

IT Skills Training through Spoken Tutorials for Education and Employment: Reaching the Unreached*

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Abstract

Spoken Tutorial is a project funded by the National Mission on Education through ICT, MHRD, Government of India, to promote IT literacy for education and employment. Ten minute long spoken tutorials (ST) are created for self learning, dubbed into all Indian languages and can be used offline. Both ST and the software trained by them are available free of cost to everyone. Spoken Tutorials are available free of cost to everyone in a large variety of subjects. Any one can create ST, learn by themselves using ST, and also conduct ST based training programmes. About 20,000 college labs use ST in their official curriculum. A total of 26 lakh students and college teachers have been trained using this methodology during the past five years. Acceptance of Spoken Tutorials is growing exponentially, with 16 lakh trainees in 2016 alone. Setting a target of 10% college student population in every state and insistence on the enrollment of every student in a college are the reasons for such large numbers.

The cost to provide an IT training through this project is less than Rs. 50 per person, with a potential for further reduction by orders of magnitude. With more than 6,000 spoken tutorials, this is the largest IT training programme in Indian languages. This valuable resource is available for other countries, who can dub the ST in their languages and train their students. The ST approach can be extended to other skills training also.

This is a corrected version of the article that appeared as [1]. In addition, all the links mentioned in this report work correctly.

The latest updated figures are:

- 900+ original (English) Spoken Tutorials are now available in spoken-tutorial.org
- A total of about 9,000 Spoken Tutorials are available, including dubbing
- A total of 4.5 million students have been trained, 1.5 million of them study arts/science/commerce
- 36,000 college lab courses have used Spoken Tutorials officially
- 10 Universities have announced the use of Spoken Tutorials as MOOCs for their lab courses
- We are now extending this approach to training on other skills, such as nutrition in general, and breast-feeding in particular

*A soft copy of this report is available at <http://spoken-tutorial.org/media/CEC.pdf>

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1 Introduction

The Spoken Tutorial (ST) project was started at IIT Bombay in the year 2009 with funding from the National Mission on Education through ICT (NMEICT), MHRD, Government of India. ST is an audio video tutorial developed using the screencast methodology and it is approximately of ten minute duration [2, 3, 4]. The main objective of this project is to improve the employment potential of our college students in the Digital India. The urgent need of providing employment to our children are well known [5, 6].

We begin with an explanation of the chosen nomenclature, ST: When this work started, there were a large number of silent screencast tutorials on the Internet. To distinguish ours from these, we used the word spoken. As we do not capture the face of the person creating the tutorials, it is strictly not a video tutorial. This word is even more important, as we dub the spoken part into all Indian languages. Owing to the fact that one can use ST to learn a topic, we call it a tutorial.

An ST is a 10 minute long audio-video tutorial, created through the screencast technology. It is created by recording a session, along with a running commentary, obtained by reading out a script that passes a novice check. The spoken part of ST is dubbed into all 22 languages in the VIII schedule of our constitution and has the potential to be dubbed into languages of other countries. It can be used in offline mode and hence useful to those who do not have access to Internet. Using ST, we have trained more than 25,00,000 students and teachers on various IT topics during the past five years. This large number is attributable to the design decisions that went into the creation of this approach. This methodology is also shown to be effective, as it raises the self confidence of its users [7].

We explain in detail how the ST method has evolved keeping beginners and less endowed people in mind. This article is organised as follows: In section 2, we explain how the creation process helps reach the unreached. The next section explains the learning process of a beginner using ST. The fourth section explains the offline and other support available to learners of ST. Section 5 is devoted to the strategies we followed to spread ST based training in a uniform way, to benefit everyone. Section 6 explains the current status, testimonials we received, etc. The last section is devoted to conclusions.

2 ST creation policies

2.1 Free software, tutorials, workshops

We have restricted our focus to Free and Open Source Software (FOSS). There are many reasons for this, over and above our own personal conviction. The funding agency of the ST project [8] mandated the use of FOSS. Use of FOSS is also the policy of the Government of India [9]. Use of FOSS helps in the quality of learning itself, see Sec. 2.3. Use of FOSS allows every student to use the software, even after the

training is completed. For the capital starved, but human resource rich countries like India, use of FOSS makes the best strategic decision. Finally, this decision synergises with our sister project FOSSEE that promotes FOSS [10].

Thanks to the funding of this project by the National Mission on Education through ICT, ST are made available free of cost to everyone. As a matter of fact, ST are available under the Creative Commons Attribution Share-Alike (CC-BY-SA) license: one may modify them and also use them for commercial purposes. The Share Alike clause ensures that in case there are improvements, they shall also be released under the same license. Thus, this license has the potential to result in manifold benefits to the public. The main objective of choosing this license is to ensure that the ST content, created by tax payers' money, gets used by many.

We have conducted a large number of workshops using ST, all of them, for free. In case there is any fee, however small it is, most managements of colleges think twice about conducting a training. One main reason is that in most colleges in India, where the Academic Heads are often different from the Financial Heads, the former finds it a hassle to get financial clearances to conduct training, however inexpensive it may be. Offering free training has resulted in a large number of workshops.

2.2 Novice check of script, for self learning

ST is not created extempore, but using a carefully created script, just as a movie is based on a script. We require a script be written before creating a tutorial as it gives many advantages to the beginner: If a section of the tutorial has to be improved, one can rewrite the script and record it. On the basis of a script, a novice can decide whether they can reproduce all the described actions. It is possible to stream this script as subtitles when a tutorial is played back, helping students weak in English, as well as the hearing impaired. It is also useful to search for key terms. If timing of the script is available, one may quickly locate the required part of a video during the recall stage, thereby addressing one of the shortcomings of Screencasts [11]. Finally, it makes translation and dubbing easy, as explained in Sec. 2.5.

When the author appreciated the fact that there were more than 1,000 members in a web and coding club at IIT Bombay, he got the answer that most of them were beginners and the experts were finding it difficult to answer the questions of the former. We decided to make our project a friendly interface between beginners and experts through Novice Check: it is a check of a script carried out by a beginner to verify whether they can reproduce every step of the tutorial. If a script passes a novice check, it is permitted to be recorded, else, it is sent for improvement. In addition to making it beginner friendly, a novice check makes ST suitable for self learning too.

We illustrate this with a bash script that the author reviewed as a novice. The script asked the learner

to download a bash file to the current directory and to type the name of the file on the console to execute it. On following the above instruction, the following error message appeared: Command not found. The script writer forgot to state that there should be a ./ (dot-slash) before the file name, as the current directory is not in the path of the beginner. After correcting this mistake, the same error message appeared. The reason for this is that this file is not executable. The script writer missed the following statement: The downloaded file should be made executable by the chmod command.

Normally, such obvious questions are not at all tolerated by most experts. In our process, unless it is rectified to explicitly state every step to be followed, the script is not even considered for recording. This requires the expert to understand the difficulties of a novice and to address them, making the latter an important player in the creation of an ST.

Because of the detailed and laborious explanation of every step in every ST, we were worried that the STs would end up boring. Fortunately, the user feedback is positive: When asked to rate how interesting the STs were, 25,076 participants reported as in Table 1.

Table 1: Feedback of 25,076 trainees of ST, who participated in a survey reported by [3]. Number of people who found ST interesting or boring. Although novice check made the tutorials slow, not many find it boring.

Response	Number
Extremely boring	182
Boring	440
Neutral	4,241
Interesting	12,073
Extremely Interesting	8,140

This is possibly because most of the people who undergo our workshops are beginners, who do not find the slow speed boring. The same respondents gave extremely high ratings of the ST methodology, details of which are presented in [3].

A novice who successfully reviews a script would understand how to execute the commands explained therein. As we give an honorarium to do a novice check, ST must be one of the few projects that pay beginners to learn. Our project gives respectability to a novice.

2.3 Pedagogy for self learning of beginners

Most students in India do not get a chance to study in good colleges, as the number of such colleges is small. As a result, most of them do not have good teachers. We need to ensure that there is an effective pedagogy, without which, learning through ST may not be effective, even if created for self-learning. We now explain different steps we took in this project towards this end. As a script is a prerequisite in the creation process (see Sec. 2.2), we begin with conditions that we impose on it:

1. All sentences in the script should be simple and short to be understandable to the novice, and to

those who are weak in English. We recommend that most sentences are less than 60 characters long. We insist that no sentence exceeds 80 characters. We refer to this as the 60/80 rule. By restricting the length of sentences, we enforce simple sentence constructs and sentences of shorter duration. Shorter sentences reduce the temporal contiguity effect, thereby improving the learning process [12]. Another benefit of this restriction is explained in Sec. 2.5.

2. We have a requirement that unless an activity is described earlier in the tutorial or in one of the prerequisite tutorials, it should be stated explicitly. For example, before a button is pressed, we recommend a script of the following type: Click the button in the bottom right, circular in shape and blue in colour. In addition to explaining well, this statement allows more time for a beginner to locate the focus area easily. To ensure that this does not become boring, we require that such a detailed instruction appears only once.
3. We also encourage the explanation of every activity in detail. For example, we have a rule that the following type of script be avoided: Go there, click this, etc.. Instead, it should be explained as in the following statement: Go to top left hand corner, click File and then Menu.
4. Checking the Mouse or hitting the Enter key has to be stated explicitly, as novice users often get stuck on these. Moreover, these do not take much time to state: Click the Mouse or hit Enter.
5. Menu items should be stated exactly as they appear in the screen. For example, if the software has File browse as a menu item, the script should not address it as File view. Although these two have the same meaning, it will slow down the user.
6. Active voice should be used in preference to passive voice.
7. Direct order of actions should be used. For example, one should not say the following reverse order of actions: Let us select file from the media option in the main menu. Direct order also makes sentences shorter.
8. In addition to giving examples to illustrate an idea, we also encourage the inclusion of common mistakes and a way to address them.
9. We recommend that examples presented first and then the theory. For example, after explaining how to write a letter through a series of steps, one can state the benefits of such an activity: This is called a letter. A letter is useful to apply for leave, job application, etc.. This goes against the conventional method of presenting the theory first and then demonstrating it through examples or activities.

10. We insist that about 80% of the tutorial should be demonstration based and only 20% of it should be devoted to theory. The reason is that if there is too much theory, a self learner at a remote location may not get any help if they have a doubt. Moreover, the 80% rule is suitable for the side-by-side method of learning, to be explained next.
11. Finally, we encourage the script writer to subject every sentence to Telephone Test to make them easy to understand.

We now explain a pedagogy that we have devised for learning with ST, called side-by-side learning [13]. In this method, the ST is reduced in size to fit in about half the computer screen, as shown in Fig. 1. We require STs be created in the 800x600 size. As a result, we can easily accommodate the ST in half the computer screen. In the other half, the software that the ST teaches is opened. In this figure, we see the Scilab ST on the left hand side and the Scilab software on the right hand side. The fact that ST is free and also the software, allows everyone to open both of these. Often, a small overlap between the two screens of Fig. 1 is also acceptable [3]. Scilab is an excellent open source alternative to Matlab, and it is promoted by us [14].

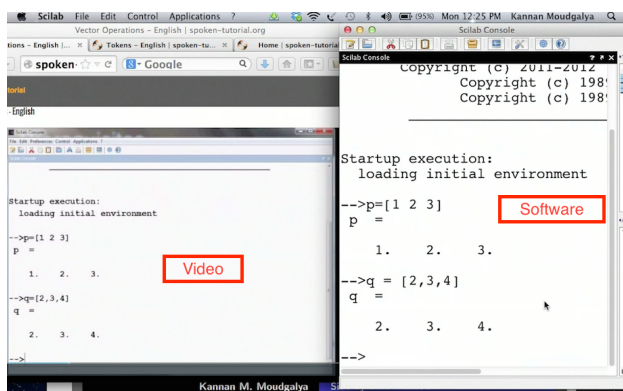


Figure 1: Example of side-by-side learning with the open source software Scilab. The Scilab ST is on the left half of the computer screen and the Scilab software on the right hand side. Seeing both simultaneously reduces the mental load.

The method to learn from an ST using the side-by-side method is straight forward: listen to a command and pause it. Try it out on the software window opened on the right. If it works, go to the next command. If not, rewind, listen to it, and try it again. It will always work, because ST is created for self learning. Keeping the tutorial and the software next to each other reduces the mental overload [15, 16, 3]. In our approach, students learn through active learning, the benefits of which are well known [17]. Learning through examples helps learn the underlying theory indirectly [18].

2.4 STs are created for low bandwidth and small screen devices

Spoken Tutorials have a small foot print: the size of a tutorial is just about 1MB per minute. This is obtained by keeping a low frame rate of 2 to 5 per second. This frame rate is generally sufficient, as usually there are no fast moving sequences in tutorials that teach an IT topic. This low file size allows more than 10 hours of instructional material to be packed in a CD that does not cost more than ₹ 10. Such small sizes also allow streaming of ST without much difficulty through mobile phones, etc. When we started this work, bandwidth was expensive and not easily available in most places. Although it has eased considerably during recent years, this difficulty still persists in India.

Keeping the requirement that only half the computer screen may be available to watch the video, STs are made in a 800x600 frame. We also enforced guidelines, such as large fonts, less number of lines in a page, etc., to enhance the quality of ST. This allows STs to be accessed effortlessly in 7" tablets and also in mobile phones. As a matter of fact, some of our student users have confirmed that they routinely watch ST through their mobiles. Playing a 800x600 frame in a mobile phone does not result in much compression of fonts, unlike what happens when an entire computer screen is compressed to play in a phone.

Our insistence that we show only a part of a computer screen through a 800x600 frame requires quite a bit of work. In software interfaces that have many buttons, we explain only a few buttons in an ST. If we have to bring in another part of the GUI, we scroll slowly, let the learner see what is done in the ST, so that it becomes easy to follow. Some times, when we feel that the learner should see a lot more, we can zoom out and let them understand the overall context. For an example of this, see [19] at 2:08 minute. Because of our requirement that we show only a small part of a screen, that too with a large font, formatting and general appearance can come out quite badly. But if they understand the reason behind it, the learner will appreciate our efforts, instead of complaining. Making the learner understand this is the responsibility of the ST creator, who can easily explain this reason in one or two short sentences.

2.5 Audio dubbing for mass outreach with employment potential

Number of children enrolling in English medium schools in India is growing exponentially [20]. This is mainly because of the perception that English helps improve employment opportunities. Unfortunately, however, this trend could potentially affect children from lower economic and social strata. Relatives, neighbours and friends of these children may not be fluent in English; hence they may not be able to help with homework, clearing doubts, etc. Very often, the so called English medium schools end up teaching in local languages only. Unfortunately, all the exam papers come in English, making it difficult for these children to perform well.

One of the largest sectors that provide employment in India is Information Technology (IT). To get placed in this sector, one must be able to use an English keyboard and an English computer. In contrast, it is more difficult to get an IT job for one who is only comfortable in a vernacular language keyboard. In addition, one should be familiar with English technical terms used in business. Fortunately, the above discussed difficulties can be handled by dubbing the audio in the mother tongue of children, leaving the video of ST in English.

Dubbing only the audio portion has been done successfully in this project. When implemented properly, audio dubbing requires only about 5% of the effort involved in creating the original. For students who are weak in English but desirous of using the normal keyboard, this is a godsend: their employment potential is maintained while the learning happens through their mother tongue.

The above mentioned low dubbing effort is possible, only if we keep the video intact. If the video also has to be edited, one may have to go through the novice check, pilot workshop, etc., once again. This will replicate the efforts required for the original for every language, making this process unviable. If on the other hand, we can get away with only audio dubbing, because of the low effort involved, a large number of languages can be accommodated.

If only the audio has to be changed, translated sentences should fit into the available time for corresponding sentences in the original video. This is possible only if the sentences in the original video are short and simple. If there are complicated sentence constructs in the original video, there is no guarantee that a translation in another language can be made to fit in the same time. The restriction on the length of sentences in the original script, explained in Sec. 2.2, helps produce simple constructs, which can most often be dubbed within the available time.

Our audio dubbing procedure allows tutorials on high technology topics be made available even to minority linguistic groups, for example, those whose mother tongue is Sanskrit or Bodo. This approach has the benefit of bootstrapping difficult skills in such groups, even if there are no domain experts who speak their language. As dubbing into other languages happen from the same original high quality spoken tutorials, the standard is maintained in all language dubbing.

We encourage those who are weak in English to listen to an ST in their mother tongue first and practise. After that, we recommend that they listen to the English version. This will help improve their command over English, in addition to getting them ready for work place. As only simple language constructs are used, it is also possible to make one understand the language of a neighbouring state, thereby helping produce citizens who are friendly to their neighbours.

Dubbing only the audio has the potential to promote national integration. This is because the video of ST retains the information of the original creator, who may be from some other part of the country. This

should result in goodwill for the brethren from across the country who create original tutorials.

2.6 Anyone can create an ST and earn

We do not insist on the use of interactive script and interactive software to create ST. A sophisticated recording software that has these features are often proprietary and expensive. We are satisfied with the features provided by FOSS recording software systems, such as Kazam [21] and Camstudio [22]. Insistence on expensive software will automatically filter out people who cannot afford it. On the other hand, we aim to achieve high quality ST by adhering to our guidelines and being meticulous, which can be followed by anyone [23]. This is the recommended method for the use of collaborative content in general [24].

In a similar way, we also do not insist on high quality, sound proof, recording studios for recording. In addition to making the ST expensive, this will ensure that the general public does not participate in the content creation. We decided at the beginning of our project that the tax payer's money, which funds our project, should go back to the public. It should be possible for an average student, who is meticulous, to create an ST and earn an honorarium for it. We came up with suggestions that anyone can follow by just being careful: Close the doors and the windows; remove the battery charger; turn off the fans; turn off the mobile phone - it is not enough if you keep it in silent mode, etc., [23].

We believe that everyone can create ST with freely available software and without expensive recording instruments or ecosystem. All that one needs to do is to follow a set of rules, which can be done through practice and self-discipline. The sum of ₹ 10,000 that we pay to create a 10 minute ST is a substantial sum for any student in India.

3 Use methods designed to make ST reach the unreachable

3.1 Friendly environment for beginners

At the beginning of our work, we decided to make our tutorials available to everyone, without insisting on registration or login. Many people do not explore the contents if a login is required. Registration and login are a major impediment to access serious content, especially to beginners, uninformed and unmotivated, all of whom belong to bottom rungs of economic, social and academic ladder that make up our target audience.

After a detailed study of users of our web page [25], we re-created our website to make it accessible and interesting to novice learners. When a topic is selected, tutorials come in a numbered sequence, indicating the sequence in which they have to be studied. For example, [26] shows a list of ST on C and C++ in English. Once a tutorial in this list is selected, one

sees the selected ST, outline for the tutorial, prerequisite, script and assignments. Thus, there is a wealth of information for every ST.

If a tutorial has to last only ten minutes, the only way advanced topics can be taught is to explain them in stages. For example, to develop an elaborate program, one has to develop it up to a point, save it, and then open it in the next tutorial and continue the development. This means that there will be at least one file to open in many tutorials. Unless the learner is provided this file, they cannot practise along with the tutorial. This important requirement is addressed through the code section of every ST. Similarly, if a plotting function is demonstrated, the data used to plot is made available. The code facility allows a learner to learn any tutorial, even without completing previous tutorials, using the side-by-side method [13].

While listening to an ST, the learner has the facility to stream the script as subtitle. This is useful to learn a foreign language, such as English, for those who are not fluent in it [27]. Previously asked forum questions and answers, discussed in Sec. 4.2, appear at appropriate times, as the ST is played. The learner also has the facility to post a question at the exact time where they have a question, while watching an ST.

3.2 Accessible without Internet

Most of our colleges and schools do not have access to Internet bandwidth. As a result, it is difficult to organise training programmes based on ST. To address this, we came up with a shopping cart like application. Using this, one can pick and choose one or more sets of tutorials, each with one or more languages of their choice. After the selection is complete, one can download the resulting zip file. A sample session to create and download such a file is in Fig. 2.

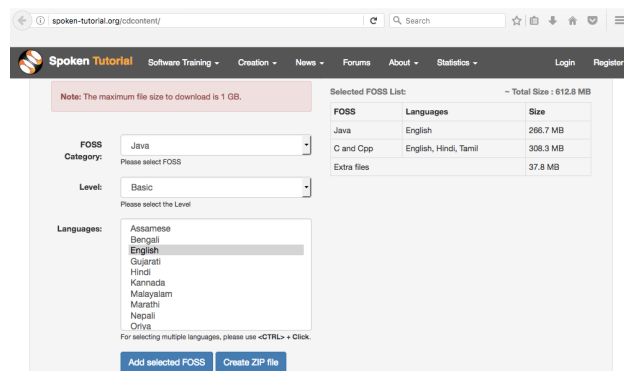


Figure 2: Shopping cart like download facility helps anyone to download topics of Spoken Tutorials, without having to log in. On downloading, and unzipping the file, one has to run index.html to get the videos started.

At least one connection should be available in a college to download the zip file created using the process mentioned above. We have found this facility to be available in most colleges. In case a college or a school does not have even one connection, someone

else can send them the required zip file through a CD. Because of the offline capability, use of Spoken Tutorials went up by about 50 times, as explained in Sec. 6.2.

One can copy the zip file mentioned above in every computer. On opening the zip file, one gets a folder with a file index.html. On opening this file in Firefox or Chrome, all downloaded tutorials, in all selected languages, appear as a play list. The look and feel are identical to what one sees on the ST website [4]. As all these tutorials are available through the local file system, one does not need Internet to practise with these tutorials. These STs play without any buffering, as they stream from the local file system. This mechanism allows us to conduct massive workshops using spoken tutorials: see 200 people participating in a Drupal workshop, which was inaugurated by the Mumbai University Vice Chancellor Fig. 3. The AICTE Chairman released a DVD containing Drupal ST, meant for use by all 1,250 MCA colleges in the country. Efficacy of this method has been validated through a L^AT_EX workshop [28].



Figure 3: The DVD, used in the massive, self learning, silent, Drupal workshop, was launched by the AICTE Chairman. The workshop was inaugurated by the Vice Chancellor of Mumbai University.

The download facility allows anyone to download the tutorials they want. As one can download the offline version just before using them, one can always get the latest version. As the offline version of ST is identical to the online version, one can switch back and forth between these two versions, depending on whether one has access to bandwidth or not.

The offline work was appreciated by Google, who gave an award to it for further work in this area [29].

3.3 Beginners can self learn from ST, without experts

The fact that an ST is meant for self learning, with a suitable pedagogy and a friendly learning environment, allows beginners to learn easily from ST. Side-by-side learning, illustrated in Fig. 1, the availability of all files required in an ST through the code section, and a friendly learning environment explained in Sec. 3.1, allow a beginner self-learn.

We recommend learners to reproduce the contents of ST in a training session. Given that there may not be any domain experts during training with ST, it is advisable to only practise the commands demonstrated in the STs. Learners can, of course, try the things not covered in a tutorial. If they get stuck, we suggest that they post their questions on the timed forum discussed in Sec. 4.2, and to move on with the rest of the ST.

If a student practises only the things covered in an ST, do they learn anything during an ST based learning session? It turns out that they learn quite a bit. For example, most students learn the following in a L^AT_EX training programme: (1) What is meant by compiling? (2) How to write letters in L^AT_EX? (3) How to write reports? (4) How to write mathematical equations? (5) Introduction to presentation using Beamer [30]. To the best of our knowledge, through no other method can a student learn so much in a short time of about two hours. In other words, for most students, what we propose to be studied in a workshop is new anyway. Hence it makes no sense to try out something else that we do not cover and for which no help may be available. We have developed a beginner friendly Forum to answer questions, see Sec. 4.2.

The effectiveness of this approach was examined in a study in which the understanding of the Java principles of 400 college students were analysed rigorously [7]: about a half of the students learnt select topics through ST and the rest through classroom lectures. Both groups performed equally well in a test conducted subsequently. Self confidence of ST learners, especially females, was higher than that of the control group. It is not surprising that Java ST are one of the accepted course material for the internal training in WIPRO.

3.4 Anyone can conduct ST workshops

SELF workshops are conducted by a volunteer, a student or a faculty member of a college. As the STs are created for self learning and accompanying instruction sheets [3] further explain what to do, it is not required for the Conductor to be a domain expert at all. The main role of the Conductor of an ST based training programme is to implement the following:

1. To ensure well in advance that all computers are in required working condition, by getting the checklist in Table 2 satisfactorily answered in advance.
2. To make all learners to listen to the side-by-side learning video [13].

3. To give a copy of the instruction sheet [3] to every learner of the training programme.
4. To produce a conducive environment for training and to maintain discipline.

Table 2: Checklist of things to get done before a ST training programme

PC No.	Is the PC booting?	Can log into PC? (if applicable)	These can be separated in 2 PCs				
			PC for spoken tutorial				PC for test
			FOSS loaded	ST copied	Plays in VLC	Audio works	Internet works
1							
2							
⋮							
N							

We will illustrate the role of a Conductor with the help of two examples. Many students who appear in a Linux workshop do not know the difference between a terminal and an editor. Some of them type a command on a terminal and wait for an answer. The conductor of the workshop will point out the mistake and ask the student to start the tutorial from scratch. In a Linux workshop, some commands are to be executed in the background with the help of ampersand (&) operator. The participants who forget to use & will complain that the subsequent commands do not work. The Conductor will point out the mistake and ask the students to start the tutorial from scratch, once again.

The reason for asking the students to start from scratch in case of mistakes is that retrieving from a mistake could require domain expertise. The Conductor, who is not necessarily a domain expert, may not be in a position to address this issue. Moreover, if the Conductor starts addressing such issues, they will not be able to handle large numbers of students and the two hour duration could become insufficient. Finally, the time a student has to spend extra in case of a repeat listening is about five minutes, which is not much. At the end of a SELF workshop, a student will realise that if they follow exactly what is shown in an ST, everything will work correctly.

Because of the generality of the procedure that a conductor has to follow, one is in a position to conduct all SELF workshops after successfully completing one: there is no difference between the procedures to follow between different FOSS courses. This procedure has greatly helped conduct a large number of SELF workshops. We do not need a domain expert to conduct these workshops. In a large country like India, one may have to conduct these workshops in thousands of places. It would be difficult to get domain experts to even visit such a large number of places, let alone lecturing in these workshops.

It may not be possible for a conductor of a workshop to answer domain dependent questions, as the

conductor may not be an expert in that area. Moreover, answering domain-dependent questions could take up a lot of time. It would be impossible even for an expert to answer all the questions of a large number of students. Specific questions of training participants can be addressed through an online forum, discussed in Sec. 4.2. A research study [28] explains why this method is effective.

4 Post training support

4.1 Free online test and certificate for college students

The first thing that comes to anyone's mind when we talk about training is assessment, even though, we seem to have converted assessment into a separate activity, independent of learning. This is illustrated by results of a test at Anna University, one of the leading technical universities in India [31]: Only 69% of the Anna University's main campus students passed a test on mathematics and computing; it is well known that all of them would have scored close to 200/200 in maths/physics/chemistry in the 12th board exams - only such students can even hope to get admission in Anna University's main campus.

The above mentioned article [31] explains how a student, despite creating a question bank of 5,000 questions, failed in the exam. Nowhere in the article is there a mention of understanding of the subject matter. Given this scenario, there is no wonder companies conduct their own assessment to offer jobs. In view of this, isn't it a lot more important to provide a good method of learning, even if the assessment method is not very accurate? - companies will assess separately any way, and understanding of subject matter is a lot more important.

As articulated earlier in Sec. 2.3, the ST method of learning enforces active learning, and learning by examples. If a student reproduces every command in a tutorial, they would understand exactly what to do. Because of this, we can claim that one who takes up the ST method seriously has the potential to understand the subject matter quite well.

If we want to provide fool-proof assessment tests, either costs can be high, or only a small fraction of our population can be accommodated, or both. For example, the cost of conducting a GATE or a JEE is in excess of ₹ 1,000 per student to the proctoring agency alone. The total cost to administer such a test could be in excess of ₹ 2,000. If there are many such tests one has to participate in, the total cost could be prohibitively expensive. Moreover, these exams are offered in only select centres, which may not be accessible to many students, especially if they have to appear in many exams.

At present, the ST team offers online exams in more than 15 topics. These exams are administered locally, in every college, under the invigilation of their own faculty member. These are offered free of cost, as our project is fully funded by MHRD. This enables every student to appear in all the exams, if they are in-

terested in. Our online certificate mentions the name of the college where a student appears in the exam and the name of the person who invigilates it. Our process is a much cheaper alternative to the commercially proctored exams.

What is the value of certificates from ST? It depends on how the invigilation is conducted in a college. In cases of good proctoring, there will be a good correlation between a student's certificate and their understanding of the subject. Once a recruiter realises this, they will value such certificates from that college. In fact, there are some universities that give weightage to ST online exam marks and also invigilate seriously. Hence, the performance in the ST exam is doubly valuable to these students. In case a college does not invigilate properly, students from such colleges with ST's certificates will end up creating a bad impression of not only themselves, but of the college as well.

In other words, our online test is inexpensive and easily accessible to every student. Enhancing its value is in the hands of the college administration.

4.2 Easy to access forum for beginners

Most Forums that support FOSS used to be unfriendly to the questions of beginners. For example, the standard answers used to be: (a) First learn how to post in the forum (b) It is already answered, check the archives first (c) Read the instruction manual first before asking a question, etc. One can confidently say that only a small fraction of FOSS exploring/loving beginners used to stay with FOSS. Of course, the reason for the response given by the experts is quite clear: there are only a few experts to answer the questions of large numbers of beginners, many of which may be repetitive. "If the experts spend all their time in answering often repetitive questions, when will they have time to do their own work, develop the FOSS, remove bugs, write documents, etc.?", seem to be valid questions.

Another standard answer given in forums in earlier days was that a question was already answered and that one should check the archive first before posting it. In old days, it was often difficult to locate those discussions, as the answer could have been given as a part of some other discussion - only people who knew how to do an advanced search could locate them. We started working on a way to come up with a friendly forum that would address these two issues quite some time ago. In addition to addressing the problems mentioned above, the forum we have developed has some additional benefits.

Our forum requires one to ask a question based on the exact time one has a problem in an ST [32]. The person who has a question in an ST has to select a series (eg. C or Java), name of the tutorial in it, minutes (eg. 4 to 5 minutes) and seconds (20 to 30 seconds) and then ask the question. These are answered by experts. These questions, along with their answers, are arranged in chronological order with respect to the video time line, and hence become a valuable in-

structional material. Answers to these questions can be used as additional instructions by those who may have the same doubt later. As a matter of fact, these discussions also appear along with the ST at appropriate times, when an ST is played. The following benefits result from this forum:

1. It is easy to locate the discussion on the topic covered in any part of the video.
2. One can see the discussions first before starting the video. This will help the learner make use of earlier discussions.
3. Asking questions based on a particular time in the video reduces duplicate postings.

It is indeed a forum that beginners can use with ease.

We recently conducted an ST based L^AT_EX workshop for about 200 participants [28]. Everyone used a pair of ear phones, using which, they watched and practised STs at a speed convenient to them. It would not make sense to answer their questions through a public address system. It was also not practical to answer their questions, by going next to them and answering them in person. We asked all participants to post their questions on our forum and experts answered them immediately. Accessing our forum did not require much bandwidth. STs were watched from local file systems, as explained in Sec. 3.2.

We obtained the following response that confirmed the efficacy of this forum [28]. 57% of the respondents found the forum helpful as they usually hesitated to ask questions in a class full of students. Only 11% of the respondents disagreed with this. 64% of the respondents found the forum helpful as they usually missed details of discussion in a live class, with 7% disagreeing with this. 50% of the respondents felt that their doubts were answered a lot faster than in a large class discussion. Only 7% disagreed with this. 64% of the respondents felt that they did not have to wait to get their doubt cleared. Only 4% disagreed with this.

We believe that this forum could be used to make announcements by the creation team. For example, this could be used to explain some changes that may have happened in a recent version of a software. We also have a problem solve: people posting questions that are totally unrelated to the topic of discussion. We are yet to find a solution to this problem, other than manual intervention.

5 Uniform development strategies

5.1 Spoken Tutorials in curriculum

At the beginning of this project, we decided that we would not give honorarium to anyone who conducted training in their colleges using Spoken Tutorials. We believed that there would be enough people who would want to use our instructional material, being of high quality. One of the main reasons for this decision not to give honoraria was that it would be difficult to verify the claims. It also resulted in huge savings to the project, given an extremely large number of training

programmes we eventually conducted and the large number of people trained.

Continuity of organisers of ST training in colleges was a serious problem. While there were a large number of people who were genuinely interested in the cause, there were some who participated mainly for their promotion. They lost interest whether they got the promotion or not. Retirements, transfers, and resignations of faculty members were the other reasons why we had difficulty in maintaining continuity. Many colleges that were doing good training programmes fell out of our radar, because of this discontinuity, as it was not possible to groom successors in a short time.

There was another problem in conducting training in colleges. There was a shortage of free slots during college hours. It was difficult to conduct classes after college hours. This is because a large majority of college students are day scholars, who leave by college buses at about 5 pm. If they miss the college bus, it could take a long time to reach home as many of them travel long distances - hostel accommodation is available only to those who come from far away places. Finally, students from lower economic strata cannot afford a hostel life.

To address the above mentioned two problems, namely, continuity of training organisers and the difficulty in finding training slots outside college hours, we explored the possibility of getting our training programmes blended into the college curriculum. We did a mapping of ST topics to lab courses. We got the proposed usage approved by the syllabus and curriculum committees, academic councils and senates of many universities. We encouraged university authorities write to their affiliating colleges about the possibility of using ST as a part of their lab courses [33]. In cases where the use of ST was mandated, universities set up trackers and monitored the progress.

In addition to increasing the reach, the use of ST in lab courses increased the quality and duration of training. Before the mapped usage in the lab strategy, we used to offer ST through two hour long SELF workshops [3]. The idea was to introduce the concept of ST to students in the workshops, during which, the participants would learn how to learn from ST. They could complete the rest of the learning whenever they had time. We restricted the duration of these workshops to two hours, as that would make available the computer time to many people; moreover, there would be no need to give anything to eat or drink in short programmes. Problems with these workshops are: (1) it was difficult to find free slots, as explained earlier (2) many students, especially day scholars, did not have access to computers after college hours and hence could not learn the rest of the learning material.

Typical lab courses have one session of two to three hours every week, for a total period of about ten weeks in a semester. As a result, students who use ST in a lab course get many hours to go through the tutorials and to complete them. So, instead of only two hours available through SELF workshops, lab courses provide 20 to 30 hours to complete the learning, using

the college infrastructure. Students find ST a useful additional aid to learn the target topic of a lab session.

A comparison of the number of training programmes conducted through different modes can be found in Table 3, available at [34]. From this Table, we can see that many college students learn topics that are not in their curriculum, during free lab hour slots they have. One can see that in 2016, number of people trained in college hours increased six times, while that done outside lab hours only doubled. Nevertheless, outside lab hour training is still substantial. This mode continues to be useful to those colleges that want to try out the ST method before adopting it.

Table 3: Number of people trained through different modes, at the beginning and at the end of 2016, cumulative, since June 2011

Mode	1 Jan 2016		19 Dec 2016	
	No. programmes	No. people	No. Programmes	No. people
Course outside lab hours through 2hr SELF workshops	20,917	8,92,772	30,019	15,06,531
Course mapped in lab hours	2,200	1,17,621	14,210	8,03,222
Course in lab hours, but not in syllabus	602	29,307	4,459	2,56,033

5.2 Targeting 10% undergraduate enrollment in every state

One of the complaints about most educational schemes we have is that only a few states benefit by it. To address this issue, at the beginning of 2016, we set a target of reaching 10% of all undergraduate level enrollment in all states, see Page 64 in [35]. By all enrollment, we mean all streams, including engineering, sciences, art, commerce, humanities, and so on. Although our focus initially was with engineering colleges only, we expanded to increase our audience to cover other disciplines, as mentioned above. We found a great reception for our training in non-engineering colleges as well, as their students also are interested in IT jobs.

Setting a target of 10% for every state made us re-focus our efforts on states that were not performing well. Mapping ST to lab courses, as explained in Sec. 5.1 helped greatly. We also encouraged new colleges to provide this facility to as many students as possible, explained in detail in Sec. 5.3. The effect of this exercise can be seen in Table 4. Although we are yet to meet the target in a few states (Odisha, Uttar Pradesh, Jharkhand, Arunachal Pradesh, Bengal, and Karnataka), we are confident of reaching it soon. This is based on the growth trajectories we have already established in these states. One can see from this Table

that the states with very high growth rates were far away from the target at the beginning of 2016.

This must be one of the few projects carried out in academia that has equal number of marketing staff members as the number of creators. Even if it is available free of cost, the educational content has to be marketed, to be accepted. The list of our marketing team, with contact details is available here [36]. As states like Tamil Nadu and Gujarat were already close to the 10% mark, it was possible to shift their staff members focus on under performing states.

Table 4: Growth of training numbers in one year for states that have either met the target of 10% or that will reach the target soon. Setting individual targets for every state helped achieve uniform development. Numbers shown are cumulative.

State	1-1-2016	Target	19-12-16	% ↑
Odisha	4,000	65,000	50,000	1150
Assam	5,000	43,000	46,000	820
Uttar Pradesh	52,000	5,23,000	4,12,000	692
Jharkhand	3,500	44,000	20,000	471
Telangana	23,000	1,00,000	1,31,000	470
Andra Pradesh	25,000	1,10,000	1,21,000	384
Delhi	11,000	28,000	55,000	400
Meghalaya	1,500	6,000	6,500	333
Kerala	25,000	56,000	1,00,000	300
Arun. Pradesh	600	3,000	2,000	233
Bengal	26,000	1,52,000	77,000	188
Chhattisgarh	14,000	31,000	38,000	171
Punjab	29,000	58,000	78,000	169
Goa	3,500	2,800	10,000	185
Madhya Pradesh	48,000	1,09,000	1,30,000	170
Haryana	32,000	68,000	71,000	122
Maharashtra	1,43,000	2,59,000	2,99,000	109
Uttarakhand	19,000	30,000	39,000	105
Hima. Pradesh	10,000	16,000	20,000	100
Rajasthan	62,000	1,37,000	1,17,000	89
Karnataka	68,000	1,37,000	1,03,000	51
Tamil Nadu	2,10,000	2,03,000	3,16,000	50
Puducherry	10,000	4,400	14,000	40
Gujarat	2,00,000	1,05,000	2,78,000	39

In Table 5, a list of states where we are unlikely to meet the 10% target in the near future is given. These are six North Eastern states, Bihar, and Jammu & Kashmir. One reason for small numbers in Bihar is that only small fraction of their students are enrolled in engineering, unlike other states. Because of our own background, it was easier for us to enter engineering colleges. If we can get help from state governments, however, we can reach the target in these states too.

Table 5: Growth of training numbers in one year for states that will not reach the target of 10% in the near future. We need help from State Governments to increase these numbers.

State	1-1-16	Target	19-12-16	% incr.
Manipur	10	9,200	70	600
Bihar	8,000	1,32,000	21,000	162
J&K	4,000	21,000	5,000	25
Mizoram	300	2,000	300	0
Nagaland	0	2,700	0	0
Sikkim	170	1,300	170	0
Tripura	500	5,400	500	0

5.3 Reaching out to all students in colleges

One of the problems we have in introducing any educational scheme in any college is that only the top students benefit by it. College administrations also find that a lot easier. Unfortunately, this leaves out average students. Students at the bottom of the class, who are often less motivated because of family background and economic reasons, tend to be left out of such efforts. To address this problem, we started insisting in this year that we would work with a new college, only if they agree to train all their students on at least one topic. Our time and efforts are better utilised by working with colleges that want to train all their students as opposed to training only a small number of students.

The above mentioned policy of insisting that a college should make available this method to every student of theirs has resulted in a very large growth in this year, see Fig. 4. As a matter of fact, the number of people we trained in this year (15,00,000) is more than the total number of people we trained in all the previous years together (10,00,000).

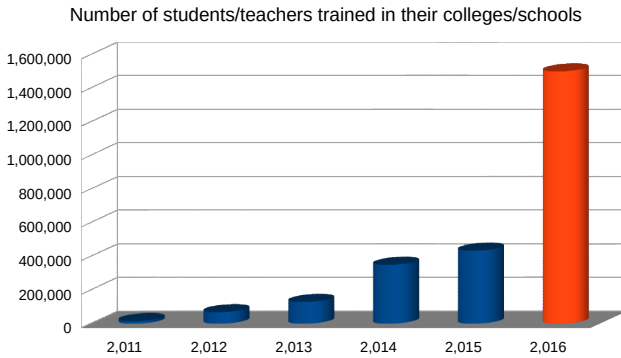


Figure 4: Growth of students/teachers trained. Our insistence that every student should be trained on at least one topic has resulted in a large growth in 2016.

6 Current status of IT training through ST

6.1 ST creation status and popular ST series

At the time of writing this article, there are a total of close to 6,300 ST, including dubbed tutorials. Out of these, there are 800 English tutorials. More than 500 of these have been dubbed into the following languages: Assamese, Bengali, Gujarati, Hindi, Marathi and Tamil. Series, such as LibreOffice Writer (FOSS alternative to MS Word) have been dubbed into 19 languages, including Bodo, Khasi and Sanskrit. We present in Table 6 popular ST series that have trained more than 1,00,000 people. These are the number of people trained by us in various colleges. There must be many others who use them directly on our website.

One can see that C and C++ make the most popular series. This series consists of 20 ST. The reason why this is popular is the employment opportunities it creates. Most IT companies that come for campus recruitment conduct a test on C. Only those who do

well in this test are even shortlisted for an interview. Linux is a compulsory subject for most computer science and IT streams. Given that many colleges and organisations are switching to Linux, many are undergoing this training. Java continues to be a popular language for those who are looking for employment opportunities. WIPRO uses Java ST as one of the approved instructional material on Java for their own internal training. LibreOffice series is popular especially in arts and commerce streams, where they have a course on introduction to computers.

Scilab is an excellent open source alternative to Matlab for scientists and engineers. If it is good enough to launch Ariane rockets [37] that placed many of our successful satellites in orbit, it should be good enough for most of our other applications too! PHP and MySQL is an alternative to Java. Learning to program in PHP helps carry out advanced programming in other popular software, such as Moodle and Drupal.

Finally, the most popular series amongst the college teachers is \LaTeX , a scientific typesetting software. Many college teachers are pursuing higher studies. They need to write reports, present talks, publish papers in conferences and journals, and write their theses. They find \LaTeX to be most appropriate for scientific writing, especially when a large number of mathematical symbols and equations have to be typeset. The popularity of \LaTeX can be judged by the continued use by those who learn it [28].

Testimonials in Sec. 6.3 vouch for the popularity of many ST series.

Table 6: Popular ST series

Name	No. tutorials	No. trained
C and C++	20	4,33,773
Linux, including BOSS	19	2,03,708
Java	39	2,09,386
LibreOffice Writer	9	1,75,302
Scilab	24	1,68,944
LibreOffice Calc	11	1,64,717
PHP and MySQL	57	1,48,080
LibreOffice Impress	9	1,23,911
\LaTeX	10	1,17,963

6.2 Interpretation of visitor statistics

For any web based project, the performance is often determined by the statistics of visits. Unfortunately, most of the content of the ST website [4] is accessed through offline mode, as explained in Sec. 3.2. Nevertheless, comparing the number of times an ST is accessed on the website to the number of students who have participated in the corresponding training programme in their colleges through an offline mode, we can get an estimate. For example, the number of times a few C programs of [26] have been watched from the website [4] is given in Table 7. These numbers generally decrease down the play list. Given that those who undergo a training programme will see the tutorials at least once, mostly through the offline mode, we

can get an estimate of ratio of scale up that happens. From the numbers given in Table 7, we can estimate this scale up to be at least 50, on an average.

Table 7: Number of times select C ST have been viewed through the play list [26] in [4]. These numbers should be compared with 4,33,773 students (see Table 6) who have undergone training in C using offline mode. The scale up that results because of our offline distribution is at least 50.

No.	Name of tutorials	Visits
1	First C program	41,017
2	First Cpp program	14,702
3	Tokens	11,186
4	Functions	9,472
5	Scope of variables	6,084
⋮		
10	Relational operators in C & C++	3,585

Keeping the above mentioned scale up in mind, we should analyse the visitor statistics of the website of ST [4]. Statistics of visits to ST are available at [38]. From this site, we present the annual visit growth profile in Fig. 5. The number of page views is likely to reach 7 million this year, with the unique visits being more than a million.

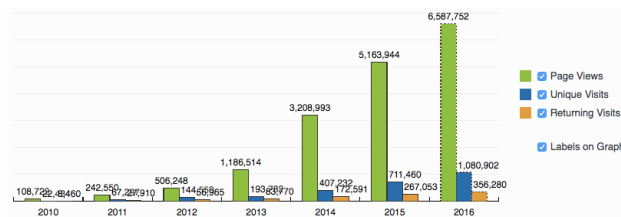


Figure 5: Growth of visits to ST website [4]. This can be obtained by visiting [38] and choosing Yearly data

We now analyse the visitor statistics of [4]. In Fig. 6, we present the overall performance of this site in November 2016, as given by [39], using the following parameters. (1) Total visits (2) Average visit duration (3) Pages per visit (4) Bounce rate. The average visit duration of ST is 10 minutes. Given that the average duration of an ST is 10 minutes, the performance of ST on this count is very good. On an average, every visitor sees about ten pages. Bounce rate of 32% indicates that only one third of the people who come to this site leave immediately. More than 1,00,000 visitors come to this site in a month. This is a large number, especially because, the scale up factor is 50, as discussed above.

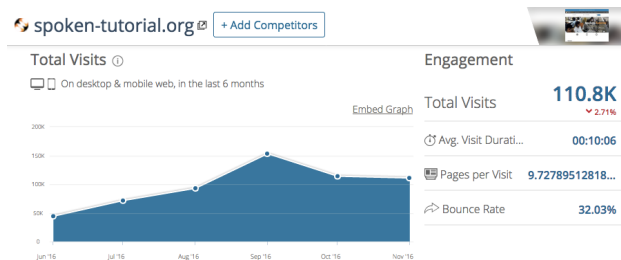


Figure 6: Analysis of visitor statistics of Spoken Tutorial, given by SimilarWeb [39]

6.3 Sample Testimonials

The ST project has received a large number of testimonials from those who benefited by it [40]. We now present a small sample of it. We begin with the testimonial of a school teacher who received the coveted ICT Award from the President of India:

I am glad to inform you that I have received the prestigious NATIONAL ICT AWARD 2015 from the Hon'ble President of India at Vigyan Bhawan New Delhi on 5th Sept 2016 (Teachers' Day). The award was bestowed due to my work in the field of "ICT in Education using FOSS" in association with CIET, NCERT, New Delhi and Spoken Tutorial Project, IIT Bombay.

I applied for the award on the basis on my work in the domain of implementing "ICT in Teaching-Learning process using FOSS" and getting the honour is really overwhelming. I would like to thank you and your team for choosing me to implement the Spoken Tutorial Project in the state of Himachal Pradesh as a Resource Person of Spoken Tutorial Project in HP. It was the support of your Training and Technical team which made it possible to organize various events like Workshops, Training and Online Testing in non-academic hours of my institution which enabled JNV SHIMLA to become the first Resource Centre for FOSS Training at School Level in HP. As you know I have been associated with the project since April 2014.

Mr. Amit Kumar, Computer Teacher, Jawahar Navodaya Vidyalaya, Theog, Shimla Dt.

We now present a few testimonials that explain how ST helped people get employment. The first one is from the Head of an MCA department.

Recently, I came across one company which wanted students with sound knowledge in PHP MySQL. As our MCA syllabus does not cover PHP MySQL, I decided to train my students using Spoken tutorial. More than 30 students took up the course, and in a very short time, I could train my students. This helped place six students, by training them to meet the company requirement, without incurring any cost. The Spoken Tutorial courses are effectively designed to train a novice user, without the support of a physical teacher, and have taken care of all possible questions that may arise during a course.

Dr. Chitra Desai, Head, MCA, Marathwada Institute of Technology, Aurangabad

Principal of an institution says that a large number of their students got placed in a company because of ST:

More than 70 of the 88 placed students feel that this Spoken Tutorial training helped them to be well-equipped for the Tata Consultancy Services (TCS) campus recruitment. So we are planning on encouraging all our students to be a part of this project, to make them stronger in their programming language skills and we have determined to plan the Training sessions through the regular lab hours for the relevant courses in a systematic way starting from this academic year and continue thereon. [Dr. S. Malarkkan, Principal, Manakula Vinayagar Institute of Technology, Pondicherry](#)

A three year B.Sc student says that she got a job as a Linux developer because of ST:

I am very glad to inform you that I got an opportunity to speak about my experience with IIT Bombay for working on a project (Spoken Tutorials). This exposure seemed to be one of the reasons for getting selected in TCS, which various engineers and other graduates would love to. The amazing certificates and having leadership qualities for organizing several workshops during my college days brought in me the confidence to undertake any task. I have got into TCS as a Linux developer. The first time I learned about Linux is when I conducted as well as undertook a test on Linux which was organized by IIT Bombay. [Krishnaveni Nair, B.Sc Graduate, SIES, Mumbai University](#)

This is what a professor at IIT Bombay says how ST is useful to beginners:

This semester I taught our introductory programming course (In C) SI-415. I introduced the students to the Spoken Tutorials on C and used some of them in class (for example on functions, pointers etc.). The students also took the test.

I found that most important is that their fear will go away. They feel that because they are learning in short simple steps they also can replicate the instructions and run the programs. In this way the initial barrier will break down. In programming it is always better and there is nothing like writing your own program, compiling and running it.

Even for language features like function, recursion, linked list – the same approach is used, all manageable programs which they can build and run. This builds their confidence highly. It is well known that listening is always better than reading and that is why this works and is suited for independent learning. It helps that instead of reading theory you see the concept in a small program, do it, practice it and understand it hands on very simply. It is interactive in nature and hence works.

I highly recommend Spoken Tutorials as a resource for a first course in C. [Prof. Murali K. Srinivasan, Dept. of Mathematics, IIT Bombay](#)

This is what a professor says about usefulness of \LaTeX that she used to write a book:

Hai all. I have some introduction to \LaTeX earlier. But when I want to type my book using \LaTeX , I struggled a lot. Spoken tutorials was the *leap in the dark* which helped me to install and use the Texnic Center and use the \LaTeX for my book type setting. I have successfully completed my book and released using Lambert Academic Publishers.

I am preparing the future editions of the book with the same. Thank You Spoken Tutorials team.

[Dr. T. Subbulakshmi, Sethu Institute of Technology, Tamil Nadu](#)

We also received testimonials who now study overseas. A student of Saveetha engineering college, Chennai wrote the following mail to his teacher:

I am doing my Masters in Computer Science in the United States of America. Here I have to do my projects using Ruby, Python, Java and all my projects are documented only using \LaTeX . All my papers are written using \LaTeX . Now I really feel the usefulness and importance of using \LaTeX . As I had no knowledge about Python I just tried the tutorial of IITB which you gave me. I have to tell you the clarity and detail they explain each topic. We cannot deny that the Internet has many tutorials. But I felt this was the best. I shared this tutorial with my other project members. They just loved it. In the course of time you wouldn't believe the whole class is using this tutorial. I am really feeling proud to be an Indian and your student. [Madhanraj, Chandrasekaran, pursuing Masters in the US](#)

A student of Kansas State University says the following about ST:

I find the OpenFOAM lecture video tutorials very useful. I am a graduate student at Kansas State University. There is no particular resource person for OpenFOAM at our University, so I tried to search over and over through the Internet, using youtube, etc., and I came across your website from thorough digging.

Tutorials in Salome are also my interests, as well as Blender, Scilab, and C++. I am already advocating your website! You are really helping out people, especially those who are not knowledgeable with open source programs, which are essentially the trend nowadays due to economic reasons.

[Howell Gonzales, Kansas State University](#)

7 Conclusions and future work

The ST project trained 26 lakh students in the past five years, because of four key features: (1) Created for self learning, with an appropriate pedagogy (2) ST and the software for practising are available free of cost for academia and for the industry (3) The spoken part of ST are dubbed into our 22 languages, with video in English, retaining the employment potential (4) ST can be used offline. With 19,000 college programmes officially accepting ST, the training rate is exponential: 16 lakh students got trained in 2016 alone.

From the testimonials we received from hundreds of students and teachers, the fact that companies like WIPRO use select ST as approved learning material, and the alacrity with which thousands of educational institutions are accepting ST without any external compulsion show that STs are useful and achieving their intended purpose. Considering that 25 lakh students have been trained using ST, the number of actual beneficiaries must be tens of thousands, even if we assume a low success rate.

We are in a position to offer this excellent IT training material to other countries, who can get it dubbed at their cost. Samples of tutorials in Thai [41], Spanish [42] and American English [43] are available now. We are in the process of creating dubbed ST in Khmer and Farsi. Such initiatives are expected from a country that aspires to assume leadership roles in world affairs. ST should be much value to developing countries that do not have English as the main link language. They should also be useful to people from lower economic strata in developed countries.

We have extended ST based training methods to people who are outside the formal system and found it to be effective [44]. IT skills training is only the tip of the ice berg. This approach seems to work for other skills also. Preliminary results are promising: masons, who had not constructed a bio gas plant before, listened to STs on this topic [45], and successfully built them in rural Maharashtra. It is possible to reduce the on the job training duration of skilled people by making them self-learn through carefully created ST, before they are hired.

Because of policies adopted and processes implemented, the ST project is able to train students at a cost of less than ₹50 per person, with a potential for a further reduction by orders of magnitude, given its acceptance rate in about 20,000 academic programmes. In addition, the outstanding ST content is available through its website [4] free of cost, without even registration/login, helping millions of visitors from all over the world.

Acronyms

CC-BY-SA	Creative Commons Attribution Share Alike
FOSS	Free and Open Source Software for Education
NMEICT	National Mission on Education through ICT
ST	Spoken Tutorial

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