

# Openness of academic subjects for single and multipart e-learning

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## 1. EXECUTIVE SUMMARY

This article is devoted to a discussion on opportunities to adapt academic subjects to asynchronous e-education with the preservation of learning effectiveness. Opportunity to change form of education may depend on environment used in a didactic process. If the only thing which can be used is a computer with an access to the Internet (such environment is called singlepart) it is obvious that no subject cannot be taught where a student has to acquire any manual skills (operating tools, doing experiments, examining real objects, etc.). In such conditions it is impossible to teach interactions between people (e.g. conducting medical examination or therapeutic interview, etc.) because to do this, direct and uninterrupted communication with a real man is needed.

In remote learning through the Internet we can use elements of a real environment. Properly formulated tasks will encourage or even force student to do certain experiments in “domestic conditions”, perform certain creative works or make contact with other people. Educational environment that considers the usage of real subjects, taking actions without a computer or talking to other people or even observing them (called multipart) allows to enrich a didactic process. So can all university subjects be taught through the Internet as effectively as in a traditional way?

Unfortunately the answer is no. There are some features which prevent from effective learning of a certain field of knowledge through the Internet. In the article, there are three main features of an academic subject defined which make that subject not susceptible to e-teaching, which means it cannot be transferred to the Internet without losing the education quality (regardless the used technology and type of environment). It was proved that this list exhausts all conditions, which means that a subject which does not have any features mentioned in the article may (sometimes with small changes in methodology) be taught asynchronously through the Internet.

## 2. INTRODUCTION

Bloom's Taxonomy distinguishes three basic goals of education: (1) cognitive (2) affective (3) psychomotor (Anderson & Krathwohl, 2001). Achieving those goals by students is possible if a teacher uses appropriately adjusted methods both to the education environment and to the presented information. Authors anticipate the following problem: whether for every subject / issue / topic we can choose such e-learning methods so that, thanks to the Internet courses, we will achieve the set educational goals?

In the article, the educational environment is regarded as a system, software (including e education platform and Internet browser) and also available multimedia together with programs to create them and scan them. Such knowledge resources will be probably enough to discuss the theoretical issues, transfer book learning, teach certain abstract reasoning, therefore to realize didactic process which goal is "cognitive". Unfortunately, the other educational goals require environment elements that go beyond virtual world - "affective" relies, to a higher degree, on a direct interaction with other people, whereas "psychomotor" relies on capturing skills of performing certain activities (other than typing and clicking). It seems to be justified to distinguish those two e-education environments. The first one which is limited to the virtual world (everything that is needed in learning is in the computer with an access to the Internet) is called *singlepart*. The second one that goes beyond the virtual world (a student has to use real things, people, landscape elements, etc.) is defined *multipart*. Each of those environments possesses certain characteristic conditioning which make it easier or impossible to teach certain content, issues or subjects effectively.

E-learning allows to overcome geographic and time barriers in relation teacher-student. It is particularly important in case of people who, due to different reasons, have hindered access to traditional (stationary) form of education e.g. economically active or disabled. Every year the number of classes offered by high schools which a student can undergo through the Internet increases. It concerns full-time, evening, weekend and postgraduate studies. Teachers of many subjects try to use opportunities offered by the new form of education and transfer their classes to the Internet. Very often it is only publication of lecture content in the Internet: on web pages, on e-learning platform, or on a blog. Then a direct transfer of the whole lecture content takes place, without changing the methodology of a certain subject. In many cases it brings satisfactory results. At the same time, we can indicate such subjects where e-learning is not effective - e-classes are less effective in comparison with traditional classes. Why it is so?

When seeking answer to that question, the authors used their own experience resulting from long-standing didactic work at the Faculty of Mathematics, Informatics and Mechanics and Faculty of Psychology at the University of Warsaw, at the Warsaw School of Social Sciences and Humanities (full-time classes) as well as at the Centre for Open and Multimedia Education at the University of Warsaw (e-classes).

We can argue that the form of presented material has the main influence on the reception of knowledge transferred within remote learning. The more attractive illustrations, more animations and videos, the more interesting for receivers (students) an e-course is. The mentioned elements added to the texts are to replace real meeting with master-teacher and make e-classes bring similar or even better results of education. However it is not true, because as it was proved in numerous experiments only well-thought over usage of illustrations will increase the quality of education, and the excess gadgets are ignored by a student or make it more difficult to use the material. (Calrk, Nguyen, & Sweller, 2005) (Misanchuk, Schwier, & Boling, 2000). Such actions only camouflage real problem connected with the transfer of classes to the Internet, of which main issue lies more deeply.

## 3. SUSCEPTIBILITY OF ACADEMIC SUBJECTS TO E\_TEACHING: SINGLEPART CASE

Term *academic subject* does not mean single courses, for which students get a course credit in the student's record. It constitutes the whole part of knowledge and abilities necessary to obtain certain level of professional qualifications. In such understanding the whole studies usually consist of several academic subjects. For instance economics may consist of the following elements: mathematics, foreign languages, (micro and macro) economics, social and political science, law, methodology of

research (probably this list is not complete but indicates basic groups of issues discussed during studies).

To understand what are the difficulties (what they result from) connected with the adjustment of stationary classes to teach them with the usage of a computer, the authors have assumed there are no technical limitations. It means that both a person conducting an e-course and all the students are fluent in using new technology and have an unhindered access to it. They are able to perform all actions and use all capabilities of domestic computers (e-learning has to be based on software available in households). At the same time it was accepted (a bit for growth) that e-learning platform allows to realize even the most challenging methodological ideas. With such assumptions, e-teaching of two chosen academic subjects was observed: mathematics and a foreign language.

### 3.1. Teaching of mathematics

Traditional teaching of mathematics is based on two types of classes: *lectures* and *practical classes*. The goal of a *lecture* is to indicate the directions of further education, discuss ideas which were the source of the research done for certain solutions and finally to present the proofs of more important theorems. It should be remembered that the proofs are showed in such a way to present the ideas and methods but not all details. Students are expected to supplement their knowledge obtained during lecture with detailed calculations, additional theorems, topics and examples included in a textbook. Whereas the *practical classes* are to obtain practical skills: problem solving, using familiar conclusions and methods in own work and to create examples and counterexamples for definitions and theorems. They are based on tasks solving presented by the teacher. Students usually solve them on their own, and then one of them, with the help of a teacher explains the solution.

The disadvantage of the whole traditional system of maths teaching is passivity or relative passivity of students. During a lecture students may ask questions, ask for additional explanations and share their doubts. However they do not have to do that (and they often do not) - they stay passive. The course of practical classes, although it should be based on a bigger activity of students, depends on the type of the discussed tasks as well as the type of teacher's work. There is often no opportunity (lack of time) to make everybody active during classes. It allows to imagine a student who will go through the studies with no engagement in acquisition of knowledge and skills.

It seems that transfer of teaching maths to the Internet does not bring a big change - the methodology of teaching remains the same. Lectures in a classroom can be replaced by videos with the participation of a teacher or well-prepared notes for the lectures (a course book describing ideas, methods and examples that will not replace a textbook). Within the lecture range, an e course gives bigger possibilities for contact with the teacher. Lecture in a classroom is limited by the time and does not allow everybody to speak. At the same time some students, in fear of the others' judgment never ask a teacher a question during a lecture. In the Internet, we have discussion forums where you can not only ask (from every place and at every time) but also discuss with other students, and all under the supervision of a teacher. The consultations are easier - you do not have to wait for a duty of a certain academic teacher. You only have to send an e-mail and you will get the answer with explanations via Internet. We benefit more from practical classes. Similarly to traditional classes, a teacher gives problems to be solved, however every student is obliged to present his own solution. On one hand it allows teacher to know better students' needs, and on the other hand any student can stay passive - with every issue discussed during a course, a student is assessed.

Transferring maths teaching to a remote mode requires only small modification connected with the preparation of necessary materials. It is not necessary to change methodology of subject teaching. It should be added that the authors are not in favour of automatic, non-reflective changing of the materials for traditional classes into e-courses in case of any subject including mathematics. They only indicate the theoretical, sometimes used in practice (see: "Zawodowe studia informatyczne" - "Professional IT studies" WMIM UW, <http://wazniak.edu.pl>) opportunity of such transfer. The main issue is the fact that on e-classes, with the accurate choice of materials and the teacher's engagement we can expect good (or even better in comparison with the traditional form of education) result of maths teaching. It is confirmed by many people who learned mathematics by individual studying with the help of books with practical tasks.

### 3.2. Teaching of foreign language

In the authors' opinion, a subject completely different from mathematics in terms of opportunities for an effective and easy transfer to the Internet (against typical opinions) is any foreign language. Traditional classes of a foreign language are based on reading parts of appropriately prepared texts in a certain language, teaching grammar rules and vocabulary and talking with a teacher and other students in a learned language. There are a lot of elements in the traditional classes that can be easily transferred to asynchronous teaching with the usage of a computer. It concerns i.a. texts and videos used in language laboratories. Apart from that, written works sent to teachers which are returned corrected and with comments as well as tests are elements which can be easily adjusted on the Internet. So, why it is a subject which cannot be taught effectively on the Internet? The mentioned elements allow only to build passive knowledge of a language, which is against the main goal of teaching a foreign language. It is an acquisition of skills to communicate directly (both face to face and with the usage of any audio equipment) which is impossible in asynchronous form of education. It can be imagined (according to what was assumed earlier on skills in using IT) that students record their statements and similarly to written works they send them to a teacher and then receive feedback. However, it is not an effective form of teaching. The asynchronicity of work in e-teaching assumes that everyone (both student and teacher) work at the most convenient time for him which means that a student does not receive immediate, direct correction of his statement. It increases the risk of incorrect habits consolidation which are difficult and sometimes even impossible to change. Indeed, most of computer courses of foreign languages contain mechanisms which control pronunciation. However, it happens on the basis of the similarity of sound wave, not verification whether message was understood. It does not guarantee either correctness or the effectiveness of education. What is more, it does not allow to control longer statements created individually by a person studying. It should be noticed that the modern technology allows for vocal and even visual connection at a real time making immediate and direct reaction of a teacher for what was said possible. Using that communication method means resigning from one of the biggest advantage of e-teaching, that is asynchronicity of a didactic process, forces students and their teachers to be present at the same time. Such solution does not constitute the object of authors' interest (according to what was assumed earlier).

### 3.3. Features of susceptibility

The presented examples of two academic subjects, possible to be realized in singlepart environment, illustrate basic differences in possibilities to transfer their teaching to the Internet. So there is a question that arises: what feature or its lack influences the fact that one subject can be easily adjusted to remote education and the other requires changes in methodology and/or resigning from the part of the taught skills?

Before completing a list of those features, the authors propose to introduce susceptibility term. A subject *susceptible to e-teaching* is a subject which can be transferred to the Internet (in a form of e-courses) without decreasing the education effectiveness (any of the taught skills is missed out). And it is not important whether methods in stationary and remote teaching are different or not.

According to a universal definition, mathematics, contrary to foreign languages, may be susceptible to e-teaching. What differentiates the two subjects? In maths teaching it is not necessary to send direct and immediate feedback to student. Very often, the immediate reaction of a teacher to mistakes is harmful for a student and consent for making mistakes brings good didactic results. A student who verifies on his own the correctness of thinking, learns more than when he is just led to a correct solution. In case of a foreign language it is difficult to imagine how to teach effective communication if a teacher does not react immediately to incorrect pronunciation, inappropriate vocabulary or incorrect grammar. The lack of reaction from a teacher makes student acquire and consolidate often incorrect habits connected with "spoken language".

The main difference is a role of a teacher in both subjects. In teaching a foreign language a teacher is a prompter and advisor who does not allow to make mistakes, which requires time synchronicity with a student. When teaching mathematics, a teacher becomes a mentor. Indicates problems to be solved, brings students' ideas for in criticism and finally direct them to correct ways of thinking but only when they cannot reach correct conclusions on their own. So for an effective teaching of maths it is not necessary that actions of a student and a teacher take place at the same time. When

comparing the role of a teacher in teaching those two subjects indicates the first feature which decreases the academic subject susceptibility to e-teaching.

**First feature - interaction:**

*A subject is not susceptible to e-teaching if its teaching requires direct interaction between people (e.g. teacher - student, student - student) which cannot be replaced by a system of artificial intelligence.*

To examine the effectiveness of the first feature, the authors have chosen two subjects: psychology and computer science due to the fact they have experience in teaching them both in a traditional way and via Internet.

In a traditional way of teaching psychology (similarly to other academic subjects) we can distinguish lecture and practical part. During lectures students get to know issues from the theoretical side. The course of classes, although different in terms of topic from the mathematics, is based on similar and even the same schema. Teacher introduces students to new term, explains what are the certain mechanisms, in this case psychological, indicates professional bibliography they should read. A student of psychology, apart from theoretical knowledge, has to acquire skills how to work with other person (e.g. reading verbal and non-verbal signs), particularly in case of clinical psychology (therapist). Such real interactions cannot be replaced even by the best computer simulations or videos with scenes that can be watched on the Internet. This situation will not change until computer systems of artificial intelligence win in "The Imitation Game" (Turing, 1950) which means going through "Turing-test". In psychology, a teacher goes from the role of a mentor (on a lecture) to an instructor who teaches how to work with others.

On the contrary, information science is a subject in which a direct contact (understood as being present at the same time) between a student and a teacher is not necessary. During stationary classes, a teacher usually discusses the basis of a topic, shows how functions, instructions or applications in a computer work, and then students practice their skills on their computers. As in case of mathematics, a person conducting has a role of a mentor - helps to solve problems, explains unpredictable "behaviour" of a computer or unusually reaction of applications. It allows to verify that teaching computer science (as not requiring direct interactions teacher-student) should be relatively easy to adjust to remote form of education. It is proved by a course "Designing didactic web pages" conducted on e-learning platform at the Centre for Open and Multimedia Education at the University of Warsaw. It has showed that we can teach how to create web pages effectively and without a real meeting between students and a teacher.

Categorizing only on the basis of the first feature does not give complete and satisfying answer to a question concerning susceptibility to e-teaching of any academic subject. Further research have led authors to reflections over elements of educating an archeologist. Apart from theoretical knowledge, which can be transferred to the Internet, an archeologist has to acquire practical skills, connected with how to do with archeological find, and that cannot be learned through the Internet. Obviously, modern technology allows for 3D shows which means presenting object from all sides, in any arrangement and lighting, however it is still an object on a flat screen. We cannot take the object from the screen, clear it with a brush and put it in a special box, and these are the actions an archeologist should learn to work effectively and operate real tools. Even the most developed virtual world (in term of the technology available at present - it is not worth analyzing the effect of availability of costumes connected to the computer and reacting to every muscle movement) will not give us the opportunity to work with real exhibit (its weight, scent, warmth, texture). The above observation justifies the presence of another features conditioning the susceptibility of a subject to e-teaching.

**Second feature - exhibit**

*A subject is not susceptible to e-teaching if it requires working with real exhibits which cannot be replaced with any of 3D presentation systems.*

**Third feature - experiment**

*A subject is not susceptible to e-teaching if it requires to acquire practical skills or doing experiments which cannot be mastered in a virtual world.*

When trying to assess the susceptibility of a subject to e-teaching in the context of the second and third feature, geology is a good example. Geologist (similarly to an archeologist), apart from

theoretical knowledge, has to possess practical skills in order to work effectively. One should know different types of soils, stones or elements of scenery which cannot be learned only through computer shows (simulations), movies or photos on the Internet. It is necessary to work with real objects and observe real space. Such line of thought is proved by experiments done by COME UW that make e-learning platform available for e-classes on geological issues ("Introduction to geology") conducted by the Faculty of Geology at UW. Although the interest of learning this subject via Internet among students is great, we cannot offer e-classes after which they become geologists. Even experienced academic teachers do not undertake to conduct geology classes without practical classes.

### 3.4. Completeness of features

If for complete, effective teaching of a subject it is necessary to have interaction with other human being or do real experiment or examine real object, then the subject cannot be taught through the Internet completely (as the above examples show). Are these all features that make it impossible to teach through and with the usage of the Internet?

Firstly, let's assume (which seems to be obvious), that if we have to present knowledge and skills that can be taught with a textbook, then they can be taught through the Internet as well, because in this case it is enough to insert a textbook in VLE (e.g. in a form of PDF). Such teaching will not be different from teaching with a textbook and as effective as the traditional way.

But if, some knowledge and skills cannot be taught through the Internet it means that to teach those issues effectively some actions going beyond a textbook are needed. It can be in a form of a real interaction with other man or other manual actions. Manual actions may be of two kinds: touch or do. If "touch", it means that it is necessary to feel something which cannot be transferred through the Internet (e.g. weight, hardness, texture, scent) and that means that we have to work with an exhibit; if "do", it means we have to do something with features created during practical works (e.g. time of the actions performed, temperature changes during actions, power we have to use to perform certain actions, scents giving off, etc.) and that means it is necessary to do an experiment.

In that way the authors indicated that the given list of features, which decrease the susceptibility of an academic subject to e-teaching: *interaction with other human being, working with an exhibit, doing real experiment* is complete and allows to categorize different academic subjects as susceptible or not to e-teaching.

For instance, we can analyze the susceptibility of economics to e-teaching. The choice is justified by the experience of COME UW in remote education connected with economic issues.

When analyzing the methodology of economics teaching we notice that the effective results do not depend on direct interaction master - student. The nature of the subject allows to replace the interaction from the lecture classroom with asynchronous communication via Internet in an asynchronous mode (via e-mails or forum on the e-learning platform) without negative influence on final effects. In that case, economics does not meet the first feature (interaction). The objects of economics are not real, physical things but rather mathematical (numerical) models of processes, and what follows - a student does not have to watch any real exhibits during the education preparing him for professional work. The economic exhibits can be observed through the Internet as numerical characteristics. So the economics does not possess the second feature (exhibit) which decreases the susceptibility to e-teaching. An economist "looks at" his domain from the angle of numbers and relation between them. To know economic events and the effects of the decisions made he can do it by observing their mathematical models and computer simulations. All those aspects are ideal to be the content of e-classes. There are no premises justifying the acceptance of the third feature (experiment). Rejecting three features which decrease the susceptibility to e-teaching suggests that economics is the right "candidate" for teaching via Internet (and it is true - e-courses of micro and macro economics conducted at the University of Warsaw are very effective).

## 4. SUSCEPTIBILITY OF ACADEMIC SUBJECTS TO E\_TEACHING: MULTIPART CASE

Using multipart environment in e-education allows student to use objects around him for doing experiments, to make interactions with people he meet, to realize tasks. The examples of such actions are e.g. instructions to conduct interviews on eating habits among people from the closest

surroundings and to transfer the collected data to e-learning platform for further analysis (course: *Internet, individual, society*, IBIZA UW 2005) or to grow salt crystals according to a given procedure (course: *Chemistry for amateurs*, IBIZA UW 2009). In both cases, to perform the task, students have to stop working with a computer and perform certain activities in a real world, record the results of their actions and transfer them to e-platform. They are very good, activating methods of teaching, however there is a question that arises: whether possibility of using those methods changes the rules described above (non)susceptibility to e-teaching of academic subjects?

In the authors' point of view, supported with experience, modifications resulting from the change of environment from singlepart into multipart are of small importance towards the general idea of susceptibility to e-teaching. Obviously, the range of using rules mentioned above is changing. Whereas in singlepart environment student can participate only in virtual shows of doing experiments, in multipart environment he can do certain experiments on his own. However, the range of those experiments is limited. For example, student does not have his own chemical laboratory equipped with appropriate reagents where he could perform all the experiments required in the academic chemistry course. He cannot perform most chemical and physical experiments, he cannot examine archeological, biological and geological objects in domestic conditions because the elements necessary for examinations and experiments are not available outside universities, institutes and require great expenditures. Leaving computer in order to perform task may have the biggest influence in social science. Factually, studying journalism requires conducting interviews with accidental people, and that can be realized in a remote education simply by an appropriate task definition. Students, on their own, conduct interviews in their environment and then transfer their results to e-education platform. However in many cases, to learn how to conduct interview well (interview, therapeutic recognition, hearing, etc.) teacher's instructions are needed which are given during such interview, not after it. What is more important, in every direct interaction between people, we use verbal and non-verbal channels, and to e-education platform we can transfer only recording of such interview that loses or disturbs some communication channels (e.g. the interview recording does not give the atmosphere of a person speaking, the pace of speaking, gestures, etc.).

The above examples prove that even using in e-education non-computer environment of a student does not guarantee the opportunity for teaching all subjects on the Internet at the same level of the effectiveness. Using multipart environment causes that the range of rules of non-susceptibility to e-teaching becomes smaller. Accepting students' actions outside the computer (but still in a remote and asynchronous mode - there are no direct meetings, student does not have an easy access to the resources of a university) we should modify the features of non-susceptibility (slightly) by limiting their range:

*A subject is not susceptible to e-teaching if its teaching requires interaction between people (e.g. teacher - student, student - student), that cannot be replaced with a system of artificial intelligence where the teacher's participation is of a great importance in an effective education.*

*A subject is not susceptible to e-teaching if it requires working with real exhibits that cannot be replaced with any systems of 3D presentation and are not available for all students at their place of stay.*

*A subject is not susceptible to e-teaching if it requires practical skills acquisition or doing experiments which cannot be mastered in a virtual world or in a typical environment of a student.*

## 5. CONCLUSIONS

Enumerating features of academic subjects which decide on non-susceptibility to e-teaching: interaction, exhibit and experiment (for environments: singlepart and multipart) should be used in academic didactics of a modern university. More often used mixed teaching is considered as the most effective form of e-teaching (and maybe of education in general). That is why we should think how to divide material between stationary classes and e-classes (asynchronous) in order to achieve best results of education. We should seek the solution of this problem in the subject analysis in the context of the susceptibility to e-teaching features defined in this article. Content of knowledge should be adjusted to the form (stationary education vs remote) so that to minimize the influence of

those features on the effectiveness of particular subject teaching. To put it simply, it is nothing but eliminating those elements which are indicated by the features, in remote part and on the contrary, to emphasize those elements in the stationary part.

Non-susceptibility to e-teaching should be also used in preparing methods how to transfer stationary classes completely to the Internet. Non-susceptibility features of an academic subject to e-teaching are indicated by those elements (content, skills, method of teaching) which we should take into account when designing e-course. It will minimize the influence of negative features.

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