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How Physics Teaching is Presented on YouTube Videos

Peter Gustafsson

Mälardalen University, Västerås, Sweden

peter.gustafsson@mdh.se

Abstract

One hundred and twenty videos on YouTube were selected and investigated in terms of content relating to physics and science teaching. This video material was used to generate categories that were then applied to three investigations: physics as taught in upper secondary school and in the introductory level at university, physics projects in upper secondary school, and science in preschool. The results revealed different practices for the use of YouTube in physics and science teaching. One practice, in upper secondary school and at the introductory level at university, was to display physics based on traditional lectures that were video recorded. Another practice was the presenting of students' projects, and a third was support for preschool teachers as a means of promoting science material for their teaching needs.

Keywords: YouTube; Video; Physics Teaching; Educational Tool; Innovation

Introduction

Innovations can change the conditions for teaching and education by providing new educational tools. Examples from the past are tools such as the printed book and the black or white board. Other innovations are tape recorders and movies and, nowadays, the Internet has become yet another tool.

Today, many users have access to the Internet through different devices that include pocket devices such as the smart phone. Using these devices to access multimedia is natural for today's youth, or the Net Generation (Berk, 2009) as they also are called. They therefore possess experience suitable for multimodal learning. Easy access to the world and the flow of information in our digital age also gives the Net Generation better potential to learn through connectivism (Siemens, 2005). Connectivism describes how the personal network connects to other users, organisations, and institutions; a process that is free in time and space and not limited to traditional learning institutions such as schools and universities. Future students will probably envisage learning activities based on student control, responsibility, and freedom and thus can be assumed to be yet more diverse learners than current students are. As teachers, we have to relate to these developments.

One potential new educational tool on the Internet is YouTube. This website was opened in February 2005 and it enables users to share video clips through uploading and viewing. The only obligation a user has in order to be able to upload movie clips, is to register—which is free of charge. YouTube is considered a social network because the uploaded clips which are user produced, can be commented on by viewers, thereby giving the producer feedback. Viewer comments can also be commented on by other users.

Of course, it can be questioned whether technical developments are useful as pedagogical tools. An important benchmark for education politics in many countries has been the Programme for International Student Assessment (PISA) conducted under the auspices of the Organisation for Economic Co-operation and Development (OECD). Because PISA has to be free of cultural bias, it is very narrow in its selection of tested areas as well as in methods for the tests. This narrowness promotes teaching methods that can be seen as rather traditional, which induces politicians to draw generalised conclusions which the test results not support regarding, for example, educational resources and class size (Sjøberg, 2012).

In contrast to this point of view, educational research continuously results in new pedagogical tools and methods that map out new ways for learning. For the purpose of identifying and understanding those new ways, it is of interest to study how each new technological tool can be helpful in teaching and learning practice. For example, as a tool for learning and as part of courses, can we as teachers guide students to produce and upload videos to YouTube and also, to view each other's productions and comment on them?

It has been documented how the use of videos, especially in introductory courses and for introducing complex topics (Berk, 2009), can support learning and enhance learning outcomes and be of value for learners who are helped through visual experiences. A review of previous research identifies how teachers promote the use of YouTube as a teaching tool and, better still, how the teachers actually use it. In the journal, *The Physics Teacher*, there is a monthly column with readers' tips of how to use YouTube, and articles on the subject too. An obvious use for YouTube is to deliver lectures (Haase, 2009), but it also has value as attention grabber, focus concentrator, and for distributing instructions (Berk, 2009; Jones & Cuthrell, 2011). Several examples of these YouTube applications can be found (Riendeau, 2010a, 2011). There are also reports of computer-based laboratory work in, for example, mechanics, which use YouTube for video analysis (Riendeau, 2010b; Ruiz, 2009).

Other than these examples of a dedicated and obvious use of YouTube, few investigations have been done to investigate how video clips on YouTube present physics teaching and, in relation to this, how teachers and students are using this technology. Knowledge of physics education content on YouTube is important for a pedagogical practice to develop, and to direct teaching and learning for future use.

The ability to describe physics concepts and laws in context, particularly everyday contexts, is of importance in science education. The importance of context for learning and recalling was established early (Godden & Babbeley, 1975), and its value has been shown in relation to studies in physics too (Rennie & Parker, 1993). Tasks connected to a context have also been found to be more tempting to solve but in order for the student to understand the tasks, the context has to be familiar and relevant; and a context suitable for one student is not necessarily of interest to others (Park & Lee, 2004; Rennie & Parker, 1993, 1996; Whitelegg & Parry, 1999). Therefore, a variation of contexts in the presentation is necessary. When using videos in teaching, various aspects of context could probably be included easily through the selection of the materials used.

It is also interesting to identify whether the on-going discussion of physics as a male domain is reflected in YouTube videos. For example, the choice of context for activities is of importance in making the subject relevant for women (McCullough, 2011; Rennie & Parker, 1993; Rennie & Parker, 1998; Staberg, 1994).

This article, based on an unpublished conference proceeding (Gustafsson 2012), has the objective of conducting a preliminary study to obtain information on what material, related to physics education, is uploaded on YouTube and also of investigating possible uses of video clips for teaching physics at different stages of school and university.

Research questions

Besides the objective of mapping out physics-related video clips on YouTube, it is also of value to connect to discussions of physics as a male dominated domain and a subject that appears dull to women. Furthermore, it is of interest to study how the context in which the subject is placed, matters (McCullough, 2011). The following research questions are therefore formulated:

- How can YouTube clips related to physics teaching, be described?
- In respect to physics education, what kind of usage can be found for these video clips?
- What representations of gender and context can be found?

Methodology

This study falls within the area of interpretive research (Walsham, 2006). The material investigated is primarily video clips on YouTube, as well as the titles and descriptions of the clips to identify the level of education presented in the clip. This is information that the producer of the video clip has submitted. The comments written by viewers of the clips have also, to some extent, been read to obtain further information for the study.

Sample selection

Because there is a huge quantity of video clips on YouTube related to physics, a limitation to the sample was needed. For this purpose, the search engine at the website was used. It was used for three investigations using three different sets of search words. Most of the searching and sampling was performed during February 2012 when 80 of the videos were sampled, and then extended with a search during November 2012 when 40 additional videos were sampled.

In the first investigation, the aim was to map out how different areas within classical physics were presented in YouTube clips. For this, four selected concepts were chosen: *physics + mechanics*, *physics + thermodynamics*, *physics + electromagnetism*, and *physics + waves*. Even though mechanics, thermodynamics, electromagnetism, and waves constitute fundamental areas in classical physics and, in that respect, are valid search categories, they can also be valid in everyday contexts that include phenomena that cannot easily be related to a subject discourse of physics. Therefore, many video clips, irrelevant for this study, were presented as result of such an open search. This is the reason why the word *physics* was also added to the search string. It gave a sharper focus to the result list.

In a second investigation, the search words used were *physics + projects*. The thought was that this would present video clips containing students' projects. In the third investigation, the intention was to find relevant videos for preschool. The search words were originally *physics + preschool* but this combination resulted in very few hits—only 163—therefore it was changed to *science + preschool*.

To limit searches and sort the results, filters can be applied to YouTube. In this investigation all filters were open but one. That was the filter that limits the search to videos. In the first investigation the combination of *physics + mechanics* resulted in over 24,000 hits, also the highest number in the whole study. In the first investigation the lowest number of hits was for *physics + electromagnetism* with 2,200 hits.

A second investigation with *physics + projects* as search words resulted in nearly 5,000 hits. The investigation on *science + preschool* resulted in just below 1,900 hits in the search performed in February 2012. However, this was well over the original 163 hits for the search combination of *physics + preschool*. The search in November 2012 for *science + preschool* resulted in 4,170 hits. This was an increase of 120% in just nine months, indicating a growing interest in using YouTube to promote ideas and material.

Because it was not viable to investigate 24,000 video clips nor even 1,900, the lowest hit result, a selection was required. A grading or rating of hits is always done by YouTube for the result presented in relation to a chosen indicator. The alternatives for this indicator are predefined by YouTube. For these investigations, *relevance* was prioritised at the expense of *published date* and *number of displays* because neither of the two latter indicators had any apparent meaning for this study. The algorithm for sorting by relevance function, however, cannot be tracked. In March 2012 YouTube also added *ranking* as a sorting parameter but that was not used in this study since most of the data was collected before that month. As a sample for further investigation, the top 10 results from *relevance* for each search were taken.

A total of 60 videos in the four traditional physics areas were used in the first investigation. Of these 60 videos, 30 were by identified using the search word combination *physics + mechanics*. In an earlier investigation of the material, the effects of language choice were studied (Gustafsson, 2012) to see if there was an Anglo-American bias. Therefore a German and a Swedish/Danish (the words for physics and mechanics are identical in these two languages) translation of *physics + mechanics* sample of 20 videos was included in the material. However, the teaching language was not found to have any effect. A chi-square test on the English versus the non-English material showed that there was no language bias regarding setting or gender (Gustafsson, 2012). A conclusion from that result could be that the teaching of physics approach was not bound to language barriers, at least not in the video material studied.

Sixty videos of the total 120 videos were used for the two other investigations with 30 videos for each investigation. Originally 20 videos, 10 for each investigation, were sampled in February 2012. These two samples were later extended in the November 2012 search with 40 more videos for the second and third investigations. Here the 20 top videos were used for each investigation and the results added to earlier findings. If a video in the November 2012 search was identical to one found in February 2012, it was excluded in order not to duplicate the data, and the next hit was used instead so as to secure new material for the investigation.

Data analysis

For analysis of the videos, a methodology in line with grounded theory (Glaser & Strauss, 1967) was chosen. A data set was then generated by studying the videos and describing the content in them with key words derived from observations made by the researcher. The key words were chosen to form a descriptive observation within several dimensions of the social situation that the videos presented (Spradley, 1980) and with focus on space, actor, activity, and object. These key words were then used to generate main categories with descriptive subcategories related to the research questions, but also to other features that were apparent in the material such as producer, organisation, or similar if identifiable.

This process resulted in three main categories with three to four subcategories each. A main category appeared, being *setting*s for the recording. Associated with this category were the underlying categories *live lecture* and *studio lecture* for a lecture with pedagogical content but with no audience, *demonstration* and *other*. The *gender* of the actors and type of *producer* (commercial, organisation, or private) were also generated as main categories. That *producer* would be a category was not directly apparent from the research question. But in relation to formulating an answer to the question, “In respect to physics education, what kind of usage can be found for these video clips?” the producer turned out to be a revealing category. See Table 1 for the structure and indicators of these categories. The same categories were used for all three investigations. For the second investigation, the category *demonstration* also included presentations of projects.

On YouTube, viewers can write comments on the videos. These were read to some extent because they gave an indication of viewers’ opinions of the videos. The headings of the videos were read because they sometimes gave information regarding age or school level.

Table 1

The categories and indicators generated and used

Main category	Subcategory	Indicators
Setting	Live lecture	A recording in a live situation with both teacher and students/children present and active.
	Studio lecture	Only a teacher present and giving a presentation/lecture that could have been given in class.
	Demonstration	A demonstration of material, phenomena, or equipment for students or children. Presentation of the activities and results of a student project.
	Other	No education-related activity.
Gender	Female	Female gender as active person/persons. That is for an adult in a teaching situation. If no adult is present, female gender of student or children.
	Male	As above but male gender.
	Mixed	As above. Mixed gender active.
Producer	Commercial	If the main purpose of the video is to promote a product or service for sale.
	Organisation	If a URL or organisation name is shown, but the main purpose is not to promote selling, but to inform.
	Private	No organisation is visible as producer.

Authenticity, limitations, and plausibility

For interpretive research methods, the authenticity and plausibility of the data must be considered as well as the pre-understandings of both the researcher and readers of the study (Walsham 2006). For this study there was no indication or reason to believe that the videos were not genuine or were placed for a manipulative purpose on YouTube.

The limited number of search words produced a sample of videos that only reflected part of all physics-related videos on YouTube. But this was also the objective of the study; through a preliminary study, present a sample of what could be found on this website related to physics teaching.

It is possible to raise questions about the selection of a sample on the basis of search words. For the present study, the top 10 or 20 video clips in terms of relevance were chosen. Other forms of selection might have given other results. For this study the procedure for selection of sample is openly presented and motivated, given that the results can be compared to results from other methods of selection.

Regarding the pre-understanding of the researcher, the key words were generated and the studied video situations were observed on the basis of the researcher's knowledge and experience as a member of what could be called a physics subculture. Therefore, to make the results plausible and consequently reliable, key words had to be found that could be understood by the general public, and not necessarily be related to the subject of physics. The video material on YouTube is also open for all to investigate so other researchers can perform studies to investigate the reproducibility of the results.

Results

The first investigation

When searching on traditional physics areas, the samples of videos were dominated by clips produced in a studio with a teacher giving a lecture on some well-defined concept or phenomenon, on a board or as a Power Point presentation. There was no audience and the clips were between three and 11 minutes long.

Of the 60 videos, 48 were in this category—*studio lecture*. For the searches on thermodynamics and electromagnetism, this was the only category present in the sample and for the mechanics and wave searches, this category was found in 22 of 30 videos, and in six of 10 respectively.

Of the 48 videos recorded in a studio, 29 were produced under a specific producer name, here labelled as an organisation. The remaining 19, and those five categorised as live lectures and demonstrations, could be defined as private productions since no name of any organisation was identified.

The second most frequent type of video for the mechanics and wave searches was the *live lecture* with a class of students present. Here, some classic American universities were included with contributions from Berkeley, Massachusetts Institute of Technology (MIT), and Stanford that had four videos between them. These videos showed full lectures of lengths between 38 and 70 minutes. The lectures included a professor talking, writing on the board, showing pictures, and giving demonstrations, sometimes with the assistance of a student.

Video recordings just of demonstrations were found in three of the sampled videos namely, a gyro, a pendulum, and an air track with several male and female physics teachers demonstrating movement. The remaining five videos were categorised as *other* and included an interview, synthesizer sound, two videos with a singing man, and one video documenting an inventory of laboratory equipment.

The quality of all videos was of good standard and it was easy to hear the lecturers and see the writings on the boards. The videos presented first-rate teachers who appeared to have long experience. The viewer comments on the videos were almost without exception very positive: "I love this, Great lesson, I am really amazed . . . very basic but really good explanation . . . wow . . ."

Of the 52 videos in the sample where live lectures or studio lectures were presented, 47 of the lectures were given by a male teacher. The videos that presented a woman as teacher all came from the same producer. In one of those, a male voice was used occasionally to comment on some of the demonstrations included in the video. For a summary of all results, in numbers, see Table 2.

Table 2

A summary of the results for the three main investigations is presented. On top (the table turned) the different generated categories are given. The number gives observed occurrence within each set of ten videos

Investigation:	*Search words:*		Setting				Gender			Producer		
		Number of videos	Live lecture	Studio lecture	Demo	Other	Female	Male	Mixed	Commercial	Organisation	Private
First, four physics areas	*Physics + mechanics*	30	3	22	2	3		27	2		5	22
	Physics + Thermody-namics	10		10			1	9			8	2
	Physics + electro-magnetism	10		10			4	6			10	
	Physics + waves	10	1	6	1	2		6	1		6	3
First, in total		*60*	*4*	*48*	*3*	*5*	*5*	*48*	*3*		*29*	*27*
Second	*Physics + projects*	30			30		7	19	3			30
Third	*Science + preschool*	30			5	5	24	1	1	11	7	12

The second investigation

For the investigation of projects, all but two of 30 videos showed student projects conducted mostly in upper secondary school. Upper secondary school is used here as a synonym for senior high school. The school level was determined both from the visual expression in the videos and from titles and descriptions of the uploaded videos. A couple of the videos showed teachers conducting projects and therefore, had the characteristics of demonstrations. Due to the electromagnetic content in these demonstrations, it is possible that the videos could also have appeared in the first investigation had a larger sample been taken there. The projects were all relevant physics projects presented with care and seriousness on the part of the students and teachers.

Nineteen videos were presentations by men, seven by women, and three were by mixed genders. In one video, no person was shown and therefore no gender could be identified. The environments where the videos were recorded varied. Some of the projects were placed indoors in a classroom or at a student's home. Other projects were conducted outside in a schoolyard or in the backyard of a home. The videos were between 15 seconds—a small trebuchet built for a physics project in Grade 12, according to the information at the video clip—and 14:05 minutes—students in their senior year of upper secondary school performing a project in physics class that closely replicated the Discovery Channel show, *Mythbusters*. Three of the presented projects were Rube Goldberg machines (Rube Goldberg, n.d.), probably participating in the yearly contest, and these seemed to be a lot of fun for the students.

The third investigation

The sample of 30 videos from the investigation for preschool videos contained 18 commercial videos promoting different preschool organisations, and learning materials for science in preschool. Many of them had the purpose of selling such learning materials and YouTube functioned as a commercial area for them. Sometimes a teaser from the material was presented—for example, a fun experiment.

In addition to the commercial videos, there were seven videos that presented organisations but selling was not their main purpose. The remaining 12 videos were categorised as private productions. These video productions were made to show how science could be done with younger children.

The content in the videos categorised as *organisation* or *private* included different science-related activities such as growing plants, producing carbon dioxide from common household items, making a paper clip float on water, and taking a walk in a natural environment. One clip presented science planning for preschool and another clip presented mathematical exercises with numbers. Their lengths ranged from 59 seconds to almost 10 minutes.

In 25 of the videos, women were present or speaking, often together with children. In two videos, a man was doing activities together with children. In one of these videos, women were also present. In 10 of the videos, children were present and in two of them, there were only children acting. Two videos could not be gender coded.

Discussion

Several interesting observations can be made about the collected material. Even though all videos were sampled from the same source, YouTube, and all sampling contained *physics* or *science* as search word, clear difference in content was observed. These differences are obviously related to the choice of additional search words.

Male dominated and traditional lectures

For the first investigation, conducted with the search word *physics* plus one of four physics areas, most of the videos featured men presenting physics in a studio setting. When *live lecture* was added to the search, in 52 out of 60 video clips or 87%, physics was presented in the form of a lecture for an audience present, or watching the video.

The target groups for the videos were upper secondary school, college, and the introductory level at university. This conclusion was drawn from the content of the lectures and the ages of the students in the live lectures and gives a rather narrow age span for the expected viewers. Of course, the selected search words could have contributed to this effect, since the selected search words represent different areas in physics that are presented and elaborated at this level of education in most school systems.

Physics as a subject was presented very traditionally in the videos. They displayed how physics is commonly taught throughout the world namely, as a presentation on a board, or as a collection of concepts and laws. The live lectures presented physics as an indoor, basically theoretical experience for the students even when demonstrations and some real-life examples were included. The fact that the video content showed reproductions of how physics is generally taught indicates that this educational tradition has not altered with the introduction of new technology.

In the present study, it is also once again demonstrated that physics is a male domain with only a few women involved in the presentations. The videos with female lecturers all came from the same organisation and it can be assumed that there was a conscious choice of gender for those presentations. If some producers showed awareness and could make such decisions regarding gender, it was surprising that no example was found where physics concepts and ideas were presented and demonstrated in more innovative ways when using video as media. It is easy to move outdoors and present physics in real life contexts.

Even when viewer comments were positive or even very positive, it must be remembered that these comments were probably posted by viewers who had found what they were looking for, that is explanations and presentations of unsolved questions regarding physics concepts. One can assume that the viewers posting positive comments were students who had been struggling with the understanding of concepts and physical models. Because attending classes in school had not helped these students to grasp the content, do the homework, complete the assignment, and perform well on tests and examinations, they considered YouTube for assistance.

Alternative views and uses

A contrast to this positive picture of traditional physics teaching is given by Slisko and Dykstra Jr. (2011) who reported on a YouTube clip illustrating a practical solution for a textbook problem that was supposed to be fun. The video, however, showed how bizarre the problem was and it had had nearly a half a million views by 2013 with comments such as: “I knew there was a reason why I hated physics!!!” and “LOL wonderful! God, I hate physics.” These could actually be the same, or similar, students who made positive comments on the YouTube clips selected for this study and who described their frustrations in the physics classroom. The attitude is also manifest as a more general attitude towards science studies (Osborne, Simon, & Collins, 2003), and presumably related to a low interest in studying science. This observation is especially valid for women in European countries and Japan (Sjøberg & Schreiner, 2010).

A partial explanation for the attitude that physics is frustrating, not connected to the real world, and only a profession for men is in line with what was evident in the first part of this study—the reported male dominance among the lecturers, indicating that physics is not a subject or career option including or involving women. This is also in line with earlier findings (Benckert & Staberg, 2001; Staberg, 1994; Tobias, 1990). For the learner who has to enter a new community of practice, two processes start. One process is acquisition of knowledge, and the other is participation in the knowledge community (Sfard, 1998). If the community more, or less, consciously presents the knowledge that must be acquired to participate in the community as intellectually complicated and hard to grasp, and if the community is both competitive and dominated by one gender the way physics is, there could be a reluctance to participate in the community, especially from women (Carlone, 2004).

Therefore, it is regrettable that no more innovative material was found among the studied videos. Using the YouTube site, there is the potential to produce and present physics in real-life contexts with both genders as participators on equal terms. Berk (2009) has presented a list of 20 possible learning outcomes of using videos for teaching. If this list can be viewed as criteria for using and selecting videos for teaching, it can also be regarded as a list of objectives when producing a video. These objectives could be to catch the viewer’s attention, generate interest, foster creativity, provide inspiration and motivation, and make learning fun. With such an agenda for producing videos or searching for YouTube clips to use in science class, a change in attitudes from physics as a subject only for a few and not connected to everyday life, could start.

YouTube could also be a resource for other activities in line with Berk’s (2009) list of learning outcomes. Jones and Cuthrell (2011) suggest reference videos in connection with elementary instructions and as springboards for classroom activities. To find appropriate videos as resources within the subject of physics, it is obvious that search words other than those used in this investigation have to be used.

The example from Slisko and Dykstra Jr. (2011) also demonstrates the possibility of using YouTube for evaluation. For example, as teacher you can let the students post comments on the YouTube site for videos used in teaching.

In other examples it has been demonstrated how to use easily accessible YouTube videos for computer-based laboratory work (Riendeau, 2010b; Ruiz, 2009). Here one can select materials actively and reject the traditional and male dominated views of physics.

Active students

A more untraditional picture of physics was evident when considering the second investigation, physics projects. The physics presented here was also related to what is usually taught in upper secondary school and at college level in terms of content, as in the first investigation. But they featured active students showing the results of projects and demonstrations. There are also female students participating. Even if these were a result of mandatory courses for both genders, they demonstrated willingness among all students to upload their videos. It is plausible that the students were instructed by their teachers to do these video recordings as a part of assignments in a course and then to upload the clips. It could even be so that the teacher watched the clips as part of the assessment of the students.

Videos of this kind could be used to inspire pupils and students before starting a project. In addition, they could provide ideas for possible projects, as well as ideas for how to realize them and how to present them. The students would not necessarily be expected to copy what they have seen on YouTube, but they might get an idea of what to do or what to avoid (everything uploaded on YouTube is not good) or just an eye-opener.

Preschool as a market

A not unexpected but still interesting gender shift was obvious when considering the third investigation, science and preschool. In these YouTube clips, women were in clear majority as among preschool teachers. There was also a more apparent commercial purpose to videos in this investigation. Approximately half of the videos were advertisements related to science in preschool while the rest showed more regular preschool activities. The result indicated the existence of a market for presenting and selling teaching material for doing science in preschool. Therefore, a shift from knowledge and competence sharing through YouTube to a market using YouTube was observed. This market contained products to help preschool teachers compensate for a lack in competence, with ready-made solutions. An extension of the teaching of these subjects appeared to be needed. It also promoted services to a target audience of education officers. A result is that these YouTube videos unintentionally send a signal to preschool teacher educators, that it might be a good idea to revise the curriculum regarding the science and technology content.

Conclusions

When searching on YouTube with traditional physical concepts as search words, a traditional picture of physics teaching for upper secondary school and college and also for science in preschool is obtained. This is not, perhaps, such a surprising finding but still a bit disappointing. Even though movies and videos have been around for years and the Internet has helped introduce new social media, the use of these as pedagogical tools has not meant a change in the teaching of physics as displayed in the reviewed videos. The lectures found on YouTube were of a good pedagogical standard and appreciated by the viewers but videos on YouTube could also lead to a change in teaching. With a sensible choice of videos, or by producing their own videos, teachers could probably help diminish the view of physics as a dull and uninteresting subject and hopefully influence the gender identity of the subject to not to be so male dominated in the future.

Videos could also be used by teachers in many ways. For example, a search on YouTube with the phrase, *physics lesson planning* gives several interesting results. There is also the possibility that teachers use YouTube as suggested by, for example, Berk (2009) and Jones and Cuthrell (2011) as a pedagogical element in teaching. To find out if this is happening, a more extended investigation must be conducted, with visits to classrooms or interviews with teachers.

For displaying student work and for active use in teaching, YouTube offers various possibilities for the prepared and interested teacher. The second investigation demonstrated that if students themselves produced material, multiple skills were involved such as physics knowledge, planning and conducting projects, working in teams, and technical control in making and uploading the videos. No gender barrier appeared to affect this.

For preschool, perhaps what is needed is not more videos for young children but instead, inspiration and knowledge for preschool teachers which may motivate them to include science in daily activities for the children. For this purpose channels such as YouTube, with more genuine uploaded clips, could be an inspirational source. It is apparent that knowledge of good science teaching and practices involving YouTube exists among teachers even if it is not widespread. This also provides the potential for teachers to reclaim the arena of teaching science that now, unfortunately, is increasingly dominated by the market.

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