Hindi Wordnet for Language Teaching: Experiences and Lessons Learnt

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Abstract

This paper reports the work related to making Hindi Wordnet[1] available as a digital resource for language learning and teaching, and the experiences and lessons that were learnt during the process. The language data of the Hindi Wordnet has been suitably modified and enhanced to make it into a language learning aid. This aid is based on modern pedagogical axioms and is aligned to the learning objectives of the syllabi of the school education in India. To make it into a comprehensive language tool, grammatical information has also been encoded, as far as these can be marked on the lexical items. The delivery of information is multi-layered, multi-sensory and is available across multiple digital platforms. The front end has been designed to offer an eye-catching user-friendly interface which is suitable for learners starting from age six onward. Preliminary testing of the tool has been done and it has been modified as per the feedbacks that were received. Above all, the entire exercise has offered gainful insights into learning based on associative networks and how knowledge based on such networks can be made available to modern learners.

1 Introduction

A Wordnet is a large digital lexical database of a language in which information is organised around cognitive synonym sets or synsets (Fellbaum, 1998). The underlying basis of such organization are the word association studies in psycholinguistics, which proved that our mental lexicon is structured on associations, *i.e.* an appearance of one entity entails the appearance of the other in the mind. Thus, it was found that subjects respond quicker than normal to the word 'nurse' if it follows a highly associated word such as 'doctor' (Church and Hanks, 1990). This property of the mental lexicon is structurally built in the Wordnets and manifests itself in the lexical and semantic relations which are encoded in it. Thus, a Wordnet is a ready resource of vocabulary of a language, which captures associative learning in its structure. Conventional sources of vocabulary learning, such as the dictionaries and thesauri, do not have these relations due to the very nature of their composition. This is the motivation to present Hindi Wordnet as a tool for vocabulary learning and teaching.

The second motivation is the fact that education is undergoing rapid digitalization. Innovative instruction techniques, which can cater to the tenets of anywhere, anytime, any size learning, flipped classroom approach and blended learning environments, are the need of the hour. Such technology based learning solutions can help in better learner engagement in classrooms and can also be used in informal teaching–learning environments, as the delivery of knowledge is in a multi-sensory mode and is available across various digital platforms. In the form of a digital resource, the language learning aid that is presented here also seeks to redress the long standing problem of the burden of the school bag of young learners in India. This pedagogical application of Hindi Wordnet will address all the above issues and provide a resource which will cater to the various gap areas of learning.

The rest of the paper is organized as follows: Section 2 provides the related work. Section 3 discusses the need for association capturing in language learning, which provides the basis for using Wordnet as a language learning resource. Section 4 presents the digital aid developed for Hindi language teaching and learning. Section 5 discusses the process, experiences and lessons learnt while

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[1]http://www.cfilt.iitb.ac.in/wordnet/webhwn/index.php

developing this aid. Section 6 briefs the field test and user feedback followed by conclusion and future work in section 7.

2 Related Work

In digital educational technology, the literature shows that psychological aspects of language learning has been explored under various conditions due to continuous advancements on the technological front. The research indicates that multimodal learning has always resulted in better retention (Dale, 1969). When the information enters the system through various senses, it helps the brain to circumvent the limited processing capabilities of each individual senses and allows for greater total information to be processed (Clark and Paivio, 1991). With technology in place, the ease of multi-modal learning environments have been studied in different settings (Mayer and Moreno, 2003; Moreno and Mayer, 2007; Shams and Seitz, 2008; Sankey et al., 2010). Mobile Assisted Language Learning (MALL) is also being explored as mobile technologies are becoming an integral part of lifestyle. The findings (Yang, 2013) show that MALL has not reached its potential and it is moving towards being the new stage of Computer Assisted Language Learning (CALL). Pedagogical experts have stressed on the need for improving various approaches to enhance the willingness of the learners for self-directed technology to maximize the technology potential for language learning (Lai et al., 2016). The use of gamification is seen as an effective pedagogical strategy which can engage and motivate the learner to learn in a relaxed environment, which is fundamental to any learning (Werbach and Hunter, 2012; Figueroa Flores, 2015).

In language learning, using semantic network relations for learning new word helps in better understanding of its meaning (Lin, 1997). The wordnet, a semantic based rich lexical resource, has been used for various language learning applications such as - the semantic and lexical relations between synsets enables the learners to know the connotations of a word along with its various possible contexts (Hiray, 2015). A gamification system based on wordnet was used to assess the depth of word knowledge of a learner(Brumbaugh, 2015). A system was experimented for similar looking and near synonyms word learning based on wordnet for English language learners (Sun et al., 2011).

3 Language Learning through Association Capturing

3.1 Need for association capturing

Association capturing lies at the core of language learning. The term association is used here to refer to the connection or relation between ideas, concepts, or words, which exist in the human mind and manifest in such a way that an appearance of one entity entails the appearance of the other in the mind (Sinopalnikova, 2004). Learning or instruction strategies must be able to encapsulate this association for the creation of better pedagogical techniques, as associative networks help not only in understanding new knowledge but also to retain it firmly in the mind.

The understanding of how the meaning of a word is understood and retained in the human mind is of crucial importance as vocabulary plays an important role in all the competencies of language learning, such as speaking, reading, and writing. Methods of vocabulary learning too have moved beyond the traditional ways which were based on the behavioristic theory (Demirezen, 1988) of language learning to the modern methods of vocabulary learning (Nation and Newton, 1997). The latter are based on the communicative theory (Brown, 2000), where understanding a word involves committing to memory its form, capturing its meaning and finally knowing how and where to use it.

The semantic network theory (Collins and Loftus, 1975; Collins and Quillian, 1972; Rips et al., 1973; Smith et al., 1974) states that a word's meaning is defined as "whatever comes to mind when someone says the word" or "you shall know a word by the company it keeps" (Firth, 1957). It implies that a word's meaning is represented in the mental lexicon by a set of associations of that word with other words. Thus, the meaning of a word is understood as collections of associated concepts . Also, it has been proved that the syntactic category of a word and the associated words that come to the mind is the same (Fillenbaum and Jones, 1965). Since it is rare in any discourse for adjacent words to be from the same syntactic category, therefore this cannot be explained as association by being contiguous. This association is because a word's meaning is represented in the mental lexicon by a set of nodes and the links between them. Here the nodes represent concepts whose meaning the network is trying to capture, and the links represent relationships between concepts.

These nodes and links translate into word relationships and meaning relationships or lexical and semantic relations. These lexical and semantic relations have been found to be cognitive universals (Lin, 1997), *i.e.*, these relations are found in all languages. Exploring the various relations in the semantic field such as hypernymy, hyponymy, *etc.*, consolidates a new word's position in the student's mind.

3.2 Associative network based Wordnet for language learning

As stated above, the learning and teaching of vocabulary with associative networks is helpful as new words are presented in semantically related group. Thus, it is best when adjectives are taught in clusters around antonymic pairs, nouns are taught as hyponyms of other nouns or with synonyms and verbs are presented as groups of troponyms or entailments. For learners, meaning is captured and retained when, for example, it is said that a horse is a kind of an animal (hypernymy relation), uniform is opposite of diverse (antonymy relation), snore is a part of sleep (entailment relation) and cultivate has as its object land (argument relation). Such associations are not captured in conventional dictionaries as much of the structural information is omitted from them and can only be provided by semantic networks like Wordnets. A classroom teacher will certainly not be able to provide associative information to students, by merely using a conventional dictionary. A thesaurus does give synonyms, but lack in lexico-semantic relations. Moreover, both the dictionaries and thesauri do not give the grammatical features that have been added to the teaching aid (discussed in section 5.4).

Various tests have proven that amongst the plethora of web-based resources for language teaching and learning, which have come up due to the exponential growth of the Internet and the World Wide Web, Princeton WordNet has emerged as one of the most reliable, authentic and useful sites (Hiray, 2015). In first of two such evaluations, three criteria, which were, (i) **Non-commerciality** – such sites were freely available, (ii) **Adequacy** – those that covered all the 570 word families featuring in the AWL (Academic Word List) 1 and (iii) **Authenticity** – the academic vocabulary exercises belong to the site itself. The result of this evaluation has marked 14 useful sites in which the Princeton WordNet stood 4th.

Another evaluation was done based on four different criteria, which were, (i) **Number of Recommendations** – those recommended by most of the ten ESL resources, (ii) **Authority** – authors of the sites should be related to the field of language, (iii) **Simplicity** – in terms of presentation, be user-friendly and material classified as per different levels of learning and (iv) **Currency** – the site is regularly updated. Here a total of 6 useful sites were marked, out of which Princeton WordNet received a ranking of 4. These results can be projected on Hindi Wordnet as well, since structurally Wordnets are similar. Thus, empirically, a strong case for using wordnet for vocabulary teaching is made.

4 A *Digital Aid* for Hindi Language Teaching and Learning

In order to employ association capturing in learning and to cater to the needs of rapid digitization of education, the vast lexical database of Hindi Wordnet has been transformed for pedagogical purpose in the form of an e-learning tool - ***Hindi Shabdamitra***[2]. In this tool, Hindi wordnet data is modified / simplified and further augmented with audio-visual features and grammatical properties, and is presented in a learner-friendly format for language teaching and learning. Depending upon the understanding level of a user and the purpose of use, this digital aid follows the selective information presentation approach. Henceforth, in this paper, this e-learning tool will be referred as *Digital Aid*.

4.1 Why selective information presentation?

The *Digital Aid* caters to various types of users, *viz.*, school students, teachers, parents, language learners, content managers, proofreaders, natural language processing researchers, mobile/web service providers, tourists, *etc*. As per the need of these users the information content has been moulded, keeping in sight the cognitive load that the user may be able to cope with. This can avoid unnecessary learning efforts, wastage of time and the burden of information overloading. In *Digital Aid*, this is achieved through the multi-layered information rendering approach, suitable for both formal and informal learning environments.

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[2] http://www.cfilt.iitb.ac.in/ hindishabdamitra/

4.2 Multi-modal learning - a psychological aspect

Humans are genetically programmed to communicate and understand things through a multi-sensory learning system. The brain processes the inputs received from different senses to comprehend concepts. As per the principles of multimedia learning (Gilakjani et al., 2011), multi-modal learning leads to comprehensive learning of a concept with higher retention rate. They have shown to stimulate thinking and learning as compared to only text based computer interfaces (Clark and Paivio, 1991; Mayer and Moreno, 2003; Moreno and Mayer, 2007; Shams and Seitz, 2008; Sankey et al., 2010).

For language learners, having a multi-modal e-learning tool provides motivation for learning the second language along with the independence to learn at one's own pace (Lai et al., 2016). It also provides the confidence of learning and handling a digital device with ease from an early age.

In *Digital Aid*, information is provided in the form of text as well as audio-visual inputs. The textual information pertains to the gloss (original Hindi wordnet or simplified), word usage, synonyms, grammatical features, lexico-semantic relations, ontological information. It also has audio pronunciations of words and pictures/illustration of concept, *etc*. This helps in learning and understanding the concept with great ease.

4.3 Multi-layered presentation - an incremental learning approach

The presented *Digital Aid* is designed keeping in mind various aspects of language teaching and learning. It is a five layered model where selective information is rendered in every layer, depending upon the type/need of the user and his/her cognitive competence. This multi-layered model is structured in a level-wise and class-wise manner.

Level-wise information presentation

The level-wise module is designed for informal setup where a user can select any of the five levels depending upon his level of expertise. The information is rendered level-wise as follows:

- **Level 1 (Beginner):** Level 1 is meant for users who are new language learners. Here information such as simplified concept definition, word usage, synonyms, grammatical features is selectively presented. The gloss is simplified so that the beginners can easily understand and learn the concept. Audio pronunciation of a searched word and a picture or an illustration of a given concept is provided. Apart from this, the corresponding English WordNet synset is provided. For those words which do not have a corresponding synset it is given a bilingual mapping (Singh et al.,).

- **Level 2 (Intermediate):** In level 2, the intermediate users are targeted. Here, users are expected to have basic knowledge of Hindi. In this level, all the information from level 1 is rendered and additionally, more grammatical features such as gender for nouns, antonym for verb and adverb, type of verb, countability for adjective, type of adjective, spelling variation, *etc*. are appended.

- **Level 3 (Proficient):** In level 3, additional information is presented which is necessary for the intended user. Here, instead of simplified gloss and simplified example sentence(s), the Hindi wordnet's original gloss is rendered. This is because, it is expected that these users have a good grip over Hindi and can understand the complexity of a language. From this level onward it is very important that the concept should be clearly explained, so that the learners can understand the fine grained difference between two synsets. Figure 1 shows a screenshot of the tool rendering a word भजन (*bhajana*, hymn) at Proficient level.

Figure 1: Screenshot of the *Digital Aid* rendering a word भजन (*bhajana*, hymn) at Proficient level

- **Level 4 (Advanced):** At level 4, other semantic relations such as hypernymy, hyponymy, *etc*. are introduced along with all the information presented at level 3. Here, all the available synsets in Hindi wordnet and all the grammatical features are rendered.

- **Level 5 (Expert):** This is the highest level in this *Digital Aid* in which all the information available in Hindi Wordnet, along with grammatical features, ontological information, semantic and lexical relations are rendered. The expected target group here is teachers, researchers, language learners, *etc*.

Class-wise information presentation

The main purpose of developing this *Digital Aid* is to target school curriculum as prescribed by the various school boards in India. In this tool, the syllabus for Hindi prescribed in the CBSE Board[3] has been selected, as it has a wide reach across India. The tool is devised to assist school teachers in teaching and students in learning Hindi vocabulary available in their curriculum. Once a particular class and chapter is selected, all the corresponding words are listed for learning in the interface.

4.4 Learning outcome - what difference does Hindi wordnet make?

There are many tools which are available for language learning. However, the *Digital Aid* has unique features which can lead to additional learning outcomes. Using the lexical and semantic relations encoded in Hindi wordnet, users can learn different senses or meanings of a word (polysemy), know about different relations like hypernymy (is-a), meronymy (part-of), troponymy, entailment, *etc*. These are the unique features which are present in the wordnet and are rarely found in traditional dictionaries/thesaurus. These will help in the understanding and retention of concepts. Besides this, they can learn the concepts of synonyms (words having similar meaning) or antonyms (words having opposite meaning), learn to associate a concept with a picture, get gender information of a word for formulating a correct sentence, develop a wide vocabulary which can aid in creative writing. Since the tool will also have the corresponding English word/synset it can be very useful in doing simple translation of text. The user can take the help of this tool in identifying parts of speech (POS) of words and learn the usage of words through the example sentences. This can be of great assistance in cases of idioms, *etc*. All this will be made available to the learners and teachers for their use through this tool. Thus, using Hindi wordnet has created a huge difference in language learning.

5 Process, Experiences and Lessons Learnt

As a part of the effort to align the project with the school education in India, the following key activities have been performed. The process, experiences and lessons learnt have been recorded here:

5.1 Word collection

In the word collection activity, the words from Hindi textbooks by NCERT[4] have been collected as these books are followed by majority of schools across the country and also in some schools in other countries. Therefore it has maximum number of students studying the same textbooks, thus improving the scope of tool's coverage. In this process, the words which are not available in Hindi wordnet, but are present in textbooks, are collected and added in tool's database. Simultaneously, these words are added to Hindi wordnet, thus expanding the Hindi Wordnet vocabulary. Some types and examples of collected words are:

- **Proper Nouns:** Words like name of persons, places, *etc*. are proper nouns. For *e.g.*, name of a person: नागार्जुन (*naagaarjuna*) and name of a place: हिमाचल प्रदेश (*himaachala pradesha*).

- **Rhyming words:** In poetry, many rhyming words are used to make them interesting and fun to sing for kids. All such words do not necessarily have a proper meaning. For *e.g.*, गमगम गमगम (*gamagama gamagama*, runs).

- **English words:** Some English words included into Hindi vocabulary. For *e.g.*, लेमन (*lemana*, lemon).

- **Idioms and Proverbs:** Some idioms and proverbs are also collected. For *e.g.*, मुँह में पानी भर आना (*muħa meM paanii bhara aanaa*, mouth watering).

- **Name of the Games:** Some common game names not present in the Hindi wordnet, are also added. For *e.g.*, पकड़म–पकड़ाई (*pakaDama-pakaDaaaii*, catch-catch or catching-catch - a popular game among kids).

- **Object:** Some lesser known objects were also found in the text-books are also collected. For

e.g., रामानंदी चंदन (*raamaanaMdii chaMdana*, a kind of Sandal).

- **Lesser known Indigenous words:** Words from the text-books which are native to the land, and do not belong to any particular language. For *e.g.*, पछाई - (*paChaaii*, a breed of domestic animals).

- **Productive words:** Words which can be produced by adding a suffix or prefix to generate a list of words which carry a similar sense are called productive words. So far such words have not been added to the Hindi wordnet. However, in *Digital Aid*, productive words have been added separately (as an appendix) for a better coverage w.r.t. the textbooks. For *e.g.*, 'नुमा' (*numaa*) as a suffix means "like a". It can be used to form a productive word as बेलननुमा (*belananumaa*, like a roller).

5.2 Gloss simplification

To make the Hindi wordnet a suitable digital aid catering to various levels of learners, it was apparent that the gloss of many synsets in the Hindi Wordnet was somewhat complex for the understanding of a language learner at a beginner stage. For the ease of the target user base, the "gloss simplification" subtask have been formulated. Gloss simplification activity was carried out by the lexicographers. An example of gloss simplification is as follows. For a word हिम्मत (*himmat*, courage), the original Hindi wordnet gloss is:
मन की वह दृढ़ता जो कोई बड़ा काम करने में प्रवृत्त करती है या जिसके कारण हम निडर होकर किसी खतरे आदि का सामना करते हैं (*mana kii vaha dRiDhataa jo koii baDaaa kaama karane meM pravRitta karatii hai yaa jisake kaaraNa hama niDara hokara kisii khatare aadi kaa saamanaa karate haiM*, that perseverance of mind which motivates us to do some great work, or because of which we face fear and danger)

Such a gloss, being too elaborate and difficult to follow at the beginner's level, has been simplified to: मन की ताकत (*mana kii taakata*, strength of mind).

A case which posed a challenge in the gloss simplification was the word रंग (*raMga*, colour), for which the Hindi Wordnet gloss is: किसी वस्तु आदि का वह गुण जिसका ज्ञान केवल आँखों द्वारा होता है (*kisii vastu aadi kaa vaha guNa jisakaa GYaana kevala aaKhoM dvaaraa hotaa hai*, That attribute of an object, etc., which is perceived only through eyes).

Now, रंग (*raMga*, colour) is such an everyday word that it was quite tough to find an easy-to-understand definition for it, hence its English translation (कलर / colour) has been provided. The English word is highly in use in the daily language and also occurs frequently in written form too, so it could be readily added to the Hindi wordnet data, thus solving the issue of all such words.

5.3 Picture depiction

As rightly mentioned in a famous idiom 'a picture is worth a thousand words', a complex concept can be easily explained by a picture or an illustration. Kanojia et al. (2016) tried to automatically collect images for IndoWordNet[5], but due to the lack of tagged images openly available for use, enough images could not be collected. In Hindi Wordnet, there are several concepts which are hard to explain using the gloss. For example, the concept of a word 'milk' in Hindi is explained as वह सफेद तरल पदार्थ जो स्तनपायी जीवों की मादा के स्तनों से निकलता है (*vaha sapheda tarala padaartha jo stanapaayii jiivoM kii maadaa ke stanoM se nikalataa hai*, a white nutritious liquid secreted by mammals and used as food by human beings).

This gloss seems to be difficult for level 1 and 2 learners to understand due to the presence of some difficult words, which would require definitions in turn. However, as shown in figure 2 below, this can be easily understood with the help of a picture. Hence, pictures and illustrations have been used to depict a concept. Also, pictures help in differentiating the fine grained senses found in Wordnet.

Figure 2: Picture depicting the concept of a word दूध (*duudha*, milk)

In the process of picture depiction, most of

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[5] http://www.cfilt.iitb.ac.in/indowordnet/

the concepts are grouped together and illustrated so that they can be reused for similar concepts with minor changes. Also, antonyms, hypernyms-hyponyms, meronyms-holonyms were illustrated together. At the initial phase, Level 1 and level 2 concepts are illustrated so that their users, being beginners, can easily understand a given concept using an illustration. This will be followed by illustrations of higher level concepts.

5.4 Grammatical feature marking

At each levels of *Digital Aid*, the grammatical features of a given word is rendered. These features are marked by the lexicographers during the process of gloss simplification for level 1 & 2. From level 3 onwards, the feature marking is carried out during word collection process as gloss is not simplified for higher levels. During the process, each word is marked with the grammatical properties corresponding to its POS category. Some of the grammatical features are as follows:

Nouns are either countable or uncountable. They can belong to any of these categories: Proper Noun, Abstract Noun, Common Noun, Collective Noun. When a noun is a compound, it may belong to one of these categories: तत्पुरुष (*tatpuruSha*), कर्मधारय (*karmadhaaraya*), द्विगु (*dvigu*), अव्ययीभाव *avyayiibhaava*), द्वंद्व (*dvaMdva*), or बहुव्रीही (*bahu-vriihii*) (Redkar et al., 2016).

The Verbs are either Transitive or Intransitive. The different types of verbs are: Simple verb, Conjunct verb, and Compound Verb. These verbs may also be Causative verb. Kinds of Adverbs that feature in this tool are of Manner, Place, Time and Quantity. Similarly, the Adjectives are categorized as Qualitative, Numeral, Quantitative, Pronominal.

5.5 Audio pronunciation

Cognitive theories of multimedia learning (Mayer, 2002) indicate that audio cues are effective aids in a learning scenario, and also help in retaining the material learned (Bajaj et al., 2015). To help in more effective learning, we intend to include audio pronunciations for all the words across the five levels in *Digital Aid* described in Section 4.3. Manually recording pronunciations for all the words is a tedious task. These recording efforts could be minimized by using text-to-speech (TTS) systems to automatically synthesise speech for most of the words. However, one cannot be sure about the quality of these synthesised clips. We built multiple TTS systems and systematically analyzed the

quality of the resulting synthesised clips, with the help of lexicographers.

We use the data provided by the IndicTTS[6] (Prakash et al., 2014) forum to create a TTS synthesis system which generates speech audio for a given word; we will refer to this system as **Model 1**. We use the voices *Hindi - Female* and *Marathi - Female* provided by FestVox[7] (Black and Lenzo, 2000) and Festival Framework[8] (Black and Taylor, 1997) for Hindi Speech Synthesis and name these systems **Model 2** and **Model 3**, respectively. We also use the tool[9] available on the IndicTTS forum website to generate a final set of audio samples and refer to it as **Model 4**. (**Model 1** was trained using the IndicTTS data while **Model 4** is a pretrained model hosted at the forum website mentioned above.)

We synthesised audio for the words corresponding to "Levels 1 and 2" using all four above-mentioned TTS systems. We chose a random sampling of 535 words and generated synthesised outputs from all four models; these outputs were presented to two lexicographers for further analysis. The lexicographers were asked to independently rate the audio clips on the following scale:

- **unusable (#0):** This rating corresponds to audio clips which are either completely distorted, or too noisy for the user to comprehend.

- **usable (#1):** This rating corresponds to audio clips which are moderately usable and suggests that the user can comprehend the underlying words, but can be synthesized better.

- **good (#2):** This rating corresponds to audio clips that are really good and clearly convey the words.

For each of the 535 words, the lexicographers were also asked to mark which of the four synthesised clips they liked the most.

The evaluation results are shown in Table 1. This clearly shows that **Model 1** was marked as the most liked audio clip most often, while **Model 4** performed the best in terms of producing the most number of usable audio clips (obtained by summing clips with ratings #1 and #2).

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[6] https://www.iitm.ac.in/donlab/tts/
[7] http://www.festvox.org/index.html
[8] http://www.cstr.ed.ac.uk/projects/festival/
[9] https://www.iitm.ac.in/donlab/tts/demo.php

	#0	#1	#2	#1+#2	Most Liked
Model 1	79	55	99	154	**101**
Model 2	37	78	112	190	90
Model 3	72	86	58	144	51
Model 4	**55**	**117**	**107**	**224**	70

Table 1: Results of manual evaluation of synthesized speech clips. The values indicate the number of times (*i.e.*, count) an audio from a particular model was rated as per the scale described.

A qualitative analysis of the synthesized clips highlighted the following issues, particularly with respect to the clips that were marked "unusable": i) Flap or tap sounds ('ड़' *Da*, 'ढ़' *Dha*) were pronounced incorrectly, ii) Intonation of the audio for heavy syllables was at times incorrectly rendered and for words such as 'एकदम' (*ekadama*), the pronunciation had a specific stress pattern which should have ideally been neutral, thus making it sound unnatural, iii) There were also a few examples of unnecessary lengthening of a vowel. For example, in बीमारी (*biimaarii*), there was unnecessary stress on 'बी' (*bii*) and hence it was lengthened, iv) Incorrect syllable breaks were observed in some words. For example, नापसंद (*naapasand*, non-favourite), was pronounced as नाप−संद (*naapa-saMda*), which is incorrect, v) It was also noted that sometimes consonant clusters were mispronounced. E.g. कुत्ता - (*kuttaa*) - dog, was incorrectly pronounced as कु−ता (*ku-taa*) or कुत−ता (*kuta-taa*).

6 Field Test and User Feedback

The prototype of the *Digital Aid* was initially demonstrated in three local schools. Two schools were following the CBSE board curriculum where students were learning Hindi as primary language from class 1 onwards. The other school was following the curriculum of the state board[10] where students from class 5 were learning Hindi for the first time as a second language. The feedback was sought from primary language learners as well as second language learners for content, ease of handling the application, classroom impact and overall experience by teachers and students. It was observed that the digital aid helped teachers in explaining concepts clearly with the help of images and simplified concepts even for primary language learner. It was also noticed that class 5 students

from the state board easily understood the concepts though they were learning Hindi for the first time. The aid assisted teachers in better classroom management, especially with the help of illustrations and reduced effort of reiterating the concepts for better retention and having the standardized pronunciation by native Hindi speakers. The application has been improved based on the feedback received. Some of the suggested changes were *viz.,* include spelling variations, give additional grammatical features, provide English word, *etc.* Accordingly, the suggested changes were implemented. The presented *Digital Aid* is now ready for the next round of field trials.

7 Conclusion and Future Work

The paper presents how a lexically rich resource like Hindi WordNet is suitably modified and enhanced for developing a digital aid for language teaching and learning. The *Digital Aid* presented here is a multi-modal multi-layered Hindi language learning aid which can be used for formal and informal learning environments such as schools and non-government organizations involved in education. While developing this digital aid, the process followed, the experiences earned, the challenges faced and the lessons learnt are recorded in this paper. The *Digital Aid* has been tested successfully during field trials and the work has been appreciated by teachers and students. With the help of this aid a better understanding and retention of concepts has been achieved, which is helped in a large way by illustrations and clear pronunciations. This has led to better classroom management and increased interest in leaning.

In future, *Digital Aid* can be expanded to the other Indian languages. Gamification and evaluation techniques will be incorporated.

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[10]https://mahahsscboard.maharashtra.gov.in

[11]http://www.cfilt.iitb.ac.in

[12]http://www.tatacentre.iitb.ac.in/digital_aid.php

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