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Deciding which technology is the best for distance education: Issues in media/technology comparisons studies

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Abstract

Distance education decision makers; who will be shaping the future of distance education; should understand the role of different technologies and their unique attributes closely. In order to achieve this task accurately, they also need to know the superiorities of different technologies to each other. Media comparison studies have been conducted to see these superiorities and to help deciding "which technology is better?" In some studies researchers make some fundamental errors and flaws in media comparison studies for distance learning. Hence, there is a need to determine these issues in order to make decision process work better. In this review study, issues on media comparison studies in distance education discussed with theoretical backgrounds. Also in this study, reader could find what kind of flaws can occur in media comparisons studies and what cause to these flaws as well as some suggestions to avoid these flaws. In this study, five of the most significant errors scholars have made in writing and discussing distance education research in technology/media comparisons studies are determined. This study aims to help distance education policy makers, distance education researchers and instructors by making them aware of these issues in comparison studies. Hence, they could make a more accurate decision when implementing distance learning solutions in their institutions.

"Keywords: Distance education, media comparison;"

1. Introduction

Distance teaching decision makers, educational researchers who are determining the future of the distance education should focus on the capabilities of new coming technology and media. They also should focus on the interaction with the media to understand what specific unique attributes of these technologies and media brings and which kind of benefits – outcomes they will have on learning.

In order to understand new coming technology and media, distance education researchers so often run media comparison studies. They mainly ask research questions such as "Which media or technology is better for learning?" or "What media or technology type is superior to traditional learning?" or "Is a new media or technology is really working better than others?" Or "which media type has superiority to others or if one new media (and related technologies) type shows more benefits than the others?" In many articles researchers; who are discussing the media; try to answer these questions. They want to if a specific media type works properly and if this media have some significant learning outcomes over the students learning. In many media comparisons studies, researchers conduct analysis by comparing a specific new media type to another media type or by comparing one media type

with traditional learning   situations (mainly classroom learning).

When answering these questions there are several research studies that could cause misleading results and interpretations because of the poor research design and/or over simplifying the variables in the research settings.

Therefore there is a need to determine these kinds of issues in order to help decision makers to be aware and help them to make better selections when implementing new distance learning technologies. In this article, reader could find what kind of flaws can occur in media comparisons studies and what cause to these flaws as well as some suggestions to avoid these flaws. These issues on media comparison studies in distance education discussed with looking to some theoretical backgrounds. Also some ongoing debates on these issues were covered by looking to the each side and all the view points are discussed to give the readers an overall picture.

The five of the most significant errors scholars have made in writing and discussing distance education research in technology/media comparisons studies are discussed in this article within sub-titles labeled as "Following Misleading Initiators", "Is it necessary (or logical) to conduct technology/media comparisons studies: Clark vs. Kozma", "Reporting media attributes", "Reporting the teaching methods", "Flaws in Research Methodologies and in Interpreting Results".

2. Following Misleading Initiators

In media comparison studies, it seems the main concern of the researchers is to show that one media is better than the other (in most cases the new technology is better than the old one) because they seem they have some worries to prove that the new technology is better. In the first place these worries come from political ideologies than comes from the commercial ideologies. When we look for the history of media comparisons research, we could understand WHY there are studies try to find out new technology is better than the old technologies or the traditional methods. These concerns can clearly be seen if we looked the main stakeholders in the research studies in the past. According to Joy and Garcia [1] "in the United States prior to World War II this kind of research designs were started to conduct and the film and radio were the focus of many comparison studies; after that times the trend were rend shifted in the 1980s as researchers and educational software developers became interested in establishing cause-and-effect relationships between computer and non-computer delivery modes ". If one thinks about those studies were conducted because of the initiatives of some specific stakeholders and he/she   also may think that those studies initiated their hypothesis purposefully to find out one specific result:" The new media or technology works better or at least equal to the old ones". This determination could cause one to ask several critical questions like "If those initial researches did ask correct questions to find out real results?" and "If those initial researches did successfully lead the upcoming studies correctly or in vice versa did the following studies just jump in blindly and repeat the same procedures that can cause some mistakes or misleading interpretation?" So shortly, the following researches may have the same errors in their results or they could look for a biased direction in these studies.

3. Is it necessary (or logical) to conduct technology/media comparisons studies: Clark vs. Kozma

In many articles, Clark [15, 11, 10, and 2] indicates that media have no influence on learning so it is a problem to make any kind of comparisons between media types. For example , there are many of studies [12] trying to compare the media types and try to show benefits of one of the media type but if one follows the logic of Clark it is a miss-leading research activity to compare media benefits because there is no media benefits over learning. According to Clark [2] there were many studies   showing that there is no learning benefits because of just media itself. The studies argued that the media have various economical advantages and accomplishments into the learning but there are no pure learning benefits for the users just by using the media instead of other methods or other media types. Also he explains his claim to strong his arguments in his following words:

"Examples of media attributes are the capacity of television and movies to "zoom" into detail or to "unwrap" three-dimensional objects into two dimensions. The problem with the media attribute argument is that there is strong evidence that many very different media attributes Accomplish the same learning goal (for example, there are a variety of equally effective Ways to highlight details other than zooming). In every attempt to replicate the published Media attribute studies a number of very different media attributes served the same or similar cognitive functions. "

From his words it is very clear to understand that the media is not a magicful formula to improve learning just

because media attributes. The benefits comes from instructional methods and strategies that can be accomplished by using one of a specific media attribute and this attribute can be substituted with some other old or new type of media attribute which have similar functions. Therefore it can be advocated that in a research study, there is no logic to compare different media attributes and media types with each other because you can get the same results if you use the same instructional methods.

On the other hand, Kozma defines media as a technology that can be defined in mechanical and electronic attributes which indicates the functions of media and in some cases the shape and other physical characteristics of the media [3]. In Kozma's view media attributes have some direct effect on learning because the cognitive processes are affected by those attributes. He claims that some learners benefit from these attributes because their cognitive learning benefit from the support of these. For example, some learners can learn better from TV because of the representation of information is reach coded ; on the other hand some learner don't need these representations of TV they could learn just from audio and text representations such as reading a book. Kozma describes that situations because of the learners' mental models are different and they have a different strategy for construction and structuring the information.

According to Kozma's theoretical framework, learning is an active and constructive process where the control of the cognitive resources belongs to learners themselves In this view point learners should interact and integrate within the external environment (which is the media or the technology itself) to create knowledge. Kozma explains this mentality as follows:

"Consequently, the process is sensitive to characteristics of the external environment, such as the availability of specific information at a given moment, the duration of that availability, the way the information is structured, and the ease with which it can be searched."

 Eventually, if someone follows the Kozma's viewpoints it could be advocated that there is differences between media types because of media's itself and media attributes. From Kozma's stand point it can be said that there is a distinction between media and media attributes because learning process is integrated accordingly. So that leads a point that different media types could be beneficial to different cognitive functions and those different functions can also work differently for different learner types. If this idea accepted, the logic of making media comparisons are clearly valid because there should be comparisons studies to find out which media attributes affects which cognitive learning process for different learner characteristics. As a clear result, if someone follows Kozma then there should be many media comparison studies.

As a result , Clark and Kozma claim counter ideas and the debate between them (and their followers) put a researcher in a position to decide his/her direction in comparisons study. In the Clark side, it is not meaningful to make any media comparison studies because media is not influencing learning, a study can only compare the extended benefits such as cost or time, delivery efficiencies etc.By contrast with Clark, Kozma has an argument that media has some affects on learning and that's why researchers surely need to make lots of media comparisons studies. Also here a clarification should be made to understand those two views. Clark is not totally refusing the comparison studies but he warns that the components of learning and the components of the media should be investigated separately however Kozma takes those components as a whole.

In our point of view there should be media comparisons studies because at least we need to determine the affects of attributes of new media on learning directly or indirectly so we find Clark position is much stronger because we think media itself is not sufficient to affect learning so extended benefits are much more important to research. We agree with Clark about usage of technology or new media is not sufficient enough to improve learning. Usage of technology and new media in the learning is a very critical issue. Most of the teachers think their teaching would be better if they use technology or new media in their lectures. Using technology/media without any conscious thinking will be no useful for the students.

As the Clark suggests, firstly a teacher should decide his/her strategy. She should know what to use in what reason and where to use. For example, before implementing any technology or the media type in their lecture students' needs must be known first. After that, course objectives must be determined. Than the contents structure must be determined by matching several user needs to the objectives. After that, teacher should select proper instructional methods and relevant media according to user needs, objectives and content structure.

In this manner, when structuring courses the media type selection becomes important. In distance education aspect, there is also need of d delivering content to wide range of distance groups. In most cases, these needs are met by hypertext or hypermedia systems [4].

Khan's [5] explains usage of hypermedia in education as:

"The World Wide Web is the latest embodiment of hypertext, hypermedia environments, Allowing the practical implementation and use of hypertext environments to graduate from the Relatively small stand-alone systems, previously developed with tools such as HyperCard or Tool Book, too much larger and universally available systems of structured information."

In distance learning area, it is important to understand hypermedia technology (or media) and see if there are any direct benefits over learning. Again it seems that Clark claims is strong about media comparisons researches. For example, studies [6] showed that selecting of hypermedia system can have no additional value if we use hypermedia just as a replacement of paper based tasks. Hypermedia and its properties were investigated according to learner comprehension, effects and individual differences. This study concludes that the usefulness of the hypermedia is limited in different learning tasks. Clearly this study [6] showed that if we use a technology as an exact replacement of an old one such as paper or other electronic media the new technology has a little or no effect in the student improvement. Also this leads us to think that Clark is right about the media comparisons studies.

On the other hand we found some points of Kozma useful such as being aware of attributes of different media types. For example, the usage of technology in education varies from students' levels and ages, teachers and their teaching styles structure of content, environment, availability. Usage of computerized methods to increase learning in different ways than the older technology or traditional methods can have some extended benefits. For example, in other review paper, [7] CAI was questioned by relating the previous researches of Clark where he declares there is no great advantage of any mediums including CAI and the CAI is just a vehicle to deliver instructional message.

The usage of CAI showed significant improvements on the students' success as the previous studies showed. Kullik's model suggests that CAI in special education has a largest effect size. CAI in elementary education also has significant differences.

Another significant results determination comes from Kulliks' study [8] where effect of computer usage in the school mathematics and science programs has been examined. According to reviews, Kullik indicates that the integrated learning system has a students' score improvement from the 50th to the 65th percentile in mathematic lessons. Also Kullik's reviews indicate the computer tutorials in science. In this area he declares the tutorial systems could raise student achievement from the 50th to the 72nd percentile. Additionally, Lio [9] resulted that (69%) of the studies in the meta analysis showed that effect size were positive for the Hypermedia Instruction.

As a result , as long as CAI materials design to improve learning in careful consideration of pedagogy including usage of quality objectives, individual feedbacks in learning sequences, motivation and active participation they can have a positive effect on learning. CAI has no greater benefit if the materials are the same. On the other hand CAI has advantage when a quality instruction delivered by computers using well designed CAI materials. Also there are other advantages of computers such as time savings, cost, realistic problems with interactive materials, immediate feedback and self-evaluation. Also as Clark [10] mentioned the technology is only a medium to deliver the message .If we can improve the message quality within the technology than the technology would benefit for us. For example, we can give information in more flexible ways information providing good quality learning activities which also leads motivation. Also tailoring instruction according to specific user needs can be possible using immediate personalized feedback systems [22].

All of those studies shows that Kozma is right because hypermedia or CAI have some benefits over the other methods but in this point they seems they are there with extended benefits of media which make Clark to stand on more strong position [23].

4. Reporting media attributes

Additional to debates between Clack and Kozma, there are some other problems in media comparisons studies such as reporting media attributes. In many studies, it is neglected to define the list of specification. In many researches, it has been assumed that the compared media type is totally different than the others and it is approached as a one whole instead of combinations of parts. However, as described in this paper, all media types are consists of some components and those components have different attributes. That case brings the need of examining each attribute separately instead of looking them as a whole structure because each of the components and attributes may have different affect on the different cognitive functions and different learning process.

In research design, a better approach should be to thinking the media (also technology) as a whole which consists

of components and investigate the specific attributes of those components separately to find out detailed results for different cognitive functions? In other words, we should not deal with media as lacking of system or structure characteristic. Researchers can construct hypothesis to find out the effect of each component and attributes (characteristic) of media on learning so whole and partial usefulness could be understood. Those characteristic can be tested separately as research variables. Those tested units variables also could be tested for their relations or as functions in the system. In this aspect using taxonomy of media attributes could be useful for research purposes [13].

In the real world, learning can also occurs within an environment where many of the technology/media integrated each other. In the research articles about distance learning, most of the times, they investigate the benefits, outcomes and effects of a specific type of technology/media and compare one of these with the traditional classroom learning.

In the distance education area, there are many technologies that can be used for multiple purposes and that can be converted to solve problems in very different learning situations or that can be applied to gain some learning benefits. An arrangement of different technologies together in a mixed model to address several learning problems or met several learning outcomes, are getting more and more common practice in the distance education area. For example, in a Second Life simulation [21] there is a combination of interactive simulation and web based online system to create an opportunity to make a collaborative learning environment for students. These kind of mixed model technologies can create a great potential for the students to students, students to teacher and teacher to teacher interaction and they can also reach very different unique way of learning structures [21].

It is not easy to investigate all of the possibilities in a research study which treats mixed technologies   just as a single module or unit. For example, we cannot compare Second Life with traditional face to face learning by just telling that second life is a single unit simulation or it is single unit web based learning media. Actually Second Life is a combination of all of these technologies and media types so if we took it as a single one there could be misleading results and interpretation. Some of the research article makes those single unit comparisons for these mixed media types so that could lead some serious problems.

There must be more studies available to provide more specific grounds with large sample size and solid research design background to investigate the effect of mixed technology/media.

5. Reporting the teaching methods

Another problem in the media comparison studies is about reporting the teaching methods applied in research. In many cases, the instructional methods are thought as merged into the media and technology and this creates a great amount of confusion to interpret the results. In many research studies, technology or the media were treated purely as the teaching methodology rather than considering technology/media as tools for delivery for teaching [15]. In these cases, it is very hard to define whether technology/media had been benefited on the learning or the use of teaching methodologies benefited. It seems impossible to identify which made a difference when there is a conclusion claiming that students achieved better. For example, in a report of SRB's Educational Technology Cooperative [14] they advocate that benefits of online learning and they show a case study for Louisiana Virtual School in 2002-2003. According to that report, *"... this study certified teachers delivered the instruction online. They served as mentors and models to teachers in classrooms who were not certified in secondary math but who collaborated with the online teachers to guide and support the students"*. In the results, they interpret the results in a way that usages of online media delivery have some benefits. However this is impossible to determine which of the component of the system worked. Is it the technology/media? Or is it the teaching methodology? When someone read this case carefully he/she can clearly see that in treatment group (online learners) there is a structured organized contents given by certified teachers other hand there is a control group (learners in a traditional classroom setting) which are delivering instruction from uncertified teachers. There is a clear distinction that online learner group was threatened with a better teaching method than the others.

Also teaching methodologies such as student centered learning vs. teacher centered learning , problem based learning vs. rote learning , constructivist learning vs. rote –learning   etc.; could have a greater impact on the learning results and so many comparisons studies neglect to describe which of those methodologies applied in research groups. For example, in a research study comparing traditional classroom learning with online learning could provide more student centered learning and problem based activities in online learning group and less of these in the traditional learning group. As long as two groups are not receiving equal treatment conditions it is impossible

to differentiate if the technology/media has any influence.

In contrast to that example, it is also possible to probate less student centered learning and problem based activities in online learning group and more of those activities in the traditional classroom group.

As a result it could be concluded that it is possible to use different technology/media to meet the requirements of same teaching methodology. It is hard to say that one technology/media is better than other as long as the teaching methodology is not exactly same in both cases. However ; at least; we could say that some technology/media types has some side effects such as supporting mass delivery , cost efficiency, visualization, interactive elements, audio-visual functions etc.

6. **Flaws in Research Methodologies and Interpreting Results**

In the media comparison researches, the variables tested for the outcomes are generally are achievement of the students, students attitudes and students satisfaction over the treatment. In many cases, treatment is the new media or the technology such as distance education (recently online learning). Basically a comparison study for the distance education typically compares the achievement of students on traditional learning environments to the achievement of students who are enrolled in a distance learning program (online learning).

According to the Phipps and Merisotis [16] there are lots of flaws in the researches which trying to determine the effectiveness of the distance learning. In their report, they indicated the several research issues such as:

　　• Much of the research does not control for extraneous variables and therefore cannot show cause and effect.

　　• Most of the studies do not use randomly selected subjects.

　　• The validity and reliability of the instruments used to measure student outcomes and attitudes are questionable.

　　• Many studies do not adequately control for the feelings and attitudes of the students and faculty—what the educational research refers to as "reactive effects."

As Phipps and Merisotis indicate above, in many distance education researches, there is a problem to determine if the students' achievements are correctly measured. This serious problem also voiced by Lockee and Burton [17] as follows: " Many studies related to distance learning use teacher-made achievement tests that may, or may not, have reliabilities or validities established. Perhaps worse than using a test that produces erroneous scores or scores that are unrelated to the content … "

In distance education studies the problem of the evaluation of the students achievements can affect the overall course of the research and these kinds of flaws in the measurements may cause to misleading results and interpretations.

In the media comparison researches, there could be some problems occurring when interpreting the results. Many of the comparison studies justify the results as "no significant difference" in their findings [19].In statistical means if the result is no significant is means that researchers fail to reject o the null hypothesis which is the treatment outcome that a researcher is trying to prove [18]. In other words this means that the researchers can not show that the proposed independent variable have no effect on outcome or dependent variables. Also" no significant difference "does not mean that the treatment is not important or not meaningful.

Sometimes researchers [16, 20] conclude that " no significant difference" means the treatment is not working or treatment is at least as effective as the other methods for treatment. In comparison studies some researchers use" no significant difference" as a finding which shows treatment effect is as good as traditional classroom teaching. In other words , research findings are interpreted as the outcomes and benefits online learning is at least equal to face to face classroom learning if there is a statistical result of " no significant difference" .

After that misleading interpretation many research studies conclude that he usage of new technologies is as good as the traditional learning environments but they are not better than traditional learning. This kind of conclusion is totally wrong in terms of statistics. More serious problems may occur in these kinds of conclusions because many studies open discussions after their conclusions. They advocate to purchase of new technologies, change in the educational systems and training of more faculties to adapt new systems. Just because resulting in a misleading reading in the findings could cause policy makers to act in a wrong direction and spent resources of the institutions.

As a result there could be places for the flaws in the media comparison studies' methodologies and findings. Therefore readers of those kinds of studies should be careful about the conclusions of these studies and may need

the double check these parts. In fact, these kinds of errors should be corrected before publishing any research articles. Journal editors and review boards should correct these kinds of problems before they publish anything.

Conclusion

In this review study authors investigated most common flaws in media comparison studies. The five of the most significant errors in technology/media comparisons studies are determined.

In conclusion decision makers should think carefully and decide critically when they read reports of research studies that asserting one media type is better than the other. They should be aware of the flaws in some of these studies so they could have a more accurate to the point action when implementing distance learning solutions.

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