A comparison of e-learning and Traditional classroom Teaching: Petra University

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Abstract

The purpose of this study was to compare and contrast (a) the effectiveness of e-learning to traditional classroom teaching, (b) the measurement of student learning performance (c) and the effects identified subjected to review of studies. ***This review found that, on average, students in online learning conditions performed better than those receiving face-to-face instruction provided variable factors remained constant.*** **The difference between student outcomes for online and face-to-face classes—measured as the difference between treatment and control means, divided by the pooled standard deviation—was larger in those studies contrasting conditions that blended elements of online and face-to-face instruction with conditions taught entirely face-to-face. Analysts noted that these blended conditions often included additional learning time and instructional elements not received by students in control conditions. This finding suggests that the positive effects associated with blended learning not be attributed to the media, per se. An unexpected finding was the small number of rigorous published studies contrasting online and face-to-face learning conditions for some high schools in Bahrain. Accordingly, the writer has to be aware of biased studies either to let his/her experiment succeed or to prove that his\her premises true in a syllogistic manner.**

Introduction

E-learning comes at a time of great transformation in how individuals and organizations learn and how they transfer learning into performance-in the classroom and online-remains as important as ever. However, e-learning is much more than e-training. The accelerating pace of knowledge growth and change, as well as increasing pressures of the market place require researchers to look for innovative approaches to complement training. Learning should not stop at the end of class. On the other hand, Rosenberg (2006) claims that classroom will continue to serve a critical function in any learning strategy. It provides a place where students, teachers can interact, experiment, collaborate and create. It is worth noting that that the goal of this study is to provide hints and clues to policy makers how they administer online learning. In the next paragraph, the writer has to illustrate what e-learning is and what its components are.

The term e-Learning simply occurs at the computer, which generally means over the internet, with the information delivered via a browser, like the internet explorer, Firefox, Netscape Navigator, the World Wide Web (www) through public internet or private intranet (Yu *et al* 2006). The first browser for the World Wide Web was released in 1993 (Cailliau 1995) and the first web pages were text rich. Fifteen years later the typical online experience is somewhat different. Rich media have been integrated into many online applications. Web pages often contain moving images and audio is not uncommon. Users download or stream media for many purposes. Simulations, games and alternate worlds are also found online and provide a particularly media rich experience for their users.

Collaboration technologies are becoming increasingly widespread and it appears that media rich content is becoming the tradition of the web. Today the web is a venue for interaction. Social software sites are not only places for users to tell and show others of their exploits, they are also venues for rich media interactions. In a recent survey (Caladine 2008), university students indicated that as well as the expected popular communications tools, Windows Messenger and Skype; video communications embedded in social software were becoming popular. It appears that as well as media rich content a tradition of rich media interactions is evolving and will soon be in demand by students and staff in higher education institutions (Oliver & Goerke 2007).

Thus it is a result of a computer oriented analysis and design of such a system. Most of the progress made in this field has been influenced by the evolving technological infrastructure.

However, the main challenge of e-learning researches is to provide efficient and adaptive e-learning systems. To achieve efficiency, the e-learning systems are modeled as a directed graph where each node represents a Learning Object (Viet and Si, 2006). Each Learning Object (LO) may contain a concept, an object, an image, or an audio session. Two events are connected if there is a dependency relation, for example, one event is a prerequisite to the other.

The e-learning systems act as an adaptive system if they select the path of learning that meets the students' requirements and needs and discard those paths, which do not comply with their needs. In addition to, such an adaptive learning system must be as efficient as possible (Webster 2006).

Online learners may have different backgrounds from those who are studying in traditional classrooms. The expected benefits of a learning object differ from learner to learner. Thus, the traditional approach that presents one selection to all learners becomes inadequate in an online learning environment because different learners have their distinctive characteristics and learning styles.

The findings presented here are derived from (a) a systematic search for previous studies of the effectiveness of online learning and (b) a meta-analysis (blended) of those studies from which effect sizes that contrasted online and face-to-face instruction could be extracted or estimated. A narrative summary of studies comparing different forms of online learning is also provided.

These activities were undertaken to address four research questions:

1. ***How does the effectiveness of online learning compare with that of face-to-face instruction?***
2. ***Does supplementing face-to-face instruction with online instruction enhance learning?***
3. ***What practices are associated with more effective online learning?***
4. ***What conditions influence the effectiveness of online learning?***

Learners may use different software, and hardware depending upon their learning environment. A framework for individualized learning object selection, called Eliminating and Optimizing Selection (EOS) was proposed by Liu and Greer (2004) which represents an approach to select a short list of suitable learning objects appropriate for the learner and the learning context. In this paper EOS framework will be further analyzed, implemented and experimented. This study is divided as follows; Section 2 gives an overview of related work and considers key studies between technologies and e-learning. While sections 3 and 4 deal with the main findings from literature review. Section 5, a formalization of EOS is presented. Then experiments and results are shown in section 6, and finally conclusion is given in section7. These experiments have commenced since last April encompassing all the departments of an international school in Manama, Bahrain and at Petra University for the courses the Writer teaches

which are: English Phonetics, English Semantics, Syntax and Report-writing. This review of online learning is part of a broader study which will take five years to complete. The goal of this study as a whole is to provide policy makers and practitioners, educators, administrators with research based- guidance about how to implement online learning for grades 1 to 12 education and teacher preparation.

Related work

This literature review and meta-analysis differ from recent meta-analyses of distance learning in that they Limit the search to studies of Web-based instruction (i.e., eliminating studies of video- and audio-based tele-courses or stand-alone, computer-based instruction);

- **a Include only studies with random-assignment or controlled quasi-experimental designs; and**
- **b. Examine effects only for objective measures of student learning (e.g., discarding effects for student or teacher perceptions of learning or course quality, student effect, etc.).**

This analysis and review distinguish between instruction that is offered entirely online and instruction that combines online and face-to-face elements. The first of the alternatives to classroom-based instruction, entirely online instruction, is attractive on the basis of cost and convenience as long as it is as effective as classroom instruction. The second alternative, which the online learning field generally refers to as blended or hybrid learning, needs to be *more* effective than conventional face-to-face instruction to justify the additional time and costs it entails. Because the evaluation criteria for the two types of learning differ, this meta-analysis presents separate estimates of mean effect size for the two subsets of studies.

Literature Search

This literature review and meta-analysis differ from recent meta-analyses of distance learning in that they Limit the search to studies of Web-based instruction (i.e., eliminating studies of video- and audio-based tele-courses or stand-alone, computer-based instruction); Include only studies with random-assignment or controlled quasi-experimental designs; and examine effects only for objective measures of student learning (e.g., discarding effects for student or teacher perceptions of learning or course quality, student effect, etc.).

The most unexpected finding was that an extensive initial search of the published literature from 1996 through 2008 found *no* experimental or controlled quasi-experimental studies that both compared the learning effectiveness of online and face-to-face instruction for K–12 students and provided sufficient data for inclusion in a meta-analysis. A subsequent search extended the time frame for studies through July 2008.

The computerized searches of online databases and citations in prior blended-analyses of distance learning as well as a manual search of the last three years of key journals returned 1,132 abstracts. In two stages of screening of the abstracts and full texts of the articles, 176 online learning research studies published between 1996 and 2008 were identified that used an experimental or quasi-experimental design and objectively measured student learning outcomes. Of these 176 studies, 99 had at least one contrast between an included online or blended learning condition and face-to-face (offline) instruction that potentially could be used in the quantitative meta-analysis. Just nine of these 99 involved K–12 learners. The 77 studies without a face-to-face condition compared different variations of online learning (without a face-to-face control condition) and were set aside for narrative synthesis.

This study deals with (a) A systematic search of the research literature from 2001 through July 2008 identified more than a thousand empirical studies of online learning. Analysts screened these studies to find those that (a) contrasted an online to a face-to-face condition, (b) measured student learning outcomes, (c) used a rigorous research design, and (d) provided adequate information to calculate an effect size. As a result of this screening, 51 independent effects were identified that could be subjected to meta-analysis. *The meta-analysis found that, on average, students in online learning conditions performed better than those receiving face-to-face instruction.* The difference between student outcomes for online and face-to-face classes—measured as the difference between treatment and control means, divided by the pooled standard deviation—was larger in those studies contrasting conditions that blended elements of online and face-to-face instruction with conditions taught entirely face-to-face. Analysts noted that these blended conditions often included additional learning time and instructional elements not received by students in control conditions. This finding suggests that the positive effects associated with blended learning should not be attributed to the media, per se. An unexpected finding was the small number of rigorous published studies contrasting online and face-to-face learning conditions for K–12 students. In light of this small corpus, caution is required in generalizing to the K–12 population because the results are derived for the most from studies in other settings (e.g., medical training, higher education).

Key findings

The main finding from the literature review was that

***Few rigorous research studies of the effectiveness of online learning for K–12 students have been published.* A systematic search of the research literature from 1994 through 2006 found no experimental or controlled quasi-experimental studies comparing the learning effects of online versus face-to-face instruction for K–12 students that provide sufficient data to compute an effect size. A subsequent search that expanded the time frame through July 2008 identified just five published studies meeting meta-analysis criteria.**

The meta-analysis of 51 study effects, 44 of which were drawn from research with older learners, found that *students who took all or part of their class online performed better, on average, than those taking the same course through traditional face-to-face instruction.* Learning outcomes for students who engaged in online learning exceeded those of students receiving face-to-face instruction, favoring online conditions. Interpretations of this result, however, should take into consideration the fact that online and face-to-face conditions generally differed on multiple dimensions, including the amount of time that learners spent on task. The advantages observed for online learning conditions therefore may be the product of aspects of those treatment conditions other than the instructional delivery medium per se.

Instruction combining online and face-to-face elements had a larger advantage relative to purely face-to-face instruction than did purely online instruction. **The mean effect size in studies comparing blended with face-to-face instruction was +0.35, $p < .001$. This effect size is larger than that for studies comparing purely online and purely face-to-face conditions, which had an average effect size of +0.14, $p < .05$. An important issue to keep in mind in reviewing these findings is that many studies did not attempt to equate (a) all the curriculum materials, (b) aspects of pedagogy and (c) learning time in the treatment and control conditions. Indeed, some authors asserted that it would be impossible to have done so. Hence, the observed advantage for online learning in general, and blended learning conditions in particular, is not necessarily rooted in the media used per se and may reflect differences in content, pedagogy and learning time.**

Studies in which learners in the online condition spent more time on task than students in the face-to-face condition found a greater benefit for online learning.5 **The mean effect size for studies with more time spent by online learners was +0.46 compared with +0.19 for studies in which the learners in the face-to-face condition spent as much time or more on task ($Q = 3.88$, $p < .05$).6**

Most of the variations in the way in which different studies implemented online learning did not affect student learning outcomes significantly. **Analysts examined 13 online learning practices as potential sources of variation in the effectiveness of online learning compared with face-to-face instruction. Of those variables, (a) the use of a blended rather than a purely online approach and (b) the expansion of time on task for online learners were the only statistically significant influences on effectiveness. The other 11 online learning practice variables that were analyzed did not affect student learning significantly. However, the relatively small number of studies contrasting learning outcomes for online and face-to-face instruction that included information about any specific aspect of implementation impeded efforts to identify online instructional practices that affect learning outcomes.**

a) ***The effectiveness of online learning approaches appears quite broad across different content and learner types.*** **Online learning appeared to be an effective option for both undergraduates (mean effect of +0.35, $p < .001$) and for graduate students and professionals (+0.17, $p < .05$) in a wide range of academic and professional studies. Though positive, the mean effect size is not significant for the seven contrasts involving K–12**

students, but the number of K–12 studies is too small to warrant much confidence in the mean effect estimate for this learner group. Three of the K–12 studies had significant effects favoring a blended learning condition, one had a significant negative effect favoring face-to-face instruction, and three contrasts did not attain statistical significance. The test for learner type as a moderator variable was non-significant. No significant differences in effectiveness were found that related to the subject of instruction.

b) ***Effect sizes were larger for studies in which the online and face-to-face conditions varied in terms of curriculum materials and aspects of instructional approach in addition to the medium of instruction.*** **Analysts examined the characteristics of the studies in the meta-analysis to ascertain whether features of the studies' methodologies could account for obtained effects. Six methodological variables were tested as potential moderators: (a) sample size, (b) type of knowledge tested, (c) strength of study design, (d) unit of assignment to condition, (e) instructor equivalence across conditions, and (f) equivalence of curriculum and instructional approach across conditions Means et al 2009) . Only equivalence of curriculum and instruction emerged as a significant moderator variable ($Q = 5.40$, $p < .05$). Studies in which analysts judged the curriculum and instruction to be identical or almost identical in online and face-to-face conditions had smaller effects than those studies where the two conditions varied in terms of multiple aspects of instruction (+0.20 compared with +0.42, respectively). Instruction could differ in terms of the way activities were organized (for example as group work in one condition and independent work in another) or in the inclusion of instructional resources (such as a simulation or instructor lectures) in one condition but not the other.**

The narrative review of experimental and quasi-experimental studies contrasting different online learning practices found that the majority of available studies suggest the following:

a) ***Blended and purely online learning conditions implemented within a single study generally result in similar student learning outcomes.*** **When a study contrasts blended and purely online conditions, student learning is usually comparable across the two conditions.**

b) ***Elements such as video or online quizzes do not appear to influence the amount that students learn in online classes.*** **The research does not support the use of some frequently recommended online learning practices. Inclusion of more media in an online application does not appear to enhance learning. The practice of providing online quizzes does not seem to be more effective than other tactics such as assigning homework.**

c) ***Online learning can be enhanced by giving learners control of their interactions with media and prompting learner reflection.*** **Studies indicate that manipulations that trigger learner activity or learner reflection and**

self-monitoring of understanding are effective when students pursue online learning as individuals.

d) ***Providing guidance for learning for groups of students appears less successful than does using such mechanisms with individual learners.*** **When groups of students are learning together online, support mechanisms such as guiding questions generally influence the way students interact, but not the amount they learn.**

Experiments and Results

Based on the above analysis and formalization, EOS was implemented using Visual Basic.Net. This is because it was not implemented in (Liu and Greer, 2004) in terms of its three phases and based on the following assumptions:

- Three Types for learners: Beginner, Trainer, and Expert.
- Languages: English, Arabic, French, etc.
- Three learning styles: Visual, Auditory, and Tactile & kinesthetic (Learn by doing).
- The weight for general popularity considered as: 0.5, while for previous learners' evaluation it was 0.25, and finally 0.25 for specialized popularity.
- Nine presentation styles: Text, exercise, table, diagram, simulation, audio, slide, problem statement, and video.
- Minimum requirements for the environment (hardware, Software): P3 CPU 1300 MHz/ 128 Ram /16 VGA/Win98 , P4 CPU 200 MHz / 264 Ram /32 VGA/ WinXP ,P4 CPU 2300MHz / 512 RAM / 64 VGA/ WinXP, Centrino PM CPU 1.3 /1G Ram / 128 VGA / Win98, BM CPU 1.6/ 2G Ram /128 VGA/ Mac,… etc.
- Four values: weak, good, very good, and excellent were considered for Reading Level, Listening Level, and General Academic Achievement.
- An hour was the time measure unit.
- For the purpose of comparison process, numerated values were given for learning styles, presentation styles, learners' types, reading level, listening level, and general academic achievement.
- Concepts were extracted from the ACM Computing Curricula 2001 for Computer Science (ACM, 2001), which defines 950 topics organized in 132 units and 14 areas.
- Six Objectives were considered (ACM, 2001): Knowledge and Understanding, Design and Implementation, Modeling, Method and Tools, Information Management, and Critical Evaluation and Testing.

EOS was experimented on three different learners and three learning objects (LO_1, LO_2, and LO3); the characteristics of these learning objects are given in Table 6.

Table 6: The characteristics of the three LOs that were used for EOS experiment

Learning Object	Characteristics		
	Presentation Type	Time	Required reading Level
LO_1	Exercise	1 hour	Excellent
LO_2	Table	3 hours	Very Good
LO_3	Diagram	1 hour	Good

The first learner was a beginner with a very good reading level and had 12 hour for learning, his learning style was Visual and his preferred presentation type was videos. The second learner was a trainer with a good reading level, 5 hours to learn, his learning style is Auditory and his preferred presentation type was audios. Finally, the third learner was an expert at reading level, his learning style was Tactile & Kinesthetic (learn by doing), 20 hours for learning and he preferred slides as a presentation type.

The results are given in Figure 6. These results show how the suitability of the three learning objects varies from one learner to another. For example, the suitability for LO_1 is 0.66, 0.74, and 0.78 for Learner 1, Learner 2 and learner 3 respectively.

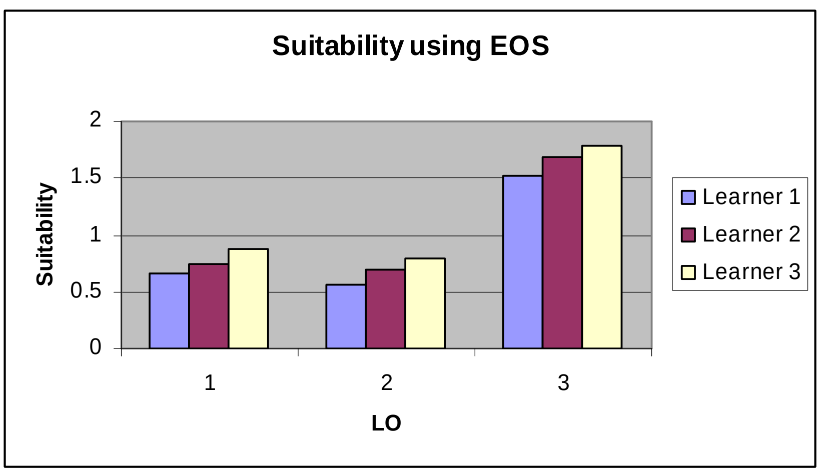

Figure 6: The suitability of three LO for three different learners

To evaluate the overall performance of the proposed approach, whose selection results matched those obtained by assumed experts. The selection performed by both was on the same simulated data set. This set includes a number of created instances of learning object metadata, a number of learners, and simulated usage history of the learning objects. The matching is based on the formula that was proposed by Karampiperis and Sampson (2005). This formula expresses the matching success.

$$\text{Matching success (\%)} = 100 * \left(\frac{\text{Correct learning object selected}}{M} \right) \quad \ldots\ldots\ldots (6)$$

<M> is the number of learning objects selected from the media space per concept node.

Thus, the evaluation is based on matching the sequence of learning objects selected by the proposed approach and the corresponding sequence selected by three experts with different points of view for preferences. The preferences and the characteristics of the three experts are shown in Table (1). Figure 7 shows the success of such matching that is affected by the number of the desired learning objects <m>.

The average matching is 73%, 63%, 51%, and 53% for 5 LO/Concept, 10, 15, and 20 respectively. Hence, the smaller the number of learning objects, the higher the matching is. However, the selection results of the proposed approach are competitive to the results obtained by the three experts despite the variations in their point of views. Moreover, representing a concept by a small number of learning objects is more efficient than representing it by a large number.

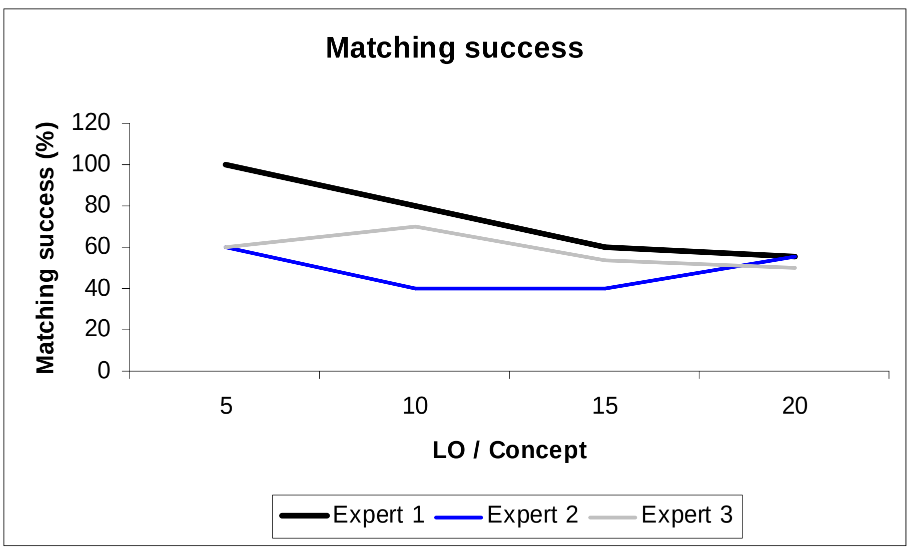

Table 1: Characteristics and Preferences of the three experts

Expert	Expert Characteristics	Preferences
Expert 1	-Specialization: Software Engineering -Experience: 3 years -Certification: Microsoft Certified Professional, IT Cambridge. - Master Degree in Computer Science. - Learning Courses: C#, VB.Net.	1. Time 2. Reading Level 3. Presentation Type 4. Learner Type 5. Learning Style
Expert 2	Specialization: English	1. Learner Type

	Experience: 3 years Certification: Master Degree, Toefl. Learning Courses: English	2. Presentation Type 3. Reading Level 4. Time 5. Learning Style
Expert 3	Specialization: Computer Science Experience: 2 years Certification: ITS Cambridge, ICDL. Learning Courses: ICDL, Programming Langues like C++.	1. Learning Style 2. Presentation Type 3. Learner type 4. Reading Level 5. Time

Conclusions

In e-Learning courses, learners may have more diverse backgrounds than those in traditional courses. Thus, selecting a learning path that is suitable for an individual learner is recognized as an interesting research area in e- learning systems. The writer wonders about the feasibility of e-learning and the time allocated to it. It is admitted that online learners may be more sophisticated than traditional classroom learners.

This research aims to improve the ability of selecting appropriate learning objects for a specific learner. In order to achieve this, the writer selects to analyze and implement Eliminating and Optimizing Selection (EOS) algorithm in order to obtain the benefits of it in selecting the candidate learning objects. Hence, a suitability evaluation for each learning object is performed depending on learning object attributes through a general framework.

In addition, the writer has compared the produced LOs sequences selected by EOS with that selected by different experts. Experiment results have shown that the success in learning objects sequencing is affected by the number of learning objects that represents the desired concept. Moreover, the selection results of EOS approach are competitive to the results obtained by the three experts despite the variations in their point of views.

In recent experimental and quasi-experimental studies contrasting blends of online and face-to-face instruction with conventional face-to-face classes, blended instruction has been more effective, providing a rationale for the effort required to design and implement blended approaches. Even when used by itself, online learning appears to offer a modest advantage over conventional classroom instruction (US Department of Education, 2009).

However, several limitations are in order: Despite what appears to be a strong support for online learning applications, the studies in this meta-analysis do not demonstrate that online learning is superior as a *medium*, In many of the studies showing an advantage for online learning, *the online and classroom conditions differed in terms of time spent, curriculum and pedagogy ibid 2009)*. It was the *combination* of elements in the treatment conditions (which were likely to have included additional learning time and materials as well as additional opportunities for collaboration) that produced the observed learning advantages. At the same time, one should note that online learning is much more conducive to the expansion of learning time than is face-to-face instruction.

In addition, although the types of research designs used by the studies in the meta-analysis were strong (i.e., experimental or controlled quasi-experimental), many of the studies suffered from weaknesses such as small sample sizes; failure to report retention rates for students in the conditions being contrasted; and, in many cases, potential bias stemming from the authors' dual roles as experimenters and instructors.

Finally, the great majority of estimated effect sizes in the meta-analysis are for undergraduate and older students, not elementary or secondary learners. Although this meta-analysis did not find a significant effect by learner type, when learners' age groups are considered separately, the mean effect size is significantly positive for undergraduate and other older learners but not for K–12 students.

Another consideration is that various online learning implementation practices may have differing effectiveness for K–12 learners than they do for older students. It is certainly possible that younger students could benefit more from a different degree of teacher or computer-based guidance than would college students and older learners. Without new random assignment or controlled quasi-experimental studies of the effects of online learning options for K–12 students, policy-makers will lack scientific evidence of the effectiveness of these emerging alternatives to face-to-face instruction (ibid 2009).

The main challenge of e-learning systems is to provide different courses to different students with different learning abilities. Such systems must also be efficient and adaptive. However, adaptivity can be accomplished by improving the ability to select an appropriate learning object for a specific learner. This is what makes e-learning different from traditional classroom teaching. Thus the traditional approach that presents one selection to all learners becomes inadequate in an online learning environment because different learners have their distinctive characteristics and learning styles. Rich media technologies are commonly defined as technologies that enable users to engage in interactive

communication, with the ability to see, to hear and to interact with multiple communication streams synchronously or access them asynchronously.

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