Exploring Prompted Self-Explanation in the Context of Second Language Acquisition in Vocational Settings

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Abstract: In the Global South, English-language fluency is strongly associated with earnings. This in particular impacts young adults in low-income settings looking to start work in urban areas without past access to high-quality English language education. In this work, we explore prompted self-explanation as a potential tool for assessing student efficacy in English grammar concepts with students undergoing a vocational training program. Using in-depth analysis of video recordings of students explaining concepts in English as a Second Language (ESL), we find that self-explanation (1) correlates with overall ESL assessment scores, and (2) assists learners identify and correct errors.

Introduction

Throughout much of the world, especially in parts of the Global South, English-language proficiency is seen as an aspiration and opportunity to achieve higher socio-economic status (Karusala et al. (2018)). It is often considered as linguistic currency (Niño-Murcia (2003)) and in fact, previous studies have shown that English is strongly linked to earnings (Azam et al. (2013)). In India, there is linguistic diversity in terms of number of languages spoken (Sonntag (2016)) and there is an ambition among the youth to learn English. Young adults from underprivileged communities face learning poverty and miss out on quality English education. The increase in gig economy work available in urban centres has been a further push for English language acquisition, since most of these jobs require basic ability to navigate written English and conduct telephone conversations. English acquisition helps them in their prospective jobs in the gig-economy.

Summative assessments are often used to assess English skills that involve a benchmark or standard comparison. For example, the descriptors in the standard CEFR (Common European Framework of Reference for Languages) can be extended to a different demographic (Alderson (2007)). To do so, it is necessary to make it culturally relevant and understand the learning needs of the student. In this work, we explore the use of self-explanation by students who have limited educational background in order to uncover some insights on learning of English as a Second Language (ESL).

Self-explanation is an engaging learning method that has demonstrated its usefulness in other fields, consisting of students illustrating knowledge of learning materials by themselves. Prior works (Chi et al. (1989, 1994); Chi (1996, 2000); Bielaczyc et al. (1995)) have explored the effects of self-explanation on learning across various domains like computer programming, math, and science. However, the participants in all these prior studies are mainly students from conventional schools and universities. More importantly, in majority of the studies, the language of self-explanation is English.

For this study, we conducted research partnering with a non-profit organisation that offers short-term vocational skill-development programs. In addition to training the students for the skills necessary for the specific job, the organization also trains all its students in certain basic concepts in English. In our study, we worked with 16 students undergoing training to become *delivery service agents*. We asked each of the 16 students to self-explain one of the concepts in English as a Second Language (ESL).

Our analysis of the self-explanations show that 1) high self-explainers spent more time explaining the concept, whereas low self-explainers spent more time on simpler tasks like writing on the white board, 2) the ability of a student to explain a concept (measured as the number of self-explanation inferences (Roy (2005))) correlates with the overall language abilities of students (determined through an assessment conducted by the training organization), 3) in certain instances, students self-corrected their mental models after they identified errors in some of their previous explanations, and 4) students use of translation and transliteration to their regional language to explain certain English concepts.

While we were planning a larger-scale follow-up study, our study was interrupted due to the recent COVID-19 pandemic. Regardless, based on a strong correlation between self-explanation abilities, time spent self-explanation and overall language skills, we believe that self-explanation technique can be a scalable approach for deeper evaluation of students' learning process.

Related work

Prompted self-explanation

Original work by Chi et al. (1989) observed self-explanations in Physics worked out examples, where students were part of college degree programs with varying majors. There is a distinct comparison between "Good" and "Poor" students and its correlation with self-explanation inferences. "Good" students generate a higher number of inferences as they learn with a more in-depth understanding, and they also closely monitor their comprehension, whereas, "Poor" students do not generate a sufficient number of self-explanations. The "Good" and "Poor" classifications were based on post-hoc analysis of student's problem-solving skills and self-explaining skills. Another evaluation by Chi et al. (1994), in a different context, with high school students where prompted self-explanation was examined as a learning tool by conducting pre- and post-tests. The results show prompted students had higher learning gains. The authors captured the initial and final mental model of each student for the functional assessment of the student's conceptual learning. Their mental model analysis shows that low-explainers did not achieve correct mental model of the topics assigned. Our study focuses on the evaluation of self-learning abilities rather than on a design where self-learning is a learning strategy. The demographic in Chi studies is comprised of undergraduate or high school students, while our studies are young adults who do not have quality education.

More work has also shown what typical sorts of errors and misconceptions can result in self-explanation settings (Chi (1996, 2000)). A tutor is involved who prompt students appropriately so that they identify and correct the errors resulting in learning gains. They capture incorrect prior knowledge via mental model analyses. The findings shows that a significant number of students repair their wrong mental models after self-explanation (deLeeuw and Chi (2003)). In this study, we videotape the process of self-explanation which is later transcribed and annotated for analysis. While we do not analyse mental models in this work, even in this context, we observe that students self-correct incorrect explanations.

Prompted self-explanation for learning English as a Second Language

Previous work pertaining to technology in ESL acquisition (Wylie et al. (2009, 2010a, 2011, 2010b)) explore self-explanation for learning English grammar. They work with adult ESL students who are enrolled in university programmes. They exploit self-explanation through the Intelligent Tutoring System (ITS) (Corbett et al. (1997)), which prompts learners to explore different modes of self-explanation i.e. free-response and menu based self-explanation. In free-response based self-explanation, the students were prompted to verbally explain whereas in menu-based self-explanation, the students select a relevant rule or explanation from a given list. Initial studies (Wylie et al. (2009)) show that ITS did not lead to better learning outcomes. Another study within the domain of the English article (Wylie et al. (2010b)) adds features to the system of ITS where students explore two different conditions 1) where students choose the correct article to complete sentence 2) students choose the proper rules or features that best explain the article highlighted in a predefined sentence. Results indicate that both conditions show significant learning gains for students.

In our study, we explore the domain of various topics in English language learning namely *Interrogative Words (why, what etc)*, *Subjective Pronouns (I, you, they, she)*, *Singular-Plurals*, *Subject-Verb-Object (splitting a sentence into its components)* and these were the concepts students learn in their vocational training program. The demographics in these studies are mainly students enrolled in university but are non-native English speakers.

Methodology and settings

Vocational training center

This experiment was part of a larger study in which we tried to understand the role of technology in English language acquisition. We placed greater emphasis on demographics of students from low-resource communities who are in the search for labour employment. Our goal was to conduct in-situ research, thus we partnered with non-profit organization whose mandate was to increase work opportunities for India's underprivileged youth. They achieve this through a residential training center where they have vocational courses for jobs including *electrician, delivery agent, beautician, call-center agent*, and similar job-roles depending on partnerships with industries seeking this kind of labour. The students in these courses are mostly drawn from rural parts of Karnataka. The students are promised job opportunities and provided livelihood support until the end of the program, which serve as motivators for them to move to Bengaluru.

The students are taught in a classroom setting and undergo training for about a month. They also study financial and digital literacy in addition to their skill-specific training. Training modules are tailored to the cultural

needs of students. The students are involved in these concepts in a classroom-based environment where the trainer mainly uses Kannada as an instruction medium. Students take part in various collaborative learning activities in the ESL classes and record their learning in their notebooks.

This training set-up and the learning environment were in line with our research criteria. We further engaged with the supporting organisation for conducting the studies (which was authorised by the IRB). We picked participants who were undergoing training for the role of *delivery services agent*. At the time of the study, the students nearly completed training requirements and were about to graduate from the course.

Participants

In this sample, we interact with 16 students who are young adults of similar educational backgrounds (up to 12th grade). As almost all delivery service agents are typically men, there were no women in our study. The students learn ESL as part of the program. The administration of vocational training filters students based on their education level required for the corresponding courses. This made it easier for us to select all the students enrolled in the program without further investigation of the demographic background.

Table 1 lists the demographics of the students who took part in this study. All our participants were in the age group of 18-25 years. A majority of them are educated up to Grade 10. Kannada is the first language for 14 out of the 16 students.

Table 1. Demographic information of the participants, topic chosen, number of self-explanation inferences and overall ESL scores

ID	Age	Education	First language	Topic chosen	Number of inferences	Overall score
1	18	Grade 10	Kannada	Alphabets	2	0.21
2	19	Grade 8	Kannada	Alphabets	5	0.37
3	21	Grade 10	Kannada	Plurals	7	0.46
4	20	Grade 12	Kannada	Subjective Pronouns	10	0.54
5	21	Grade 10	Kannada	Plurals	11	0.62
6	22	Grade 9	Kannada	Alphabets	14	0.23
7	18	Grade 7	Kannada	Subjective Pronouns	15	0.37
8	22	Grade 10	Kannada	Describing people	18	0.46
9	24	Grade 12	Telugu	Interrogative Words	23	0.62
10	19	Grade 12	Kannada	Interrogative Words	25	0.69
11	18	Grade 10	Urdu	Interrogative Words	33	0.77
12	23	Grade 10	Kannada	Alphabets	37	0.54
13	24	Grade 10	Kannada	Reversal	38	0.69
14	21	Grade 7	Kannada	Subjective Pronouns	45	0.44
15	19	Grade 10	Kannada	Interrogative Words	54	0.83
16	23	Grade 12	Kannada	Subjective Pronouns	58	0.83

Procedure

The research was carried out at the training centre premises. All the students were interviewed, and in addition to the interviews, they were briefed about the project. The principal researcher had been an observer at the institution for several weeks prior to the core study period. The learners took part in self-explanation based engagement at the same premises. Each student in the learning cohort participates individually in this study.

Figure 1 shows a student self-explaining as part of the study. The set up then is the participant alone in a room with a camera. Once they pick the topic they plan to discuss and decide to start, the researcher leaves the room and allows the participation to continue the recording while they are by themselves.

Few students had difficulty in choosing a topic, in such cases, they were prompted to self-explain the *English alphabet*. Table 1 shows the topic explained by each student.

Figure 1. Self-explanation by a student

Codifying self-explanations

We transcribed the video-recorded self-explanations and translated them to English. The transcriptions serve as codified forms of self-explanations. Any utterance having enough context is considered as a self-explanation inference. We do not consider non-verbal actions such as writing on whiteboard. However, some students elicit explanations along with the writing and it qualifies to be an inference. We also exclude insignificant utterances such as murmuring, which is common in the think-aloud process. For example, we see the following act of self-explanation by *Student 13* (Phrases highlighted in grey were spoken in Kannada and translated to English).

Student 13:	In this example of “I am coming” [Not an inference]
Student 13:	“I am coming” means “Can I come?” [Inference]
Student 13:	(Pointing to the pronoun ‘You’ on whiteboard) “You are going” would mean “You are going” [Inference]

In the above case, we see that the first line is just the individual clarifying something to themselves, rather than making a point of learners' understanding. However, there are specific explanations for the next two lines. As a result, of the three lines above, we count the last two as inferences.

Using this data, we count the number of inferences that are made in the progression of a learning dialogue by each student. In the process of self-explain, the individuals typically do three things – they provide explanations, they offer rote conceptual repetition, and they provide examples. In our study, we code each instance separately. We present our analyses of self-explanation ability, its association with the overall ESL scores and time spent on different activities.

Since we were dealing with an unique demographic, we mainly explored self-explanation as “in the wild” method. We were interested in empirical analysis of self-explanations and one of our inherent goals were to test if students could “self-explain” or not. Therefore, there was no pre-hoc assessment on the concepts that they self-explained. However, we examine their reading, speaking and listening abilities as per CEFR standards (Common European Framework of Reference for Languages) (North (2005)). There was one reading assessment done by the primary author as part of a larger study. The organisation tested their reading, speaking, and listening skills. We later obtained these scores for analyses. We combined these scores into a single overall ESL score. Table 1 shows the overall ESL score for each student.

Findings

Figure 2 shows the breakdown of time spent in different activities of self-explanation for each student. The x-axis is sorted in the ascending order of number of self-explanation inferences made by the student. As the figure shows, almost all students use the whiteboard to write down rote information or preparing text. However, low-explainers

sometimes spend more time in this activity and less time on explaining concepts and examples. High explainers, on the other hand, spend more time on explaining examples and this also results in higher number of inferences.

Figure 2. Time-wise breakdown of various activities during self-explanation

We analysed the correlation between the time spent on different activities, *fraction* of time spent on different activities and the number of self-explanation inferences. Our results show that both time spent explain examples and total time spent speaking (explaining concepts and examples) have a strong correlation with the number of self-explanation inferences – 0.79 and 0.84, respectively. Figure 3 shows a scatter plot with total time spent speaking on the x-axis and the number of inferences on the y-axis.

Figure 3. Correlation between number of self-explanation inferences and total time spent speaking

These results suggest that the amount of time a student spends in speaking serves as a good metric for how well they have understood the specific concept. As we can design simple ML models to automatically measure this time from an audio file, we believe such a self-explanation exercise can be a scalable mechanism to identify concepts and students that can benefit from further attention from the trainers.

Self-explanation and overall ESL scores

Figure 4 shows the scatter plot with Overall ESL score of a student on the x-axis and the number of self-explanation inferences on the y-axis. There is a strong correlation (0.72) between these two metrics. This result shows that a student's ability to self-explain a language concept is a good measure of how well they have understood that concept and their overall abilities in that language.

To present some empirical observations, we look at the topic *Subjective Pronouns* which is self-explained by *Student 4* (Low-explainer) and *Student 16* (High-explainer). *Student 4* states the instances of *Subjective Pronouns*, translates them and provides examples but does not engage further in explaining them. There is rote information put out without any elaboration of the concept. In contrast, *Student 16* has enhanced recall of details and does not miss out on trivial but useful information. This student explains the usage, provides multiple examples and translates them to Kannada.

Figure 4. Correlation between total number of inferences and overall ESL scores

Incorrect self-explanations and repairing

Incorrect self-explanations have been studied by Chi et al. (1994). The previous studies also demonstrated the repairing process of these errors. In this study, we notice similar observations where students amend their incorrect self-explanations. We find following patterns with errors during self-explanation:

- Frequent spelling and grammar errors
- Instances of translation errors where students get the meaning of vocabulary wrong.

Interestingly, the high-explainers, even though their overall ESL scores are relatively higher make incorrect self-explanations. One possible reason for this is that their English fluency is sub-standard. Their actual grades on CEFR scales would be around B2. We also notice that corrections add to a greater number of explanations. The students would identify the errors immediately or some students would identify their error because of cross-referencing of the explanations.

Students could correct themselves in the process of self-explanation by realising the error, thus repairing their mental model of the ESL concept. Here we describe one such case. This student who chose *Subjective Pronouns* as the topic makes a translation error and realises the error after about 10 inferences later. (The phrases highlighted in grey were spoken in Kannada and translated to English.)

- Student 16: Now, the pronoun “They”
- Student 16: “They” translates to “We” (*Student makes translation error*)
- Student 16: *Writes on the whiteboard and enunciates:* They are my best friends. They are playing cricket. They are going to Mysore Palace.
- Student 16: Here, “they” means “we” (*Translation error*)
- Student 16: So, how do we use the word “They” in framing a sentence?
- Student 16: The meaning of ‘They are my best friends’ is...
- Student 16: (*Mumbling*)
- Student 16: ‘We are best friends’ (*Translation error*)
- Student 16: ‘They are playing cricket’ means that ‘We are playing cricket’ (*Translation error*)
- Student 16: ‘They are going to Mysore palace’ would mean that ‘We are going to Mysore Palace’ (*Translation error*)

(a) Student makes a translation error

(b) Student identifies and corrects the error

Figure 5. Whiteboard snapshots of Student 16 correcting a previous error

The student makes consistent translation error at almost every instance, especially when trying to explain the examples. As the student moves on to explain the pronoun “We”, he realises there has been using the wrong translation. At this point, he identifies the error and attempts to self-correct.

In the following transcript, we see how the student identifies the error and corrects them. Figure 5 shows how the student makes these corrections via text presentations on the whiteboard.

- Student 16: Now, the pronoun “We” (*Moving on to explain the next pronoun which happens to ‘We’*)
- Student 16: (*Realises the translation error made previously and corrects this on the white-board by changing the translation of pronoun “They”*)
- Student 16: We means “We”

Discussion and conclusion

Compared to other studies, our research concentrates on underprivileged youth. However, our findings are consistent with previous work in certain aspects, such as the number of inferences produced and its correlation with the grades of students. Our analysis shows that high-explainers spend more time on examples, and their ESL scores are strongly correlated with the number of inferences they generate.

One of the drawbacks of the design of learning materials or technologies is that potential learners might not be able to express their learning difficulties and, this technique may allow us to gain more insights into the student’s approaches to learning. The self-explanation method might be useful when summative assessments do not give us enough accurate reflection of learning. It can reveal insights regardless of the student’s experience and skills. Our findings make a good case to show that self-explanation can be explored as an evaluation methodology. We may also use other qualitative approaches to supplement the results and broaden our understanding of student’s mental models.

For example, this work shows that low-explainers spend a greater fraction of their time writing rote knowledge. Our next series of studies will look at why students use their time in these activities. This can be achieved by conducting post-hoc interviews. Future studies can look at the concrete behaviours seen on students during self-explanation and then qualitatively analyse these behaviours.

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