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YouTute: Online Social Networking for Vicarious Learning

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Key words: *e-learning, vicarious learning, web-interface, peers, interactive, video, tutorial, higher education*

Abstract:

Imagine a tutorial at University: a classroom filled with students, a tutor and maybe a blackboard to write on. Students discuss with their tutor, work quietly on tasks and talk to their peers. There is a lot of complex learning going on in the tutorial – but usually this is ephemeral. Once the tutorial is past it is gone forever. We could try to record the tutorial – but passively watching 50 minutes of tutorial is quite boring. YouTute aims to provide a means for students to engage actively with the material of tutorials. YouTute allows students to select, tag, index and restructure captured tutorial-based learning and use this as the material to build a social network of learners. Thus YouTute users can "overhear" learning experiences and can also actively structure that overhearing and share it with others.

1 Introduction

YouTute is a web-based tool that gives students the opportunity to watch recordings of their own and fellow students' learning. At present we have used YouTute in the context of small group tutorials but it could be used in a range of learning activities. Since students cannot participate in the recorded activity, they are involved in a form of vicarious learning [7,10]. However we have sought to augment this passive learning with the ability to select, structure and compare a range of learning experiences relating to a particular topic. Our web-interface presents three synchronised videos from different angles of each tutorial together with related learning material, e.g. lecture slides and worksheets [1].

Video data provides students with a rich experience of the tutorial; they can see reactions of fellow students, the tutor and a recording of activity on the electronic whiteboard in the room. We call this Vicarious Learning because it is widely assumed that watching others [4,5,6] – especially peers – can improve learning [9,10].

YouTute's flexibility affords Vicarious Learning by allowing students to: recap discussions that took part during class; see how others approach a certain problem [5]; get ideas how to verbalise their thoughts in a tutorial by observing their peers [3]; and how a range of tutors explain the same topic [2, 8]. In addition, YouTute provides a social resource that allows a class to share the work of selecting, tagging, recommending and structuring vicarious learning experience. This activity requires the active engagement of the learner with the recorded material.

1.1 Motivation

Within the YouTute project we developed a web-interface for students in higher education to provide flexible access to recorded tutorial material. The goal is to augment student learning by providing the means to access and structure recordings of learning experiences of other students on shared topics and link these recordings into other learning resources..

Our motivation was to give the students a tool that will aid their revision as well as give them a chance to recap a tutorial they might have missed due to illness or another University obligation taking part at the time of their usual tutorial. YouTute is also seen as a possibility for foreign students to go back to their weekly tutorial, watch and listen to it again in case they might have missed some crucial information during the live tutorial due to language-understanding problems. Additionally they can get information about other tutorials teaching the same topic but by a different tutor. To be able to watch a different tutor and different students might help the onlooker to develop a new point of view about a certain problem and possibly understand it better than before. This might not only happen because they are watching a different tutor explaining the problem in a different way but also discussion contributions of their peers can be very helpful in this situation. Often peers can verbalise a problem in a way that is more easily understood by other students compared to the language used by experienced tutors. In addition, students may see another student with similar learning issues in another tutorial.

One more motivation for us was giving students a possibility to share notes, comments and interesting parts of tutorials online. We believe they will start their own community within YouTute by exchanging tutes (short video sections), tagging them to make them available for a search engine; commenting on tutes to give other students an opportunity to read these comments and decide if they agree or disagree.

To encourage students to experiment with this system we realised it should require little effort to learn and use and should offer clear benefits to the students. So we designed the user interface to be as easy and natural to use as we could. We also decided to give the students the chance to watch segments of the tutorial videos and the chance to define new video segments they found interesting. Since a full tutorial takes up to an hour we suspected this might be an obstacle hindering students to use YouTute. If they had missed a tutorial they might have to watch the whole hour only to find the problem they are interested in and that could be tedious since a tutorial consists not only of speech all the time, there is a lot of silence going on as well. This inspired us to pre-segment the tutorial videos into shorter parts (we call these segments *tutes* because they are similar to videos posted on YouTube) in this case students can watch 8 – 15 minutes of a tutorial at a time and can decide to watch more of it later if they like. At the moment each one of these pre-defined tutes covers one task discussed during a tutorial, this leads to a variation of length for each tute. Additional to the tutes already provided by YouTute the students are encouraged to create their own tutes. All tutes can be tagged with short-descriptive tags.

Students might use YouTute in small groups at University or on their own at home, most important is that they will always be able to share their thoughts with co-students or even tutors while their using YouTute and are able to be always in contact with other students wherever in the world they are (as long as they have internet access).

1.2 Vicarious Learning

The term vicarious learning was derived from A. Bandura's well-known Bobo doll experiment in which he looked at social learning where people learn through imitation [4]. He used nursery school children in his experiment since they are less social conditioned than adults are. In his experiment Bandura examined if children are copying adult aggressive behaviour towards Bobo dolls (inflatable dolls the approximate size of a primary school child). His findings suggest that there are a significant number of children who copied adults behaviour.

John Lee et al. [6, 9, 10, 11] transferred this idea into the field of higher education learning. If children copy what they observe then this behaviour of learning by observing might happen in many daily situations ergo it could also happen in classroom learning. Students who attend a class but don't contribute to a discussion for whatever reason could learn as well as students involved in a discussion, as long as they listen actively.

In one of their project studies Lee et al. [9] found increase contributions to topic related discussions by students who used their Dissemination tool that provided videos to augment written course material in Informatics while a control group used only the written course material did not show any increase in the use of subject related utterances. On the contrary the control group seemed to be more easily ,distracted and ready to stray away from the topic they were discussing.

This suggests that providing students with the possibility to re-watch tutorials may be of benefit. Using video material in addition to standard learning material could enhance learning. Giving students the possibility to be an active learner (observer) by tagging and creating new video episodes means they engage in more positive learner behaviour and with the added opportunity of social networking with their peers they might gain even more.

Additionally YouTube gives the possibility to watch peers participating in a tutorial. Since peers are usually on the same verbal and learning level observing these students could support the "overhearer's" learning. Peers are able to simplify a task description using language that is more comprehensible to other students. Tutors can use unfamiliar language to young undergraduate students. Hence students who get discouraged in conversation with their tutor can observe co-students paraphrasing a problem in a less intimidating way. Another argument for observing peers in a tutorial is that they could articulate an important question or other thought during the tutorial that can give the observing student crucial information to solve a problem. It is also possible that co-students in another tutorial were able to articulate a question that could not be articulated by the watching student and so receive an answer from the tutor or another classmember that can be accessed by the watching student.

2 Design and development of YouTute

The design and development of YouTute is key to its effectiveness. Because YouTute is provided as an additional tool for learning then we wanted to ensure:

- The users should see clear benefits from the use of the system.
- The cost of adoption was low for the students. Ideally it should require no training to use and even new users should be able to work effectively.
- The system should be capable of effectively sharing users work in accessing and classifying information
- The system should support different style of use since we know our learners have a range of approaches to learning.
- The cost of accessing additional information should be as low as possible.

2.1 Data collection

We recorded tutorial classes of second year students in the School of Informatics. Second year students are good choice since they are already used to the daily routine of University. In addition, second year Informatics tutorials are quite structured. Scripts containing a number of tasks are used during class. This leads to a guided, spontaneous discourse. We recorded all meetings of three tutorial groups studying the same topic. Each meeting comprised a tutor and 3 to 7 students. Student numbers varied over the semester. Each tutorial lasted about 50 minutes.

Three video streams were recorded for each meeting stored on YouTube (see figure 1). Students and the person writing on the board (often the tutor), were recorded separately with 2 MiniDV camcorders. The third recording is of material on a portable electronic whiteboard (smartboard). The smartboard allowed us to record what was written using smartboard inbuilt software. Our collection comprised twenty complete tutorials stored in YouTube.

The screenshot displays the YouTube Tutorial videos interface. The main content area is titled "YouTube Tutorial videos" and shows a search for "Hashing and AVL Tree" under the topic "Hashing and AVL Tree". The interface includes a list of video segments (WSQ1 to WSQ5) and a "Questions" section with four tasks related to reversing a linked list, bucket-array hash tables, AVL trees, and AVL tree families. On the right, a video player shows a whiteboard with handwritten code and diagrams, and two smaller video windows showing students in a tutorial session.

figure 1: YouTube interface

Since tutorials are designed to facilitate dialogue, especially discourse, and not monologue we thought it important to have all speakers on video. Therefore we recorded all students attending a tutorial for this reason and additionally to be able to recognise any possible speaker who is making a contribution during the tutorial. Especially discussions between the students would be interesting to follow and this camera-view will give us the possibility to do so. Another advantage of this view might be that it is helpful for an observing student to see the face of the speaker and therefore any motion of their mouth making it easier to understand the spoken word. The angle of this recording only allows to film students or any other person

sitting around the desk within a tutorial room, neither smartboard nor any person standing in front of the smartboard can be seen.



figure 2: Video of students

The second recording contains a tutor or person who is writing on the board and the board itself. Thus we can see where the person writing on the board is pointing at when they are explaining some part of the problem, an important aspect when this video is watched in connection with the smartboard capture. Another reason for this recording is that we capture the person writing on or standing in front of the board while communicating with the class. Additionally, similar to the classroom recording, we think it is of value for a user to see the face of a speaker and their gesture while speaking. From this recording it is not easy to identify what is written on the board mainly because of the reflection of the projection. Hence we used an electronic whiteboard to capture everything written on it.

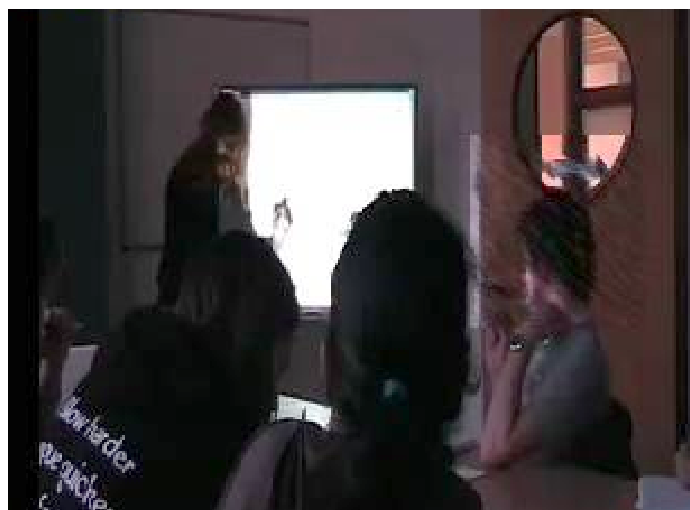


figure 3: Video of tutor

Capturing the writing on the smartboard was feasible due to its inbuilt software. Using the new generation of smartboard-software allows us to capture a movie file directly on the computer used to operate the smartboard. For our purpose this turned out to be the best way to

make everything written onto the smartboard available to the students by including it into our interface.

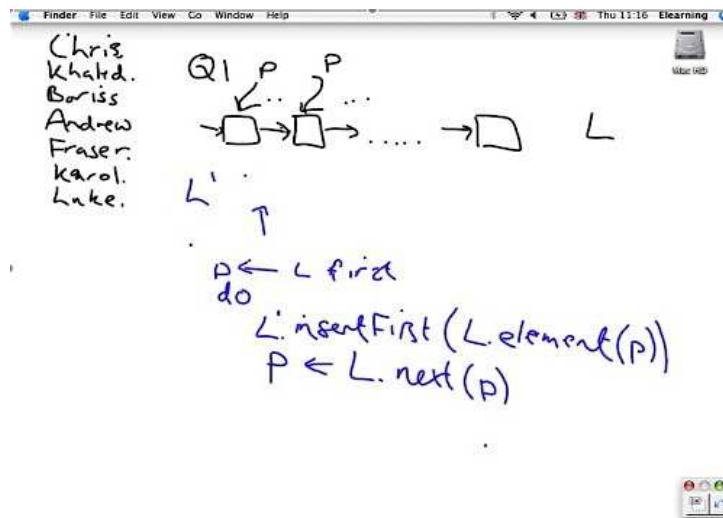


figure 4: smartboard capture

2.2 Interface design

Video data was processed into flash files while the interface was mainly build using Java. The design aims to be user-friendly and clear. A choice of topics and tutorials is listed as well as possible edited points of video (tutes) on the left side of the YouTube screen. Additionally a window for PDF files containing lecture slides and tutorial scripts can be found on the left side of the interface (see figure 5). Students can create, tag and share tutes as well as view other students' tutes and link them to related material. We see this stage as the basic infrastructure that will allow us to experiment with automatic indexing and selection, different structures for sharing learning and allowing students to structure personalised learning materials.

YouTube is designed to allow students to select pre-recorded tutorial videos and watch them to aid revision. In addition to basic playback it is possible to designate subsections of the videos to focus on a question of interest. We will use the term *tute* for a selected section of video that has been identified and tagged. Tags allow us to use search facilities and facilitate resource sharing. Longer comments can be applied to specific points in the videos to share thoughts with others or as an *aide-memoire*. Tutorial materials such as PDFs are provided for reference.

A major goal in the interface was to avoid reloading the page as far as possible, in order both to avoid the repeated overhead of building and initialising the page and its (heavyweight) elements, and to allow the players to continue while updates are being performed, hence improving the sense of workflow. This suggested the use of AJAX and asynchronous HTTP requests.

Server Backend

There are two servers; one streams the video using RED5; the other is a Tomcat server that is tied to the frontend.

Database

The basic information supporting the interface is maintained in a database on the server. User-created information such as tutes, tags and comments are appended to this database. Interaction with the database is achieved through two standard approaches; a) the use of JSTL tags in the JSP pages, and b) interaction with Java servlets provided on the server.

Client User Interface

The front-end to the interface consists of a web-based GUI based on Java Server Pages, and using JavaScript to mediate interaction of components with one another and with the server. All the JavaScript classes are self-documenting; they are annotated using the Javadoc standard, and appropriate 'Javadocs' can be generated from the code using JSDoc (<http://jsdoc.sourceforge.net>).

QuickTime™ and a
TIFF (LZW) decompressor
are needed to see this picture.

figure 5: The user interface, showing the major regions of activity

The selection components are linked to the database and allow the user to narrow down the area of interest for revision. Once a tutorial is selected, appropriate materials are loaded and displayed, and the tutorial's videos are loaded into the video display area. At this point a timeline is also displayed which represents the progress of the videos and the extent of the tute selection (see figure 5 and figure 6).

Video Control

The ‘video display’ section of the screen is central to YouTube and is supported by the ‘timeline interaction’ section containing widgets for interaction with the videos, and display components indicating the status of the videos. The videos themselves are played in the Jeroen Wijering FLV Player (http://www.jeroenwijering.com/?item=JW_FLV_Player), which provides a JavaScript API for controlling and monitoring the player.

Although there are three videos representing the tutorial, they should be treated as a single unit, playing, pausing, scrubbing and muting in parallel. Thus we introduce the concept of a **Timeline** as an abstraction of the three videos, and use this to coordinate them with the slider; this functionality is contained within the *tuteSlider* class.

QuickTime™ and a
TIFF (LZW) decompressor
are needed to see this picture.

figure 6: The timeline controls -- showing video control buttons, the slider with drag-able start and end thumbs, and time displays

The slider represents the timeline, the playable range of video; and start and end thumbs on the slider allow a range to be described within the timeline (see figure 6). The associated displays indicate the status of this overall timeline. This includes an indication of progress through the timeline, and of the start, end and length of a tute selection. There are a number of buttons facilitating interaction with the timeline; it is played, paused and muted as a unit. Further buttons allow the current selection to be played or to be saved as a new tute. Methods updating the time display should accept the most accurate values available, which in this case is seconds, as received from the JW player.

The appearance of the timeline is delayed until the video length is known, so it can be scaled correctly. The video length cannot be directly requested from the player, but can only be calculated from the update callbacks, so this introduces a delay during which the timeline slider is hidden. The videos must be started programmatically to force them to generate update events.

Synchronisation

Synchronisation is not currently implemented. A temporary fix if the videos become staggered is to click on the start thumb in the time-slider; this will reorient all the players to the position of the thumb.

At the moment synchronisation is created manually by pre-editing the videos before they are implemented into YouTube

3 YouTube in action

Since YouTube is designed for students we were keen to see students use it as soon as possible. Therefore we tested it on postgraduate students to see how clear and user friendly it is. If there would come up any obstacles we wanted to be able to alter YouTube if necessary before undergraduate students would use it under real life learning conditions. The next step is to distribute YouTube to undergraduate students, currently to second year students. This will allow them to prepare for examinations using YouTube.

3.1 Testing YouTube

YouTube was tested on Informatics, Psychology and Education postgraduate students. We used postgraduate students for this because we believe they are less sensitive to the relevance of the videos in contrast to undergraduates who might have been very concerned with the details of the content of the videos. We wanted to test the general usability of YouTube rather than the effectiveness of the learning material in the tutorials. In addition, we wanted undergraduates to use YouTube outside an experimental setting under actual real life conditions to give us feedback from this point of view.

But before we could release YouTube to undergraduates we were interested in YouTube's general usability. In the case that its handling would turn out to be less user friendly and self-explanatory than expected we could conduct modifications if necessary. Therefore we generated a task in which we tested YouTube's clarity. The test included how to create and tag a tute which we saw as important innovations in the YouTube system.

Task

The task for participating students was to watch 3 tutes of an Informatics tutorial for second year undergraduate students. Most Informatics postgraduate students should be familiar with the topic. The same topic was discussed in each video but in each video different tutors were teaching different tutorial groups.

The PhD students were instructed to view a specific tutorial topic ("Nearest Neighbours Methods") and watch the discussion of the first topic covered in the tutorial (labelled as 'tute W7Q1') of this tutorial. After finishing they were instructed to choose another tutor and watch the same topic covered by the new tutor. They were also instructed to do the same with the third tutor. The order in which they watched the videos was not predetermined; it was up to their own preferences which tutor they wanted to watch first.

After they finished watching these tutes they were asked to tag the tute they found the most interesting from their personal point of view. In addition to tagging, the participants were asked to watch the tagged video for a second time and find a part in here where a student is contributing to the tutorial task. On finding a student contribution, the evaluation test participant was asked to create a tute from this part of tutorial with the help of the timeslider to scan the video for the section they wanted to define as a tute. Thus they created a new tute from an existing tute. The PhD students were advised to use all features of YouTube they found helpful; they were also asked to talk aloud during the task; and they were told that they could approach the task in any way they like without restrictions.

These tasks were followed up by a discussion including a structured interview. Here the YouTube project team was also interested in hearing the participants' individual impression of YouTube.

During the duration of the task a member of the YouTute project was present in the room with the test participant. Participants were allowed to ask the member of the project questions whenever they got stuck or had the feeling they needed help.

Since the PhD students were not using YouTute for exam revision, the content of the tutorials was less important for them than it would be for a second year undergraduate student. The main aim of our YouTute evaluation test was to find out if YouTute works in a natural way for the students and if they could tag or create tutes easily themselves with no, or only a small amount, of help from a project member. This test was created to find out how we could improve our system to make it more likely to be adopted by undergraduate students revising for examinations.

Results

Most noticeable was the highly positive acceptance of YouTute by all test participants and that all participants could picture where and how to use YouTute to benefit their personal learning. Additionally they had good ideas for its use in the area of remote learning, other fields than Informatics and how students could personalise it. These results proof that the students can see clear benefits from using the system.

The participants also found the possibility to watch more than one tutor very helpful since each tutor has their own individual teaching style. But, in addition, it was beneficial for them to watch different tutorials because they could observe different students' contributions to the topic.

Postgraduate students involved in this user test were informed that during the task a screen capture was taken, this capture included video and sound. The purpose of this was to support our data analysis. The capture allowed us to see which functions of the interface the students used while they were working on the task, in addition, we recorded sound which gave our project member the chance to engage fully in the discussion at the end of each session instead of being distracted or interrupted by the need to make a transcript of the session.

YouTute usability

We were primarily interested in how self-explanatory our interface is. Since our users should be able to use YouTute without external help, just by reading the on-line instructions this is one of its main points if not **the** main point of its serviceability. The user is clearly able to work with YouTute without needing an extra introduction class to explain the system.

Is interface self-explanatory enough to use it without help	
Yes	No
80%	20%

table 1: Results of clarity of the YouTute interface use in general

Creating a tute

In the next step of our evaluation we wanted to see if creating a tute presented problems for novice users. Fortunately our results show that none of our participants had any problem in

creating a tute without previous knowledge how to do it (see table 2). Since only 50% of participants claimed to have read YouTube's instructions we can assume that our interface itself was clear enough for the other 50% to discover how to create a tute without help. That was an important finding for us since we expect users to be able to create a tute by themselves at home or at University. Our participants were not only generating tutes but were also naming and providing a short description of each tute. All participants managed to do everything without difficulty which again states that a student using YouTube can work independently and effectively with our interface.

User created tutes are stored in the data base and are accessible by other users which makes naming and describing a tute important because then a users, can select tutes directly rather than needing to refer to the main tutorial video. This also shows that YouTube's is a viable instrument of the online-learning and social networking community.

Was it clear how to create a tute in YouTube (without help)	
Yes	No
100%	0%

table 2: Results of clarity of how to create a tute in YouTube

Tagging

A tag is here defined as a very short description, usually 1 to 4 words, added to a tute. This implies that each tute can be tagged more than once which again means that it can later be included in a search engine on more then one level. The same tute may come up for a tag i.e. "Interesting" or "AVL-trees".

YouTube already contained a list of pre-defined tags and additionally all tags created by any participant were stored in this list. Presenting pre-defined tags is one possible explanation for why more than half of the postgraduate students decided to use existing tags. An analysis of all screen captures taken during this task shows that more than half of the students looked at how to create a tag but in the end 60% of all participants used one of the tags already available from the list (see table 3). The preference to tag tutes with already listed tags might have been caused by the fact that we did not ask our participants to create a tag in our instructions and they might not have found it as important for the task to create a tag as to create a tute. But this can only be an assumption since we cannot say how they would have used the tag function of the interface outside an experimental setting. In addition our test was primarily to assess the usability of YouTube and so the subjects were not particularly interested in the content of the tutes. We anticipate more new tags will be created in a context where users are concerned with the content of the videos.

In the event of tagging a tute: Did you use a pre-defined tag or created your own?	
Pre-defined	Created own
60%	40%

table 3: Usage of pre-defined or self-created tags

Our evaluation was able to show that we are having an effective and easy to adapt online-learning and social networking system in YouTute. We could proof that its users can see clear benefits from using the system. Additional we were able to show that YouTute is an intuitive system that a novice can use effectively without previous training or practice. All its users can exchange information between each other by creating and naming individual tutes. These tutes will be recommended from one user to other users who themselves can again create tutes. Thus YouTute is formed from the community it is used by. Looking at statements from our evaluation participants also shows that each one of them could imagine how to increase their personal learning benefit using YouTute, although they all have individual approaches to learning. Since YouTute comprises not only of video but also of lecture slides and tutorial scripts it gives students the possibility to approach it in their personal ways of studying.

3.2 YouTute in Real Life

At the moment all second year Informatics students have been invited to use YouTute as revision-tool to prepare for their exams. Within this group of students some took part in the recordings while others attended classes on the same topic but were not recorded. To be able to evaluate YouTute we integrated a questionnaire into our interface, each user is asked to complete it. Already completed questionnaires show a strong tendency of acceptance to use YouTute regularly.

We are still in the process of collecting data from the second year students. We anticipate that students will continue using YouTute for their revision until resit diets for this term are over.

3.3. Next steps

Our next steps are to further analyse the data we collected from the postgraduate students in our experimental setting as well as the feedback we will get from second year students using YouTute under real learning conditions.

It is already planned to improve observers' condition by re-sizing the videos, especially giving them the opportunity to enlarge the smartboard video. A second step will be to enable the user to delete their own tags, something they are not able to do at the moment. And something the postgraduate students mentioned they were missing was a space where they could write down notes within the interface which they can later share with their co-students. We also intend to improve the search facilities since this will become more of an issue as the volume of content and tutes grows.

4 Outlook

Further research will reveal how much students can benefit from using this vicarious learning web-solution. Our hope for the future is to introduce YouTute to more students in Informatics as well as making it available to students of other Schools at the University of Edinburgh. It is built to evolve with time and is used by a student community which hopefully creates more and more tutes and tags over time. Currently we are aiming to include more tutorials over the next term.

Another aspect of YouTute is that it may not only be beneficial for students. It can be helpful for tutors as well. Inexperienced tutors could, for example, watch tutorials of more experienced tutors to observe their teaching style. Or a tutor could watch their last tutorial or a tutorial lying back further in time to allow them to review the material covered, the response of the students and the effectiveness of teaching strategies. In general YouTute can be

beneficial to students and tutors. In later rounds of testing we will involve tutors in the evaluation.

Additionally YouTute shows good potential to be used in remote learning. Students who are not able to attend a tutorial because of long travel distance to their University during certain times or students who might not be able to leave their house can still have the feeling of being part of the tutorial experience and will therefore also be part of a students' community able to stay in dialogue about class-content with their peers. It should be noted that we are not aiming to make the classic tutorial, containing a tutor and students in a classroom, redundant with our interface. YouTute is designed to support students' learning and not to substitute experience of real tutorials and personal contact to a tutor. One of the goals of YouTute is to support and increase the value of traditional tutorials by capturing what is usually ephemeral and allowing learners to process that material to support their learning.

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