ELEMENTARY SCHOOL STUDENTS' COMPUTER AND INTERNET USE AT HOME: CURRENT TRENDS AND ISSUES

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ABSTRACT

For the past decade, the number of computers in the home have been steadily increasing. Yet relatively little is known about how children are actually using computers at home. This article elaborates on the results of a survey in which 291 parents of an urban elementary school (K-6) participated. Parents reported on their computer equipment at home, the type and frequency of their children's educational software and Internet use, and shared their ideas how better connections between computer use at home and school might be created. The results indicate that most of students' computer use was dedicated to game playing followed by various other software activities. Students reported more limited Internet activities. While home computer ownership is not necessarily contingent upon gender, some software and Internet use tended to be gender specific activities. Many of the parents' suggestions for connecting school and home focused on the ways in which information about students might be obtained from the school and support through exchanges with teachers. In our discussion we address in which ways these results replicate earlier observations of children's academic home computing. Furthermore, we discuss problematic issues and potential directions in academic home computing.

INTRODUCTION

Since the introduction of the computer, many scenarios about its educational potential have been developed and discussed [1-3]. An impressive array of different technologies has been developed and considerable information has been collected on how to implement technologies within classrooms and schools. We

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have today a far better understanding on how students learn with computers, of what it means to integrate the use of computers with other subject matters in classroom activities, and of how teachers need to be prepared and supported [4, 5]. More recent efforts have concentrated on making educational technologies part of informal learning environments such as afterschool programs [6], summer camps [7], or museums [8].

Much less attention has been paid to the home setting which nevertheless features computers in increasing numbers. According to a recent survey, 45 percent of all computer purchases by people with children are made for expressly educational intentions [9]. Yet we know little of what happens with computers at home, whether they are actually used for educational activities, and if so, in which ways. The few case studies in the past that have examined children's academic home computing revealed astonishingly little educational use [e.g., 10-12]. Conducted when the first wave of microcomputers hit the market in the mid-80s, these studies concerned primarily early-adopter families. Now that over 50 percent of American households feature a computer, many with Internet access, the time is right to analyze again academic home computing and to examine whether computer use has undergone significant transformation.

This article describes and analyzes a survey that was conducted in the spring 1997 with 291 parents of students in a metropolitan elementary school (grades K-6). The parents reported on their computer equipment at home, the type and frequency of their children's educational computer, and Internet use. They also contributed ideas for creating better connections between school and computer use. In our discussion we situate our findings in relation to previous research and address the ways in which these results replicate earlier observations of children's academic home computing. Furthermore, we discuss problematic issues and potential directions in academic home computing.

RESEARCH BACKGROUND

To date, the major emphasis among educational researchers and practitioners has been on the development and implementation of educational technologies within formal learning environments such as schools, colleges, and universities and informal settings such as museums, summer camps, and afterschool programs. Most of this prior work has neglected to address adequately educational technologies in yet another important learning environment, the family home. While computers at home in the 80s were only available to a minority of families, in recent years the numbers have increased dramatically: currently, over 50 percent of American households count a computer among their possessions in use for work, entertainment, or educational purposes. Many students use the computer at home for word processing, learning things, and playing games as suggested by recent NAEP data [13].

In reviewing the rather sparse research about academic computing at home, it is helpful to describe three different categories of computer use in that literature. In the first category, academic home computing is mostly concerned with the use of software for educational purposes independent from school activities. A second category connects computer use at home with that in school in the form of homework as continued practice or additional enrichment [14]. The third category, mostly based on recent network or Internet technologies, not only provides activities for educational purposes accessible from home and school, but also facilitates communication between teachers, parents, and students [15].

The pilot research conducted over ten years ago falls mostly into the first category. The first wave of microcomputers made the presence of computers at home economically feasible, at least for some families. In one of the most extensive studies conducted in the mid-1980s, seventy families with computers at home were observed for two years [10, 16]. The researchers documented, through activity logs and interviews, the computer use of different family members. One of the surprising findings was the little educational use of computers by children; most children used their home computer for playing games. Only in one family out of seventy did children pursue school-related activities such as programming. Several other studies report similar results [11, 12, 17]. Foremost among the reasons for the absence of academic home computing were parents' insufficient training, gender-based disparities in use, the paucity of appropriate educational software, and the lack of connections between school computer and home activities.

In the second category we find studies that examine the academic benefits of doing homework on the computer at home. The studies conducted in the '80s were mostly concerned with homework activities that could be considered continued practice. One early study examined whether computer use in the home provided educational benefits for a group of kindergarten students who were compared to students using the computers only in school [18]. It found significant positive results for those students who used the same software at home and at school in terms of their keyboarding skills and reading readiness. Nichols studied whether the ownership of a home computer had a positive impact on students' learning of programming languages such as BASIC and LOGO [19]. He reported statistically significant differences between computer owners and non-owners in regard to their post-test scores and homework completion. In the BUDDY project, an Indiana school district provided computer take-home options [20, 23]. Assessments compared students with computers at home to those who did not have computers at home and found that students' writing activities improved significantly in terms of their quality (in regard to the state's standards) and length. While these few studies document the impact of computer use and ownership at home as positive contributions to children's education, researchers uniformly pointed to parent involvement, curriculum integration, and teacher

preparation as equally important factors for making the home-school computer connection a success.

Computer homework that might function as an enrichment activity has been less examined in research literature. A recent pilot study conducted with one classroom provided first insights. In the spring of 1998, a class of thirty bi-lingual fourth- and fifth-grade students participated with their teacher in an effort to combine mathematics software design activities in school with those at the computer at home. The students were asked to design and implement on the computer various educational game scenes to learn about fractions [24]. All the students had computers and the appropriate software at home for the duration of the project. They could take their software designs started in the school setting to continue working on them at home. Many students found it difficult to operate on their own at home in the absence of their teachers or their more knowledgeable peers, key support components of their school software design environment. In those few instances where students continued to work at home on their fraction design activities they often did so with support of their parents. As later interviews revealed, students as well as parents had problems conceptualizing the nature of their home software design activities. The more open-ended software design activities posed a problem to students who were more accustomed to take home packages of well-delineated worksheets and activities.

The increasing availability of Internet and network connections has given rise to a third category of research about academic home computing. In these projects, homework activities on the computer are but one of a range of activities. Many projects facilitate dialogues between students, teachers, and parents. For example, in the NetTv project, students of Latino families were given set top boxes providing increased access to science homework activities [25]. Researchers also studied the participation patterns of other family members in terms of Internet usage and found that those increased not only for the students but also for participating parents. MOOSECrossing provided a virtual community in which students could write and program their own design worlds at school and also at home [26]. Ehrich et al. created a network in their school district in which parents, students, and teachers participated in computer-based discussion groups formed around school and community topics [27]. All these projects examine what particular new technologies might be especially well suited to the home, which strategies work for getting parents involved in learning, and whether the home can be a social learning environment when the student might be physically alone.

Equity and access are focal points in assessing how technology has come into use in everyday life. Gender functions as a key determinant in what has already been yielded by studies on academic home computing. Girls tend to use computers less frequently than boys [10]. This should not come as a surprise given what we know from school observations and video game play at home. Boys tend to represent the vast majority of video game players [28]. In schools, girls often seem less interested in participating in computer activities [29-31] or have a

harder time getting access to computers [32]. Like gender, socioeconomic background ostensibly plays an equally important role in access to computers at home. There is an uneven distribution of computers and Internet access across socioeconomic strata [33]. These equity issues, which are as prevalent in schools [34], are of equal importance in academic home computing.

As this research review specifies, the increasing number of computers at home has prompted many research projects in the absence of specific data. For example, the recent NAEP survey gave us some general sense of academic home computing but did not provide us with any empirical information about gender or income differences nor did it provide us with any details about software uses. It is time to revisit children's academic home computing activities. Subsequently, we conducted a survey at an urban elementary school with all parents of registered students and assessed the availability of computers at home and the type and frequency of students' computer and Internet activities. Furthermore, parents were consulted about their ideas of how to use the computer to create better connections between school and home.

RESEARCH METHODS

Research Participants

The survey was conducted at a laboratory school located on the campus of a major public university. The 457 students, ages four to twelve years, come from diverse ethnic and socioeconomic backgrounds reflecting the demographic composition of the state of California at the time of the survey. Forty-seven percent of the students are Caucasian, 19 percent are Hispanic, 12 percent are Asian, 14 percent are African-American, and 8 percent are of mixed background. The socioeconomic background of the students is less evenly distributed and is more representative of that of a private school. While the school is part of a public university, admission to the school is fee-based with reduced or waived fees for those families with limited resources for more than half of the attending students.

Survey

All parents (N = 357) whose children were attending the school in April 1997 were sent the survey through the mail. The questionnaire was presented in an English and Spanish version because a considerable percentage (9.4%) of parents were bilingual. The two-page long questionnaire consisted of eight questions which queried computer ownership and Internet access, frequency of software and Internet use, and parental suggestions for computer use in school and home. A sample questionnaire of the English version has been included (see Appendix).

Data Analyses

The survey return rate was 100 percent. All the questionnaires from parents with children in the elementary school grades (grades K-6) were selected for the following analysis ($N = 291$). The data from the questionnaires was entered in a spreadsheet. Questions which requested specific information such as the computer brand were re-coded in general categories. Information about the CPU unit and processor rate of computers at home were not included because many parents either did not provide this information or listed incorrect numbers. The suggestions from the last, open-ended question were entered verbatim into a file and categorized by two independent coders.

RESULTS

Availability of Computers and Internet Access at Home

Of the 277 parents who answered the question about computer ownership, only 11 percent reported that they did not have a computer at home (see Table 1). Over 65 percent of these parents said they intended to purchase a computer in the near future. It is clear from these numbers that the parents of this school are not representative of the national picture: more than twice as many households had computers at home compared to the current 40 percent of American households. The parents' household income played a statistically significant role in computer ownership (Chi-square ($df = 2$): 18.4, $p < 0.001$).

The commercially available computers were nearly equally distributed between the two prominent platforms: 45 percent of parents listed having an Apple™Macintosh computer at home whereas 52 percent of parents had an IBM™ or DOS-compatible machine. While this distribution is not representative of current market shares, it might reflect that parents included in their purchase decisions the school's choice of the Macintosh as the primary platform. Of those parents having computers at home, 77 percent had CD-ROM drives and slightly less, 75 percent, had a modem. Similar to other trends, machines equipped with

Table 1. Number of Computers at Home by Household Income

Number of Computers at Home	Income		
	<19.9K	20K-59K	60K>
0	4%	4%	3%
1	6%	18%	31%
2	2%	8%	34%

these features were mostly found in households within the upper income brackets irrespective of students' age or gender.

About 89 percent of families had a computer at home and 71 percent of them had Internet access as well (see Table 2). Again, we find that Internet access is tied in a statistically significant way to household income, with 48 percent of families in the highest income bracket also having Internet access (Chi-Square ($df = 4$); 55.2, $p < 0.001$). The majority (68%) used a subscriber-based service such as AOL followed by 15 percent of parents who had a school-related account, 7 percent who used a work-related account, and a minority of households that either used a freenet service or a telephone company.

Children's Computer and Internet Use at Home

Of central interest was what children were doing at home with the computer (see Table 3). We created two categories, frequent use (combining listings of "at least once a week" and "more than once a week") and rare use (combining listings of "never" and "less than once a month") for better comparison. The predominant use of computers at home was for game playing followed by educational software, creativity software and word-processing, and other educational software.

Table 2. Internet Access of Computer Owners at Home by Household Income

Internet Access at Home	Income		
	<19.9K	20K-59K	60K>
No	6%	9%	14%
Yes	3%	20%	48%

Table 3. Frequent Student Computer Use at Home by Gender

	Girls (%)	Boys (%)
Games	69	86
Word Processing	51	49
Educational Software	59	70
Other Educational	34	53
Creativity Software	59	51

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These results confirm earlier observations of children's use of computers at home [10].

There are significant differences between boys' and girls' software use at home which are particularly pronounced in game playing ($z = -3.13$, $p < 0.05$; pooled estimate—test of normal proportions) and use of other educational software ($z = -2.99$, $p < 0.05$; pooled estimate—test of normal proportions). While not significant, we found the reverse pattern in the use of word-processing and creativity software: here the girls spend more time than the boys.

While 70 percent of students had Internet access at home, they tended to spend much less time on Internet-related activities than on software (see Table 4). The most frequent activity was net-surfing followed by information retrieval and e-mail. A minority participated in chat rooms, if at all.

A detailed analysis of frequent Internet use (i.e., students who used the particular Internet function at least once or more than once a week) pointed out that girls and boys differed significantly in their use of net-surfing ($z = -2.13$, $p < 0.05$; pooled estimate—test of normal proportions). The differences in frequent e-mail use were less pronounced, most likely because fewer children were allowed to use this feature as was also the case for the chat rooms.

Parents' Interests and Suggestions for Computer and Internet Use

In the last question of the survey parents were asked for their suggestions about using computers to improve their child's education and connections between parents and school. While not all parents provided an answer, 35 percent of them offered a variety of suggestions, some of them more than one (see Table 5). We also note that these suggestions were made by parents who had a computer at home.

The majority of all suggestions articulated a desire for information orientated activities of various kinds. Forty percent wanted to receive information about upcoming field trips, student grades, and other school-related activities. Parents also expressed interest in receiving homework assignments, submissions, or evaluations via the computer. Another interest was in finding out about appropriate

Table 4. Frequent Student Internet Uses at Home by Gender

	Girls	Boys
E-mail	17%	22%
Net Surfing	28%	43%
Chat Rooms	10%	7%
Info Retrieval	29%	43%

Table 5. Parent's Suggestions for
Computer Connections between
School and Home

Suggestion	Percentage (n = 101)
Information Offers	40%
Information Exchanges	18%
Technology Needs	14%
Comments	28%

educational software for purchase or other relevant educational sites on the World Wide Web.

Eighteen percent of the parental suggestions focused on using the computer for information exchange; in particular, communications with the teacher were listed. It is worthwhile knowing that at this school, students do not receive grade cards but parents are informed about their child's progress through written reports as well as personal meetings throughout the school year. The scheduling of such parent-teacher conferences often poses logistical challenges for both sides. Only three suggestions expressed a desire to see school and homework computer assignments coordinated or use the Internet for communication exchanges with other students.

Fourteen percent of all parental suggestions addressed more generic technological needs. Not all parents had computers at home and many were interested in finding ways of purchasing one at a reduced price. In some instances parents also were concerned that their children did not often enough use the computer in school and suggested that there ought to be one computer per child. (The current ratio at the school is one computer for four children.) Parents were also interested in having extracurricular computer activities offered to both parents and children or special classes that would allow parents to get more acquainted with existing technologies.

Besides direct suggestions, 28 percent of the parents took the opportunity to comment on the general usefulness of computers for learning while stressing the need for their children to learn computer and Internet search skills in various subject areas. Five percent of the parents expressed their general positive feelings about students' computer use at the school while the same percentage voiced some ambivalence about too much focus on computer use.

DISCUSSION

We conducted a survey to gain a better understanding of children's current computer and Internet use at home. Twenty years after the introduction of the per-

sonal computer we found that elementary school children use their computers at home quite frequently for games and educational software. This pattern of recreational and educational uses also applies to the Internet, but in lower numbers. In our discussion, we situate these results in relation to assessments of academic home computing conducted in the '80s. Furthermore, we address the equity issue—the significant gender and access differences found in our data set. Lastly, we discuss assessment issues related to studying academic home computing.

Past and Present of Academic Home Computing

In discussing our survey, we need to acknowledge that the results are not representative of the current distribution of computers in American households. In our survey, computers were present in households more than double the national average. And many parents were on their way to connecting to the Internet as well. At this moment, this group of parents represents a special group very much like the seventy families examined in the Giaquinta, Bauer, and Levin study [10]. One of the original intentions of this survey was to assess children's current academic home computing. What we found in our survey was that computer games are still most frequently used in home computing. If there is any change, then it is that most children in our survey also used a variety of other software, not all of which was related to specific educational purposes. We also found significant gender differences in some aspects of software and Internet use at home, which again were documented in earlier studies. In sum then, the results of this survey reconfirm the findings of studies conducted in the '80s. While the number of computers at home has changed significantly over the past ten years, children's academic home computing as such has not changed in substantial ways.

There are several possible explanations for this result. To begin with, our explanation for the increased use of other educational software in this survey is that children's software has become more accessible. Many general consumer good stores now sell children's software. Children's software has also become more affordable. Furthermore, many parents buy computers to enhance their children's education and buy more educational software as well. It is important to remember that the families surveyed for this study are quite affluent and consequently have the financial means to purchase more software titles. For those reasons, children in the '90s might have had available more educational software for their home computers than they did in the '80s.

One could have expected more academic home computing with more computers and software available at home. Yet an increase in quantity of computers and software does not necessarily correlate with an increase in quality of computer home activities. In many ways, these results are reminiscent of computer use in schools. Just putting computers into classrooms and connecting them to the Internet does not address how technology is integrated into subject matters, classroom activities, and student learning and teaching. The same applies to the home

setting: just having a computer at home does not mean that children will use it for educational purposes. In fact, most children get introduced to interactive technologies within an entertainment context by playing video games. For that reason, it should not come as a surprise that entertainment uses such as game playing are more prominent than educational uses of the computer at home.

A further explanation quite possibly resides with parent's inadequate familiarity with technology. While in the classroom, teachers and peers provide context and guidance for instructional activities, at home parents are instrumental in creating children's learning environment, with and without computers. In the pilot study that examined integrated school and home software design activities, we found parents were key in getting students to continue these activities at home by providing assistance. This assistance did not necessarily come in the form of expert software design advice (none of the parents were familiar with the programming environment) but in the form of time and general guidance. It therefore seems, if educational computer activities at home are to become a reality then parents need to be prepared to provide the form of guidance found in classrooms through teachers and peers. Furthermore, we note the missing integration and coordination of computer work in school and at home. This might be one reason why there is such little academic home computing. There is also the issue of what kind of school activities would afford good opportunities for continued work at home. If academic home computing is to change in the coming years, all these factors need to be addressed.

Equity and Access in Academic Home Computing

We now turn to another central finding of our survey, the significant gender and access differences in home computer use. As we pointed out, there were no significant differences in computer ownership contingent upon students' gender. But we found significant differences in some aspects in home computer and Internet use. Some of these observed differences are hardly surprising given what we know about boys' interest in video game playing [28]. While it was not a pervasive significant trend in the data, it appears that elementary school age boys simply used the computer at home more frequently than did the girls. Whether this was due to children's differing interests or whether parents fostered different stances toward technology [e.g., 10, 35] remains to be studied.

A further striking but not surprising result concerned the relationship between computer ownership and family income. The data pointed out clearly that families at the lower socioeconomic end had a much greater likelihood of not having a computer at home. This did not tend to be a problem in the '80s because schools were the only place where most children would work and learn with computers. But it is very obviously becoming a problem in the '90s given the growing disparity in wealth (and the widening margin between socioeconomic classes). As

interactive technologies become inextricable aspects of our daily lives—work, education, and entertainment—a substantial number of children will have to rely on schools to gain critical knowledge and technological skills. Given the many problems schools face with preparing teachers and integrating computers into school work, this will be a formidable challenge.

Assessing Academic Home Computing

This survey provided a first glimpse of what children do with computers at home. But time spent at the computer and the kind of software used are only two facets of computer use at home. It would also be valuable to understand the environmental setup of computers in homes and how accessible they are for children. The physical location of computers at home might be indicative of the ways in which computers are integrated or separated from other play and learning activities. Many computers at home are shared with siblings or with parents. It would be important to find out how this resource is shared among family members and for what purposes. The larger goal would be to gain a better understanding of how computers are integrated into family practices, if at all, and how this can lay the foundation for creating connections between school and home activities on the computer.

We also need to develop other methodologies for assessing academic home computing practices. In the present survey it was unclear what sources of information parents used to make their judgments: actual observation and time spent with their children in front of the computer, children's own reports of what they were doing when they were using the computer, or sibling's or other caretaker's descriptions about the nature and frequency of children's engagement with technology. One could address this issue by having parents and children independently report in a survey about the type and frequency of their computer and Internet use. A comparison of the two data sets would reveal to which extent parents' assessments overlap with those of children.

Another possibility is to ask children to record in diaries their daily computer activities. A pilot study conducted by the first author revealed some problematic issues with such an approach. As observed, over 70 percent of children in a class of thirty fourth- and fifth-graders failed to record on a daily basis their computer activities during the test week and many of them were seen to fill in information for one or more days afterwards. While self-assessments are likely prone to inaccurate activity reporting (e.g., children might spend considerable time playing computer games but they might report less because of social desirability), home visits, such as those conducted by Giaquinta, Bauer, and Levin [10], pose another challenge in that computer activities might be specifically arranged in their type and nature for the purpose of the evaluators.

OUTLOOK

The current study provided updated information about children's educational home computer use. From parents' suggestions, it became clear that not only increased use but also increased integration of computational learning activities are needed. Most of parents' interactions with school are centered around supervising and helping children with homework assignments as well as maintaining contact with the teacher. Consequently, having better information about the homework or getting additional sources via WWW-sites to help children in their learning endeavors are legitimate needs. What requires further exploration is how parents' information needs and exchanges are best served. How would one optimally structure electronic conferences between parents and teachers? Would those be real-time or could those be asynchronous? These are compelling logistical as well as conceptual issues to consider that are predicated on how much disposable time teachers have during the school day, if indeed at all. Currently, teachers and administrators function as intermediaries and interpreters of students' work and accomplishments.

To make educational computing work at home and at school obviously requires the well-tuned efforts of many constituents. Computers alone, as often has been found, do not change learning culture and activities [1, 36]. The learning practices of students, teachers, and parents need to undergo significant transformations for that to make it happen.

ACKNOWLEDGMENTS

APPENDIX

COMPUTER USE SURVEY
Please fill out the following questionnaire to help us in developing our computer technology program. Thank you for your cooperation!
FAMILY USE SECTION
Family Name: _____
UES Child's Name: _____ Teacher: _____
Phase _____
UES Child's Name: _____ Teacher: _____
Phase _____
UES Child's Name: _____ Teacher: _____
Phase _____

1. **How many working computers are there in your home?**
   _____ None
   _____ One or more (please indicate quantity _____)

2. **Do you have any plans to buy a computer if your child doesn't have access to one now?**
   _____ Yes
   _____ No

3. **How often do your UES children use software in your home?**
   (Circle one for each type)

   a. Games

   | Never | Less than once a month | At least once a month | More than once a week |

   b. Word processing

   | Never | Less than once a month | At least once a month | More than once a week |

   c. Educational (mathematics, reading, science, social studies, etc.)

   | Never | Less than once a month | At least once a month | More than once a week |

   d. Other educational (Internet, typing, test-preparation (ISEE), languages, encyclopedia)

   | Never | Less than once a month | At least once a month | More than once a week |

   e. Creativity-related (painting, drawing, music, etc.)

   | Never | Less than once a month | At least once a month | More than once a week |

   f. Other, specify _____

   | Never | Less than once a month | At least once a month | More than once a week |

4. **If you have a computer at home, what brand is it?**
For each computer in your home, please write down brands (Mac or IBM- compatible such as Dell, AST, etc.), RAM (.5MB to 16MB or more), and the power of the CPU (286, 486, Power PC, Pentium, etc.). Please note if you have a modem and CD-ROM drive by writing "yes" or "no" in the far columns.

Brand	RAM	CPU	Modem	CD-ROM

5. **Do you have Internet access and electronic mail (email) service at your home?**

_____ No

_____ Yes. Please check the system you use:

    ___ Subscriber service (America Online, Prodigy, Compuserve, or
         other: _____)

    ___ School-related account (Bruin Online, Eudora, Quickmail,
         Orion, OAC, Gina)

    ___ Work-related account (Specify provider: _____)

    ___ Free-net service (LA Freenet or other: _____)

    ___ Telephone company subscriber service (MCI Mail, or other: _____)

6. **How often do your children use these E-mail and Internet services at your home?** (Circle one for each service)

    a. Send e-mail

Never	Less than once a month	At least once a month	More than once a week

    b. Surf the net

Never	Less than once a month	At least once a month	More than once a week

    c. Participate in chat rooms

Never	Less than once a month	At least once a month	More than once a week

    d. Access or retrieve information from the Web

Never	Less than once a month	At least once a month	More than once a week

7. **If you had the opportunity, would you like access from your home to information about UES via a UES web site or bulletin board?**

_____ Yes

_____ No

8. **Please share any ideas you have about how computers could be used to improve your child's education and the connection between parents and the school.**

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