resources to the citizens in the Indian context. Online quizzes are conducted to practice and evaluate user knowledge based on online learning (Access eResources, 2019). In the epathshala mobile app, the e-content is developed under four quads. The first quad consists of only static e-content. The second quad has e-tutorial in the form of videos. In the third quad, web resources are linked with case studies and other relevant information. Finally, in the fourth quad, self-assessment is included in the form of quiz, assignment, and discussion in the forum. The main aim of the ePathshala mobile app is to achieve Sustainable Development Goal 4 and bridge the digital gaps. More than 1,000,000 users download and use this app in India (ePathshala, 2021).

2.2.7 E-CBSE

The central board of secondary education launched 'E-CBSE' a mobile e-learning app for higher secondary school students (Central Board of Secondary Education, 2019). This app is also launched as a part of the 'National e-Governance plan'. It helps students in rural areas to promote awareness about online education. It also provides a high-speed Internet connection to rural areas to bridge the digital divide issues. The e-book is also available for the students from class 1st to 10th. In addition, the National Council of Education Research and Training (NCERT) (NCERT, 2019) enables the digital resources for the students in rural areas. More than 67,000 users download this app for CBSE board exam preparation (ECBSE, 2021).

One of the major limitations identified in civic learning is the lack of awareness among users. This is because only limited information is provided to the citizens about government policies, laws, and constitutions at the school level (Semela et al., 2013). Bayeh (2016) concluded that the promotion of civic learning is less in developing countries like India. Semela et al. (2013) reported that no proper mode of delivery is used in civic education. The previous studies confirmed that India is affected by the digital divide based on geographical and technical factors (Bansode and Patil, 2011; Singh, 2002). These are the main drawbacks identified in civic education in India. Bayeh (2016) also concluded that the reach of civic learning is limited because of geographical constraints.

The e-learning service has the following limitations. First, the lack of users' technical skills in the online platform is the main reason to reduce the e-learning effectiveness

(Willing and Johnson, 2004). Second, the inadequate infrastructure facilities and unequal resource distribution create digital divide issues within the country (Kipsoi et al., 2012; Güllü et al., 2016). Third, the lack of technical support also reduces the user's willingness to use e-learning (Graham et al., 2013; Nagunwa and Lwoga, 2012). Finally, the lack of Internet connectivity is considered a primary reason to drop out of many online courses (Reilly et al., 2012).

In this study, the common drawback for both civic and e-learning services are identified. The two factors that affect both services are inadequate infrastructure and lack of user awareness. The mLearning apps provide flexible infrastructure services and promote awareness about both the civic and e-learning services to overcome this problem. These mobile platforms have connected citizens from different geographical locations and provide solutions for the digital divide issue.

The research gap identified in this study is that only limited studies are conducted on civic learning in the Indian context. Even though there are a lot of mLearning related studies reported, only a few studies discussed the civic learning mobile apps. No specific studies have compared the user awareness level based on the mobile apps so far. Therefore, this study is the first of its kind that compares the awareness level of the citizens between the civic and e-learning service in the Indian context.

3 Methodology

Sentiment analysis is a technique used to extract the opinion or feedback of the users from the information system. It is considered as an advanced version of data mining techniques. In sentiment analysis, the users' opinions are extracted as a statement from the social media database (Udanor and Anyanwu, 2019; Bozanta and Kutlu, 2018). In this study, the lexicon analytic technique was used to extract opinions in polarity values from the database (Quan and Ren, 2014; Shahzad et al., 2017).

Many researchers perform sentiment analysis to extract the opinion of the users (Udanor et al., 2016; Butts 2008). Therefore, in this study, the sentiment analysis was carried out to measure user's awareness of mobile apps. Three civic learning apps and three e-learning apps were analysed in this study. Social media analysis, such as Twitter and Facebook analysis, are utilised by researchers to analyse the individual opinion of the users within the particular domain (Jennifer, 2015). Thus, the present study adopts social media analysis to collect and analyse secondary data. In our study, the Twitter database has been chosen to perform this analysis.

R tool is an open-source programming tool used to perform sentiment analysis. The sentence-level polarity sentiment is extracted from the Twitter database (He et al., 2011; Chang et al., 2019). The recent tweets were collected using hashtags. Finally, the opinion of the users is aggregated into different polarities and emotions (Udanor and Anyanwu, 2019).

The main intention of this research is to measure the emotions of the users towards e-service in the mobile platform. Six different emotions like anger, disgust, fear, joy, sadness and surprise are analysed as a part of sentiment analysis (Ekman 1992; D'Avanzo et al., 2017). In addition, the polarity values like positive, negative and neutral are also identified in this study (Liu et al., 2008). UMANG related tweets were collected from the Twitter database. Both civic learning and e-learning apps related tweets were also collected in this study. The Twitter database has been chosen in this study because

users often use Twitter to show their emotions (Statista.com, 2021). Social media is considered a powerful platform to reflect the users' emotions for real-time scenarios. Martinez-Rojas et al. (2018) also suggested that Twitter is a better social media platform to provide feedback about all domains, especially education-related tweets shared as a daily routine. The different hashtags are used to collect the tweets from the Twitter database are shown in Table 1.

Table 1 Hashtags used in this study

<i>Categories</i>	<i>Mobile apps</i>	<i>Hashtags</i>
Civic learning app	cVIGIL	#cVIGIL OR #VoterAwareness OR #LokSabhaElections2019 OR #DeshKaMahaTyohar OR #elecquiz OR #ceoup
	Divyang Sarathi	#Divyang Sarathi OR #Department of Empowerment of Persons with Disabilities OR #Universal Access and the provisions of the Rights of Persons with Disabilities Act 2016 OR #UNCRPD
	Agrimarket	#AccessibleIndiaCampaignMobile OR #AgriMarket OR #DigitalIndia OR #DigitalIndiaEssentials OR #AccessibleIndiaCampaignMobile
e-learning app	SWAYAM	#SWAYAM OR #SWAYAMPrabha OR #SWAYAM OR #SWAYAMPrabha OR #TransformingEducation OR #TransformingIndia OR #NewIndia OR #SabkoSikshaAcchiSiksha OR #qualityeducation
	ePathshala	#SchoolEducation #NCERT #CBSE #ePathshala #GSEB OR #e-pathshala OR #ePathshala OR DigitalIndAward OR #goDigital OR #digital OR #MobileApp OR #webapp OR #Institutional OR #attendance OR #homework OR #Exam OR #results OR #fees
	E-CBSE	#E-CBSE OR #cbseclassXIresults2019 OR #DigitalIndia

Many users like Twitter because of its 'concise and expressive nature' (Kumar et al., 2020; Wu and Shen, 2015). Most of these applications were widely mentioned in the news during the election period, as per the current study done in April 2019. More than thirty thousand tweets were collected related to civic and e-learning mobile apps.

3.1 Data pre-processing

The Twitter database is used to predict the election results based on user opinion (Ennaji et al., 2019). The Twitter application program interface (API) extracts the tweets from the social media platform (Jeong et al., 2019). The Twitter dataset was chosen as each tweet approximately consists of 0.47 emotion tokens (Suresh and Raj, 2017; Liu and Zhang, 2012). These emotion tokens reflect the users' feedback on the social media platform (Jamali et al., 2019).

In this study, the rule-based approach was chosen to categorise the tweets based on emotions (Okeyo et al., 2018). The data extraction process was carried out in four steps. In step 1, tweets were extracted from the Twitter database with the help of hashtags (Chang et al., 2019). In step 2, tweets were cleaned to remove the duplicate entries from the input dataset (Pang et al., 2002; Pang and Lee, 2008). The data cleaning was also

done manually to remove typographical errors (Van den Broeck et al., 2005). In step 3, the rule-based approach was used to classified the tweets based on positive, negative and neutral words (Yang et al., 2019). Meanwhile, the tweets were classified based on NRC emotion tokens (Taboada et al., 2011; Kušen and Strembeck, 2018). Finally, in step 4, the results obtained from step 3 were aggregated based on emotion tokens and the final result was achieved.

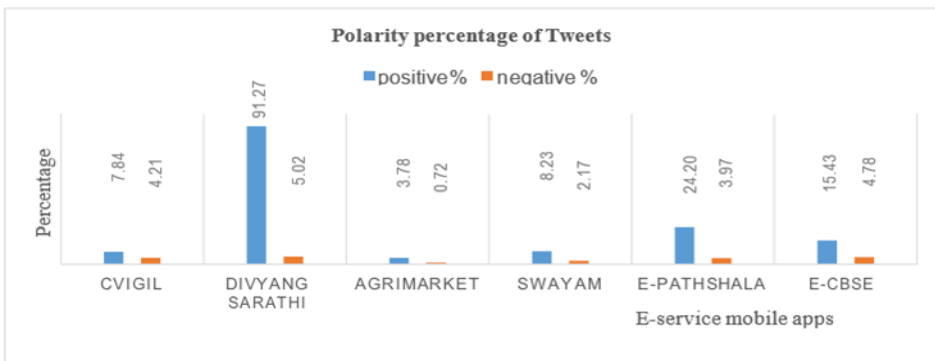
In this study, tweets related to civic and e-learning services were pre-processed. The awareness of the digital e-services was analysed and compared using Twitter sentiment analysis. cVIGIL, Divyang Sarathi, Agrimarket, SWAYAM, ePathshala, and E-CBSE hashtags collected civic and e- learning related tweets. The present study has chosen these mobile apps because the Indian government introduced these e-services under the National e-Governance Plan. These mobile apps were launched simultaneously, and an updated version was introduced at the same period. More than thirty thousand tweets were analysed in this study. The maximum of five thousand plus tweets for cVIGIL and a minimum of eight hundred plus tweets for Divyang Sarathi were extracted.

The data were collected between seven day time intervals in April 2019. Tweets were collected weekly for one month and were collected in the form of unofficial instructions. In the first phase, appropriate keywords or hashtags related to the mobile apps were collected. Then, using R – script, the tweets were extracted from the Twitter database. Therefore, those tweets were pre- processed using R-script and converted into n-grams (Rathore and Ilavarasan, 2020).

3.2 Data analysis

In the data analysis phase, the users’ emotions were explored from the tweets. The user sentiments were measured in two aspects, polarity and emotions (Zhang et al., 2019). Based on sentiment analysis, the user awareness levels were compared. Emotions help to identify the outreach of the ICTs among citizens in India. It also shows that the awareness of e-service increased the usage of digital resources. Twitter positive emotions encouraged other users to use the mobile assisted e-service for their daily activities. It will also spread the necessity of e-service among mobile users through social media platforms (Goh et al., 2013). The positive and negative emotions were again classified into different labels (Giachanou et al., 2019).

Figure 1 Polarity percentage of tweets (see online version for colours)



Out of 30,000 plus tweets, the percentage of positive and negative tweets of each e-service is analysed. As a result, the majority of the tweets shows positive polarity. In civic learning mobile apps, 91.27% positive tweets were expressed for Divyang Sarathi, 7.84% for cVIGIL and 3.78% for Agrimarket. The percentage of positive and negative emotions in the tweets were measured in this study and shown in Figure 1.

The users have more awareness of e-learning apps, specifically 24.20% in ePathshala, 15.43% in E-CBSE and 8.23% in SWAYAM. The result shows that the awareness of the mobile e-learning app is more compared to civic learning.

3.3 Polarity and emotions

The polarity can be measured as positive, negative and neutral based on tweets. In this study, the sentence selection method is used to classify emotions. The sentiment classifiers are analysed using machine learning algorithms (Washha et al., 2019). Using these algorithms, the sentiment scores were assigned for each token separately. On the other hand, the lexicon directories were used to classify the tweets based on polarity. Because the tweets are a mixture of emotions with special characters in the instruction format, this study combines these two approaches to perform Twitter sentiment analysis (Agarwal et al., 2011).

In the first phase, the Naive Bayes' classifier filters the tweets based on polarity. The naive Bayes' classifier uses four steps. In step 1, it built the vocabularies, and then it matches the tweets against the vocabularies and based on these, the polarities are identified. In step 2, the test set is prepared as an input file. In step 3, the test set is converted into emotion tokens. The package 'syuzhet' in the R tool is used to perform NRC emotion lexicons, which converts the tweets into NRC emotion lexicons (Mohammad and Turney, 2013). Finally, in step 4, the polarity and emotion labels are classified based on tokens.

4 Result analysis

The present study evaluates the awareness level of users about the civic and e-learning service in the mobile platform. Our result shows that the awareness level of civic learning is less compared to the e-learning service. This result is matched with the previous studies conducted in the Indian context (Saxena, 2018). We have tested the awareness level of the users through sentiment analysis. Two different domains were selected, and three different types of mobile apps were tested under each category.

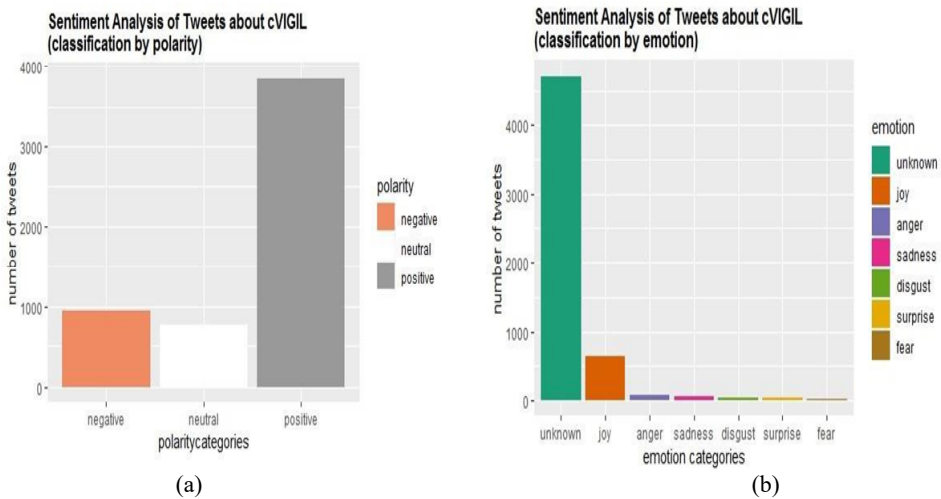
4.1 Civic learning

Civic learning is how young people develop their knowledge and skills by interacting with others in society. Under the Civics Learning Act 2021, the American history and civics education national act (AHC-NA) promotes civics learning among schools and higher education institutions. In addition, grants are provided for the students and teachers to encourage their e-service learning and community service projects (Congress (2021–2022): Civics Learning Act, 2021). Similarly, the government of India takes initiatives to enrich civic understanding among Indian citizens under the UMANG schemes.

4.1.1 cVIGIL

The cVIGIL mLearning app scored more positive polarity during analysis. It indicates the high awareness level of citizens about the election proceedings. The number of users using this app increase the positive feedback. This shows that the civic learning and awareness of the citizens is more because of mobile apps. This app is user-friendly and easy to operate by users so that many users download this app through Android and iPhone. Figures 2(a) and 2(b) show the cVIGIL awareness level of the citizens based on polarities and emotions.

Figure 2 (a) cVIGIL polarity analysis (b) cVIGIL sentiment analysis (see online version for colours)



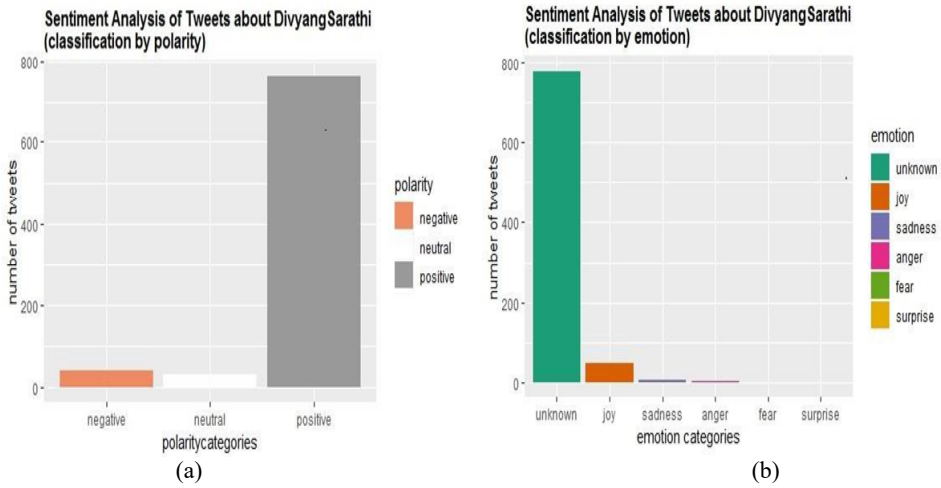
Our result shows that the positive polarity scores were more than the others, indicating that the users have awareness and satisfaction with the civic learning app. The positive emotion ‘joy’ has more scores compared to other emotions. It suggests that the users are happy with the cVIGIL mobile app. Thus, the perception of users about this mobile app is concluded as positive.

4.1.2 Divyang Sarathi

The total number of tweets collected for Divyang Sarathi was more than 800 within one month. It shows that the awareness of this mobile app is comparatively less than other apps. Figures 3(a) and 3(b) show the Divyang Sarathi awareness based on polarities and emotions.

The result shows that the positive polarity and the emotion ‘joy’ scored more than the other emotions. This app is discussed less in the social media platform compared to other apps chosen for this study. From the above results, it is identified that the awareness about the Divyang Sarathi mobile app is low. To create awareness, the government often needs to take necessary steps to advertise this app among special needs people.

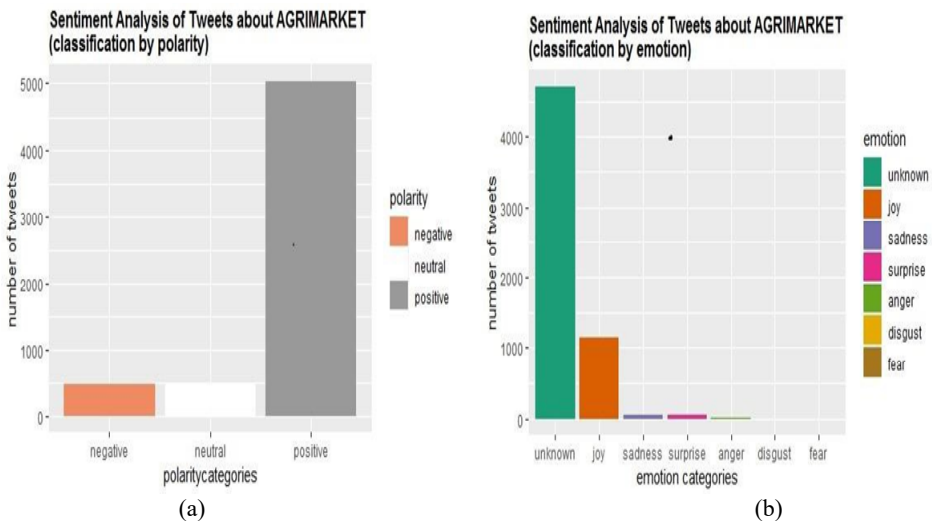
Figure 3 (a) Divyang Sarathi polarity (b) Divyang Sarathi sentiment analysis (see online version for colours)



4.1.3 Agrimarket

The total number of positive tweets collected for this mobile app was more. The positive polarity scores were more than negative and neutral. It indicates the farmers have more awareness and are satisfied with this mobile app. Agrimarket awareness based on polarities and emotions is shown in Figures 4(a) and 4(b).

Figure 4 (a) Agrimarket polarity (b) Agrimarket sentiment analysis (see online version for colours)



Our result shows that the emotion ‘joy’ is more compared to others. Moreover, it shows that the outreach of the Agrimarket is more. Among civic learning e-service, the

Agrimarket mobile app scores more compared to cVIGIL and Divyang Sarathi mLearning.

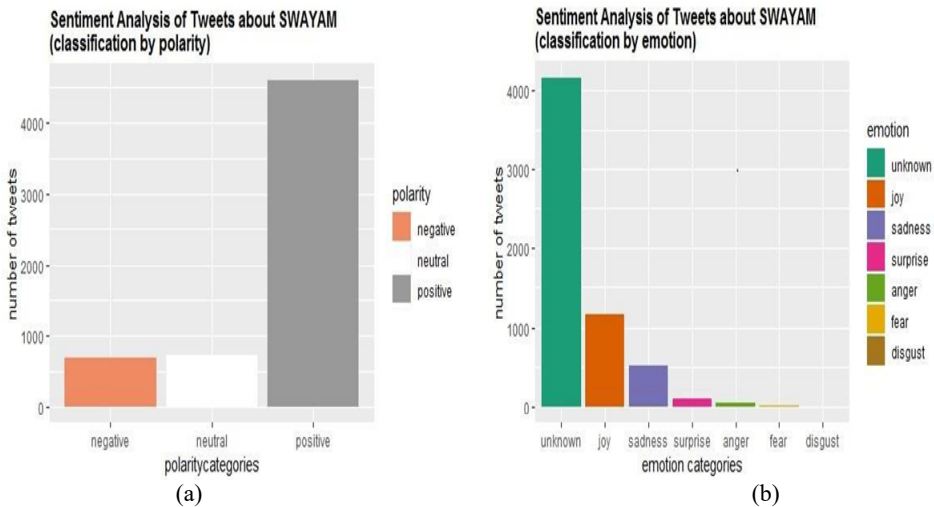
4.2 E-learning mobile app

The Government of India promotes online courses for the improvement of education sector. The main aim of these mLearning apps is to bridge the digital divide among rural and urban areas. The three different types of e-learning mobile apps were selected under each category and were analysed.

4.2.1 SWAYAM

The sentiment analysis result shows that the user’s expectations are achieved through SWAYAM mobile app. The awareness of this app is more because most of the higher education students use this e-learning mobile app. The higher education institutions are also promoting this app to their students as an additional academic resource. The reach of this mobile app is high because most of the mobile users fall under the student categories. The higher education students are also familiar with other online environments, such as Coursera and edX. Therefore, the students show more interest to use this mobile app.

Figure 5 (a) Swayam polarity (b) Swayam sentiment analysis (see online version for colours)



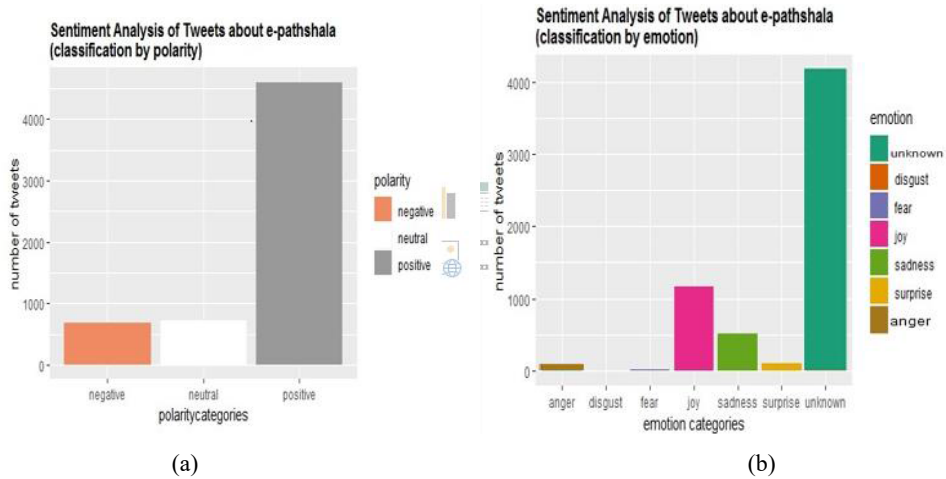
The user’s emotion ‘joy’ scores are higher than the other emotions. It shows that the positive polarity of the user is more compared to other polarities. It is because the students have prior knowledge about the e-learning platform. Therefore, many students used this e-learning mobile app to learn online courses. The sentiment analysis of SWAYAM mLearning app with polarities and emotions is shown in Figures 5(a) and 5(b).

4.2.2 e-Pathshala

e-Pathshala provides particular services for students, teachers, and educators. For the student, it allows access to the digital textbook and e-Resources. Because of the user-friendliness of the service, the awareness level about this mobile app is high. The positive feedback about this app is more compared to other mobile apps.

Our result shows that the positive polarity and emotion ‘joy’ is more for the e-Pathshala mLearning service. It shows that the outreach of the mobile app is high compared to other e-service. The sentiment analysis of the e-Pathshala mLearning app with polarities and emotions is shown in Figures 6(a) and 6(b).

Figure 6 (a) e-Pathshala polarity (b) e-Pathshala sentiment analysis (see online version for colours)

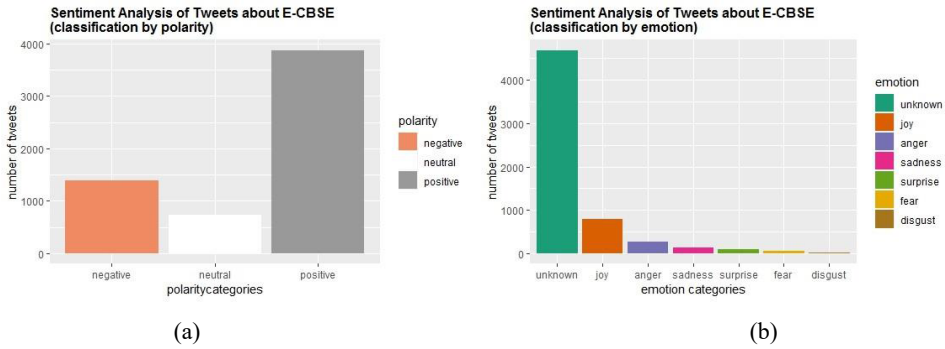


4.2.3 E-CBSE

E-CBSE mobile app provides e-learning materials for school students and teachers. It also offers high-speed Internet and digital infrastructure service, which increased the digital literacy rate through this mobile app. The positive polarity of this app is high compared to others polarities. It shows that the students are active participants in this mLearning app. The Indian government has conducted many awareness programs among school students to spread the benefit of this app. Therefore, the reach of this app is more in secondary schools.

The result shows that the emotion ‘joy’ is more compared to other emotions. It indicates that the awareness of the mobile app E-CBSE is more among school students. The output of sentiment analysis with polarities and emotions are shown in Figures 7(a) and 7(b).

Figure 7 (a) e-CBSE polarity (b) e-CBSE sentiment analysis



4.3 Performance measure

Overall performance of the model is analysed using two approaches:

- a chi-square test
- b Naviye Bayes approach.

The chi-square test is used to measure dependency between two quantitative variables. At the same time, the Naviye Bayes algorithm is a technique used to construct classifiers. It is based on Baye’s theorem and used to handle high dimensional data (Song et al., 2017; Jianqiang and Xiaolin, 2017).

4.3.1 Performance measure using chi-square test

The chi-square test or ‘goodness of fit’ statistic compares the observed values to the expected values in the dataset (Khan et al., 2014). It also identifies the difference between two frequencies (observed and expected) and represents the result in a contingency table. Each row consists of one categorical variable in this table, and each column contains another categorical variable (Go et al., 2009; Singh et al., 2017). The chi-square value is computed using the formulas,

$$\chi^2 = \sum \sum (f_{ij} - E_{ij})^2 / E_{ij} \quad i = 1,2 \quad j = 1,2 \tag{1}$$

where f_{ij} represents the indicator frequency in positive or negative tweet sets.

E_{ij} represents the expected frequency of i and j .

The expected frequency is calculated by using the formula,

$$E_{ij} = \text{row total}_i * \text{column total}_j / \text{total number of observation} \tag{2}$$

The user awareness about m-learning apps (civic and e-learning apps) is analysed via the chi-square test. Based on the literature support, the hypothesis is framed as,

H_1 Assuming there is an association between Twitter frequency and m-learning apps awareness among users.

To accept the hypothesis, the significant value of p should be less than 0.05 ($p < 0.05$). Our finding shows the χ^2 value is 371.121 and the value of $p = 0.00$, and the

result is significant at $p < 0.05$ (Wang et al., 2018); therefore, the hypothesis is accepted. The chi-square test confirms that the tweets are associated with m-learning apps' awareness among users. Hence, this study confirms that the mobile apps' awareness level is high among Indian users through Twitter sentiment analysis. According to a Statista (2019) report, the total number of mobile phone users increased to 420.7 billion in India, and 79% of students use smartphones as the primary mode of online learning (Statista, 2021). Hence, the Statista report also supports the result of this study.

4.3.2 Performance measure using Naviye Bayes approach

In this study, the Naviye Bayes method predicts the overall sentiment of m-learning apps in the Indian context. With the help of the RapidMiner software tool, the performance measure of the model is analysed (Arunadevi et al., 2018). As a result of the Naviye Bayes algorithm, the confusion matrix is created. The confusion matrix summarises the performance of the classification model. It consists of two classes (actual and predicted class) and four parameters (true positive, true negative, false positive and false negative). The true positive (tp) has correctly predicted values in both actual and predicted classes. At the same time, the true negative (tn) consists of correctly predicted negative values in both categories. On the other hand, the false positive (fp) and false negative (fn) are represented in the contradicted values in both classes (Jianqiang and Xiaolin, 2017). Based on these four parameters, the precision and recall values are calculated as,

$$\text{Precision} = \text{tp} / (\text{tp} + \text{fp}) \quad (3)$$

$$\text{Recall} = \text{tp} / (\text{tp} + \text{tn}) \quad (4)$$

The precision values are correctly predicted positive values observed out of total positive observations (Ismail et al., 2018). The recall values are calculated based on the ratio of correctly predicted observations to the total observations (Saif et al., 2016). Finally, the accuracy of the model is estimated using the following equation,

$$\text{Accuracy} = (\text{tp} + \text{tn}) / (\text{tp} + \text{tn} + \text{fp} + \text{fn}) \quad (5)$$

The accuracy shows the correctly predicted positive observation ratio to the total observations (Panasyuk et al., 2015). The result generated by Naviye Bayes approach is shown in the Table 2,

Table 2 Naviye Bayes production model result

Class precision		Class recall		Accuracy
pred. positive	81.72%	True, positive	99.64%	81.42%
pred. negative	59.09%	True, negative	7.14%	

In our model, the precision rate is 81.72% (pred. positive) and 59.09% (pred. negative), and the recall value is 99.64% (true positive) and 7.14% (true negative). Therefore, the accuracy of the model using the Naviye Bayes approach is estimated as 81.42%.

5 Findings and conclusions

The study finding clearly explains the awareness level of users about e-service in the mLearnig platform. Mobile phone usage is identified as the main reason for the growth of e-service (Sakibayev et al., 2019). In India, the internet penetration rate is considered as a root cause for the development of mobile apps. Therefore, this study confirms that mobile phones' reachability promotes mLearning among users in India. The tweets were extracted from the Twitter database, and the users' opinions were analysed in various domains such as election, agriculture, and special education (Qazi et al., 2017). On the other hand, the e-learning service in higher education and school level were also analysed. Finally, the emotions of users' regarding the civic learning apps were compared with the e-learning apps.

Our study result shows that the users' have more awareness of e-learning services compared to civic learning. It is because half of the population who use mobile phones falls under the youth categories. Many higher education students and school students use mobile apps for their daily activities (Thakur and Srivastava, 2013).

The usage of the election app is more, but the active time is less compared to other apps. This is because the cVIGIL app is functional only during election time, and the usage is limited to a specific period (ECI, 2019). Kiyohara (2018) explored how smartphone penetrates into the election process and campaign in South Korea. As a result, the authors confirmed that civics learning helps people understand democratic values, especially in election time. It also enhances people's knowledge about their citizenship and improves the relationship between political parties and voters in developing countries.

Kukulaska-Hulme and Shield (2008) stated that the mobile platform is a mediator to promote e-service anywhere anytime. Therefore, the research team at the University of Granada, and the University of Murcia, Spain, used iPad and iPod devices to promote e-service to the special students (Fernandez-Lopez et al., 2013). As a result, the special students are satisfied with the mobile apps that are easy to download through playstore (Ismaili, 2017). In India, Divyang sarathi mobile app is helpful for a particular group of users with special needs. Therefore, the usage of this mobile app is limited to a special community. Our result shows that the awareness of this app is less compared to other civic apps. The two main drawbacks identified in this study are lack of understanding and the limited number of users (Balaji and Kuppusamy, 2016).

The agricultural mobile app will provide information about the markets and services as well as connect farmers and customers. For example, in Germany, farm management software named 'AGRO-NET' is used to reduce the complexity of the farmers (Steinberger et al., 2009). Similarly, in Greece, the bio@gro m-learning app provides information related to agriculture practice, government service, markets, and increasing farmers' revenue (Prasad et al., 2013). Likewise, the F-Track Live farm management app enhance the agriculture-related mobile service to the Australian farmers. Many past studies also confirmed that the growth of mobile agricultural app is significantly high in developed countries like Sweden, Kenya, Australia and developing countries like India and other European countries, including Uganda, Tanzania (Steinberger et al., 2009; Prasad et al., 2013). Similarly, in India, the agriculture-related app Agrimarket is introduced along with the agriculture insurance app. The farmers who are familiar with the mobile app gets the full benefit of this app. The mobile app's integration with the agriculture management system has a positive impact on agriculture. It brings in a

revolution in Indian agriculture while also increasing the revenue of the farmers (Inwood and Dale, 2019). The farmers in India are more aware of and use this agriculture app.

The usage of e-learning mobile apps is more among student communities, including school and higher education students. The main intention to introduce mobile apps is to bridge India's digital divide (Waheed et al., 2016). When e-learning is provided through other platforms, the infrastructure is considered as an important challenge. To overcome this drawback, the e-service is promoted through mobile platforms (Sakibayev et al., 2019; Jampala and Shivnani, 2019). Many developing countries create m-learning programmes that are suitable to the specific needs of their students. To meet the needs of students in Taiwan, teachers primarily focus on technical issues and content quality (Lai et al., 2016). Many e-learning contents are developed and promoted through mobile platforms in India as well. SWAYAM is one of the most popular online platforms that provide courses through videos and text format. The users show more interest in the online courses because they are already familiar with the MOOCs platform like Coursera, edX (Gupta and Jain, 2017; Gupta, 2019; Pujar and Tadasad, 2016). Apart from this, the digital initiative schemes and promotions about the e-learning service quickly reached the student community through mobile platforms. Therefore, the reach of SWAYAM is high among the student community. The same result is reflected in the sentiment analysis.

In Ghana, an m-learning app called iREAD 2 is developed to improve the childrens' literacy for school students with grades 1, 2, and 3. E-books were provided in the form of storybooks to encourage the reading activities of the students. This mobile app will help overcome limitations such as lack of human and other material resources across geographical distances (Oakley and Imtinan, 2018). Similarly, in India, the epathshala app provides a digital textbook for students. The e-content of this mobile app has more content quality and attracts many users to use this app. As a result, many users are satisfied with the e-content, and the same effect is reflected in the sentiment analysis (Balaji and Kuppusamy, 2016). Therefore, the usage of epathshala is comparatively higher than the other two education-related applications.

In Egypt, the m-learning app is designed based on the content quality service. It provides up-to-date content to the school students along with quizzes and exams. Ali and Arshad (2018) confirmed that students' performance has increased after using m-Learning apps in academics. On the other hand, in India, E-CBSE is a special mobile app for school students, and it provides e-content for the students from 1 to 10 standard (National Council of Educational Research And Training, 2019). As a result, many Indian schools recommended this app to their students and promoted awareness about the usage of this mobile app.

The above result shows that the usage of mobile apps is more in India. The chi-square test confirms through Twitter analysis that the awareness of mlearning apps is high. In addition, the accuracy of the overall model is estimated through Naive Bayes approach. The AppsFlyer report (2018) also supported the same result and reported that India is the number one country to install mobile apps and use them per month. Overall, 12.1 million mobile apps were downloaded by Indian users in the year 2018 (Natanson, 2021). Because of the above reasons, India creates the fastest developing mobile app market in the world. It is one of the primary reasons to conduct this study in the Indian context.

The comparison of civic and e-learning mobile apps were performed, and results were discussed. It is identified that online users have more awareness about the e-learning mobile apps than civic learning apps. Even though smartphone usage is more, the use of civic learning is comparatively less among Indian users. Therefore, to create awareness,

the government should initiate some digital campaigns from the National e-Governance plan.

Advertisements should be given through media like newspapers, televisions other than social media. It will create awareness among citizens in rural areas. It also seeks the attention of the ordinary person in society. Thus, it helps them to know the roles and responsibilities of the citizens in the country. The feedback from the online platform should be considered for the future development of mobile apps. It will help to maintain and improve the constitutional democracy in India. The awareness about civic learning will improve the social and emotional thinking of the users. It also encourages a sense of unity and cohesion in society. This study concluded that the civic and e-learning service promotes awareness about technology usage and educates citizens about the roles and responsibilities better.

This study aims to measure awareness levels of the citizen towards e-service in the Indian context. Two different categories of e-service: civic and education-related services, were considered for the analysis. First, the general e-service, including *cVIGIL*, *Divyang Sarathi*, and *Agrimarket* related tweets were extracted using hashtags in the Twitter database. Second, we collected tweets about educational services like *SWAYAM*, *e-Pathshala*, and *E-CBSE*. The maximum number of tweets searched in each category was 6,000. Third, both the user awareness and emotions were analysed using Twitter sentiment analysis. Overall, the awareness level for the general e-service is less compared to the education-related e-service.

This paper compared the usage of mobile apps in civic learning and e-learning service. It is identified that the user perception towards *mLearning* service in civic learning is less compared to e-learning. Even though mobile devices are widely spread in developing countries like India, the usage of civic learning is less. The reason was found through Twitter sentiment analysis. The awareness level of the users towards e-learning is more. It is because the government initiated many awareness programs through the digital India campaign. *UMANG* scheme has an excellent reach to the students compared to the public.

As evidence, many online users discussed their opinion about mobile apps on a social media platform like Twitter. There were many positive tweets found related to mobile e-learning apps. Overall, the *e-Pathshala* mobile app has a more favourable score compared to other apps. For *e-Pathshala*, the high-quality curriculum-based interactive e-content is developed by experts from Indian universities. It also provides various modules for different subjects across all disciplines. Therefore, this study concludes that the users have more awareness about *e-Pathshala* than all other service categories. Overall, the users' awareness of the e-learning mobile apps are more compared to civic learning apps in the Indian context.

This study collected the feedback of online users regarding different types of mobile apps. The polarities and emotions were identified in this study which will help the app developers to improve mobile applications. In addition, this study helps to find out the requirement of the citizens based on emotions. This study is also helpful for the government policymakers to introduce new schemes and policies to guide citizens better. Thus, the conclusion of this study would support the policymakers to develop mobile apps to fulfil the government's intention and attract citizens towards technological revolution. This study includes only limited mobile apps, and more apps could be considered for future research.

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