

Factors Influencing the Acquisition of Science Concepts in Secondary School Students

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It is gaining importance among psychologists and researchers to understand the ways of learning of science concepts and particularly recognizing factors which cause retention of science concepts in students. The present study was carried out to assess the influence of socioeconomic status of family and other variables on understanding of scientific concepts in secondary school students from districts of Punjab Province. The sample size of this study was 720 enrolled male and female students of class 9th selected by using purposive sampling from the public schools in six districts covering the central, southern and northern region of the Punjab province. For data collection two types of instruments were administered to the subject of the study; The Science Concept Acquisition Test and self-constructed questionnaire regarding demographic and other variables. The collected data were analyzed by using t-test, ANOVA and correlation. The obtained results were as follows ; the socioeconomic variables of parents did not show noticeable impact on students' performance whereas family structure, family size showed the noteworthy influence on the students' performance. In this study no correlation was found between study hours and test scores, however, a negative correlation existed with the domestic working and TV watching hours. In the future, it is suggested that parents should create and promote the conducive environment for getting better understanding of science education in students at home.

Keywords: Science Concepts, Family Structure, Study hours

Science education is a mode to address global requirements, therefore it is important to expand its understanding, identify issues related to its expansion and seek solutions for promoting science education at the foundation levels (Bybee, 1997). This thinking has led to broadening viewpoints among many professionals and policy makers in investing science teaching and education in many countries, thus in present times education in science begins at primary levels and Pakistan is no exception. From classes 1 through 8 it is offered as a compulsory subject called general science, whereas at secondary level (9th and 10th classes), science is partitioned into general and natural sciences, offered as elective courses. The estimated school time assigned to these sciences is 12-14% of the total school time, which is rather low. At these class levels, natural science is a mix of biology, chemistry and physics and includes topics on life, animals, matter, forces, earth and the universe (Aly 2007).

Like many other countries, Pakistan also faces issues with science education including low allocation of funds, unavailability of adequate number of science teachers, labs and equipment, outdated syllabi and inadequate grading systems of the science courses (Memon, 2007). Riazuddin (2002) reported that Pakistani government spends about US \$2000 for every soldier as contrasted with US \$2 for every student. So it is very important in this situation to target science education in Pakistan multi-dimensionally for effective results.

Getting a better understanding about factors that are significant for learning science is gaining popularity as teachers want to help learners to comprehend science concepts instead of mere rote memorization. In this regard research studies have expressed the effect of family structure, family size, socioeconomic foundation of

Learner, study and TV watching hours, domestic working hours and etc., on science performance (Amato & Keith, 1991; Martini, 1995; Campus, 2012; Singh, Granville & Dika, 2002; Walker et al., 1998; William & Haertel, 1982; Zill, 1996)

Numerous other studies have been conducted to measure the science achievement and accomplishment of students at different stages of school grades. Khan et al., 1999 led research to measure the learning accomplishment of students at primary levels in Pakistan from 28 districts and found 4-5th grade students performed well enough in science, whereas Pervez (1995) found the contradictory results by measuring the performance of students of grade 3 & 5 in science subjects.

The current situation of science education in Pakistan is still under debate. Malik (1983) depicted that, the science course content in Pakistan is completely filled with factual data; the science teachers are not properly trained in educating science; the foremost procedure for lesson delivery is the chalk and talk strategy; lab work is missing; the course substance is outdated and mental retention of text content is the commonly considered equivalent to getting science education. These circumstances may bring reduction in enthusiasm for the science subjects. Rowlands (2008) explored the trend of worldwide decrease of students' enrollment in science subjects. According to him, the developing countries are confronting a danger that they would fail to provide the next generation of researchers and particularly instructors who can teach science. Thus it is important to explore and understand factors that support learning of science.

Analyzing how science education might be better disseminated in secondary schools is a problem that has caught restricted reactions and is, therefore, understudied in Pakistan. Educators, mentors, and specialists have long been attracted by investigating variables helping successfully for imparting the quality knowledge into learners. These variables, inside and outside the school may influence the students' scholastic accomplishment. These components may be labelled as student's personal characteristics, family variables, school variables and peer's influence (Crosnoe, Johnson & Elder, 2004). Numerous studies contended that the home

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and family inputs or pupil foundation were really the essential determinants of their accomplishment (Hanushek, 1995; 1996; Hanushek et al., 1996; Lee & Barro, 1998; Hanushek & Kimko, 2000 and Betts, 2001). In this regard mothers' educational status and family earnings impact were also considered important (Rhea & Otto, 2001).

Many studies highlighted that parental education and family socioeconomic status have a positive connection with the understudy's academic accomplishment (Jeynes, 2002; Mitchell & Collom, 2001; Ma & Klinger, 2000). The pupils with a high state of SES perform better than the white collar class students and the working class students perform better than the students with low level of SES (Garzon, 2006; Kahlenberg, 2006; Kirkup, 2008). The working status of mothers is also considered important for the academic achievement of students (Alim et al, 2008). Whereas Beblo and Lauer (2004) findings were contradictory and found the weak effect of parent's income and their working status on children's education.

Krashen (2005) inferred that pupils of educated parents, are a grade higher on state sanctioned tests than those whose parents were not educated. Knowledgeable parents can better correspond with their children in regards to the schoolwork, the exercises and the knowledge being taught at school. They can facilitate better their children in their studies and school activities (Fantuzzo & Tighe, 2000; Trusty, 1999). Glick and Sahn (2000) discover that though father's education has factually important positive effects on both young females and males education in Guinea, mother's education helps just girls.

Stronger impacts of variations in family earnings on girls' schooling, and (conceivably) stronger relative inclination of mothers for teaching girls, suggest that the earnings impact of the mother's occupation ought to help girls' education more than boys. Then again, the time effects are unfair against girls, who are more inclined to be solicited to hold up the load of work in the home due to their working mothers. Various studies in the struggling countries (not so much concentrating on mothers work effects) demonstrate that girls are not sent to school because of their duties to look after their younger siblings or to perform other household chores; this explanation is frequently mentioned by participants in ethnographic studies (Nieves 1981; Safilios-Rothchild 1980; Engle et. al. 1985).

Exploration in regards to the impact of family structure on pupil accomplishment is uncertain. The work of few researchers demonstrates students from nontraditional families are scholastically poor when contrasted with pupils from conventional families (Bachman, Coley, & Chase-Lansdale, 2009; Uwaifo, 2008; Yara & Tunde-Yara, 2010). However, others reject that the obvious presence of an accomplishment difference between pupil from nontraditional families and those from conventional families (Chiu & Ho, 2006). As Pong (1998) recommended, single parent families may be one sort of non-conventional family in which accomplishment stays high regardless of a by and large accomplishment difference for all students from non-conventional families. Hence, non-conventional families were further sorted as either single mother families, single father families, mixed families, extended families, or others.

In the context of Pakistan, Khatoon (2008) investigated the impact of home background. She was of the view that family structure applies an extensive impact on the accomplishment of the students. She explored the impact of joint and nuclear family frameworks on the scholarly accomplishments of the students and ended up "there is a relationship between family structure and

scholastic accomplishments". Suleman, et al., (2012) likewise inspected the impact of family structure on the scholarly performance of the students. Yet they took family structure as far as family size and number of children and suggested that the small family size and small number of children coupled with parents' support improves pupil's academic achievement. Some other researchers study the effect of family size on the academic performance of children (Blake, 1989, and Coleman, 1988).

Few scientists examined the connection of domestic work with scholastic accomplishment. Though sound negative relationship between child labor obligations and academic achievement has been built (e.g., Heady, 2000 & Post and Suet-ling, 2000), less consideration has been paid to the impact of girls' household duties with their education. Jones et, al, (2011) found in the investigation of girls' secondary education in Uganda that the gender related household work was frequently thought to be an expense' to have girls join classes as opposed to help with cultivating, look after of their siblings and family obligations. Likewise, in family crises, girls were required to get control over the home, which may influence their study in schools. Campus (2012) explored in their combined study led in Zimbabwean school that female students did not have sufficient time to deal with their school work at home.

One generally unresolved issue and fundamental variables of scholastic accomplishment of pupils is study time. Study time is a particular time an understudy allocates for himself or herself to study. A few different studies have been completed on study time and students' accomplishment (Logunmakin, 2001, Kumar, 2002 and Gbore, 2006). They all concurred that study time behavior influences solid association with scholastic accomplishment of learners while Owolabi (1996) and Adeyemo (2005) inferred that students' accomplishment was the result of the study time behavior and different components in any course of study. Adeyemo (2005) particularly debated that study time approach is a practice that is related to reading for joy. Whereas Kember et, al (1995) and Schuman et, al (1985) did find little or no relation between study hours and academic achievement.

In education, the impact of TV is generally documented. "The impact of Television on accomplishment relies upon the measure of watching. Up to 10 hours in every week of watching may really upgrade accomplishment somewhat yet past this accomplishment reduces. Moses (2008) uncovered that direct measure of TV review was discovered to be advantageous for perusing, and that the substance of projects by children matters different studies report that persistent viewing of TV adds up to low achievement in school subjects (Caldas and Bankston, 1999). The specialists discovered critical long term harm had happened even at 'humble levels' of TV watching; somewhere around one and two hours of every day (Hancox R.j. et al., 2004). Zavodny (2006) also found the negative relationship. TV does impact accomplishments; however, its impact is less.

Parent's interest is thought to be an extremely significant and positive aspect of child academic achievement. In Pakistan few parents participate in the homework exercises of their children, however, some cannot, so those parents arrange private coaching for the scholarly progression of their children. Especially at secondary level the courses are hard, long and troublesome; they require constant supervision and direction, so parental consistent participation or private coaching might consider the most ideal approach to tackle this issue. (Atta, Khan, Sheik and Akbar, 2014).

According to Kay (2010) clarified that secondary school students who avail coaching perform better than their fellows. Goh

(2010) also highlighted the benefits of private coaching for students like; it's improvement in confidence, more attention to problem areas and opportunities to try and bring improvement in studies by giving more time to practice whereas Zhang's (2012) study which is conducted in china showed opposite results that private coaching mostly has no effect on student academic performance and that the effect may in some cases be negative. Cheo and Quah (2005) explored the negative impact of private tutoring on the performance of secondary school students in Singapore.

Rationale

This study was led with the intent to measure the conceptual understanding among students and to investigate the demographic and other variables that might be influential in science accomplishment of students who had passed their middle level examination in session 2013. For this purpose, a survey study was conducted in which the data were collected from the public schools of the six district of Punjab Province .

This study is expected to provide facilitation in the science concept development, understanding and application of basic science ideas in daily life. The analysis of pupils' understanding about science concepts is needed to understand the distinctive basic variables affecting significant science learning at schools. It is anticipated that recognizing evidence of the variables that help the accomplishment of students in science will assist school leaders and parents to distinguish practically identical attributes that will help the learners in acquiring concepts.

Objective of the Study

The main objective of the present study was to measure the students' concepts of science acquired in public schools and how it is affected by various demographic factors.

Hypotheses

Students living in nuclear families perform higher in science than the students living in joint families; science learning and understanding in students whose fathers and mothers are employed should be greater to students whose fathers and mother are unemployed. There is a significant impact of father's , mother's educational status ,private coaching and siblings on test scores of students. Test scores of students with father's and mother's income is higher than the students having father and mother with no income. There is a correlation between study hours and students' test scores, whereas negative correlation is expected between TV watching hours and domestic working hours with students' test scores.

Method

Participants

In this study, the survey research design was used to gather the information. The participants of the study included 720 students of secondary school students of six districts of Punjab. Participants were selected by using purposive sampling. In order to collect the data, the Science Concepts Acquisition Test (SCAT) constructed by Shahed (1989) comprised of 40-item related to basic science

concepts taken from the science text books used in public schools. The split –half reliability of SCAT is .79 whereas maximum score of this test is 40.

A self-administered questionnaire was formulated to determine the gender, family structure, socio economic foundation of students and many other variables. Data was analysed by using one way Analysis of Variances (ANOVA), t-test and correlation .

Procedure

The information for this study was collected from public schools of six districts of Punjab after taking informed consent from participants and administration of schools. Data was collected personally by researcher in Lahore whereas, personal contacts were used for data collection from the other districts of the Punjab. Assurance of confidentiality was provided to the students and school administration. This test was organized in the group of 30 students and 40 minutes were recorded as an average time taken by students for the completion of this test.

Results

Table 1
Independent sample t-test measuring the difference in test score of students

Factor		Mean	SD	t	p
Family	Nuclear	22.89	5.49	1.98	.048*
	Extended	22.05	5.66		
Mothers	Employed	20.70	5.86	3.16	.002*
	Unemployed	22.65	5.53		
Fathers	Employed	22.37	5.61	.41	ns
	Unemployed	22.69	5.59		
Coaching	Yes	21.72	5.40	3.94	.001*
	No	23.38	5.76		

*Significance

The analysis shows that the mean of the student group living in nuclear families is greater than the student group living in extended families with the significance level of .048, $p < .05$, which indicates the real difference between two groups. This hypothesis illustrate that the students living in nuclear families performed well in science test than students living in extended families. In case of occupational status of parents, the mean of the students' having unemployed mothers is greater than the student having employed mother with the significance level of .002, $p < .01$, which indicates the real difference between two groups. This hypothesis explains that the performance of students in science test with unemployed mothers is higher than academic performance of students with employed mothers, whereas analysis shows that the mean of the students having unemployed fathers is slightly different the students having employed fathers, which indicates that no real difference exists between the working status of father and students' test scores. To measure whether taking private coaching can influence the academic performance of students, t-test is performed. The analysis shows that the mean of the student group without taking private coaching of science is greater than the student group who used to take private coaching of science subjects in their classes with the significance level of .000, $p < .001$, which indicates the real difference exists between the students' test scores with and without taking coaching of science.

Table 2
Analysis of Variance of Test Score of Students across the Educational level of Mothers

Variable and Score	SS	df	MS	F	P
Between Groups	62.62	4	40.65	1.29	.271
Within Groups	22463.97	715	31.418		
Total	22626.59	719			

* F value significant at $p > .05$

Table 3
Analysis of Variance of Test Score of Students with the Educational levels of Fathers

Variable and Score	SS	df	MS	F	P
Between Groups	331.396	4	82.84	2.65	.032
Within Groups	22295.20	715	31.182		
Total	22626.59	719			

* F value significant at $p > .05$

Table 4
Analysis of Variance of Test Scores of students across Income levels of Father

Variable and Score	SS	df	MS	F	P
Between Groups	276.684	3	92.22	2.95	.032
Within Groups	22349.91	716	31.21		
Total	2626.59	719			

* F value significant at $p < .05$

Table 5
Analysis of Variance of test score of students across income levels of mother

Variable and Score	SS	df	MS	F	P
Between Groups	332.39	3	110.79	3.55	.014
Within Groups	22249.2	716	31.215		
Total	22626.59	719			

* F value significant at $p < .05$

Table 6
Analysis of Variance of Test Scores of students across the Number of Siblings

Variable and Score	SS	df	MS	F	P
Between Groups	468.156	5	93.63	3.017	.011
Within Groups	22158.44	714	31.03		
Total	22626.59	719			

* F value significant at $p < .05$

The finding of ANOVA reflected that there is no significant difference between test scores of students with the five levels of mothers' education. The scores were not found to be significant across the five educational levels $F(4,715) = 1.294, p > .271$. The SCAT scores of students differed significantly across the five educational levels of fathers $F(4,715) = 2.657, p < .05$. This was further analyzed in the post hoc Tukey's HSD comparison. The results indicate that the students whose fathers had less than ten years of education ($M = 22.73, SD = 5.33$) scored significantly higher on SCAT than the group of students whose fathers had sixteen or above years of education ($M = 20.07, SD = 5.50$). Other comparisons between groups did not yield any statistical differences at $p < .05$. The SCAT scores of students differed significantly across the four levels of fathers' income $F(3,716) = 2.95, p < .05$. This was further

analyzed in the post hoc Tukey's HSD comparison. Tukey's HSD test was conducted for post hoc comparison of fathers' four income groups. The comparisons between groups did not yield any statistical differences at $p < .05$.

The SCAT scores of students differed significantly across the four levels of mothers' income $F(3,716) = 3.55, p < .05$. This was further analyzed in the post hoc Tukey's HSD comparison. The results indicate that the students' group whose mothers had not any income ($M = 22.64, SD = 5.54$) scored significantly higher on SCAT than the group of students having mothers with low, high and middle income level. The SCAT scores of students differed significantly across the six categories of the number of siblings $F(5,714) = 3.017, p < .05$. This was further analyzed in the post hoc Tukey's HSD comparison. The results indicate that the students with 7 to 9 numbers of siblings ($M = 23.49, SD = 5.28$) significantly performed higher on SCAT than the group of students who had number of siblings 16 to 18 ($M = 12, SD = 4.24$). Other comparisons between groups did not yield any statistical differences at $p < .05$.

Table 2
The Pearson Correlation between Study Hours, Domestic Working Hours and TV Watching Hours with Students' Test Scores (N=720)

Variables	Study	TV	Domestic	Total Score
Study Hours		-.08*	-.09*	-.035
TV Watching Hours			.062	-.213**
Domestic Working Hours				-.09*
Total Score				

* $p < .05$, ** $p < .01$

There is no relation found between the study hours and SCAT scores of students whereas, TV watching hours and domestic working hours had been found to have a negative correlation with the test scores of students.

Discussion

In this study, to measure the difference in test scores of students from different demographic background, data about three variables (parental income and educational status, employed and unemployed status) were collected in this study. It was assumed that the test scores of students having employed parents would be higher than unemployed parents. The analysis somehow revealed the opposite results especially in case of mother. The most interesting findings of this study were that students' scores of unemployed mothers found to be higher than students with employed women which is inconsistent with a finding of Gupta & Katoch 2013, Considine & Zappala, 2002 & Jeynes, 2002. The most possible explanation of this finding would be the mothers' involvement in studies, as the majority of mothers were found non-working, so it is assumed that they would manage to pay more attention to the studies of their children at home for the sample used in this study. While regarding fathers' working status, no significant differences found in the test scores of students having employed and unemployed fathers, which is again inconsistent with the findings of various previous studies (Gupta &

Katoch 2013, Considine & Zappala 2002 & Jeynes 2002). The most conceivable reason behind this result would be that the present study was based on the students of public schools in the Punjab Province, where fee charges are almost nothing, beside this provincial government also provides free of cost books. So this

might be the contributing factor in this case. Other possible factors can be the students personal characteristics regarding their study and behavior.

In the present study, it was also expected that the test scores of students with different parental educational level would be different. The finding of this hypothesis contrasted in case of mothers' educational level and no significant differences found in the test scores of student across the educational level of their mothers. However, significant differences found in test scores of students across the educational levels of father. The distinctive discovery of this study was that students whose fathers had less than ten years of education were found to be better in test than the students whose fathers had sixteen or above years of education. These findings are opposed to the findings of other researchers which were conducted in other societies where possible literacy rate would be high (Krashen, 2005, Glick and Sahn, 2000, Fantuzzo & Tighe, 2000). So the possible reason of this result would be other possible factors related to students personal characteristics, motivation and attitude related to science subject or school related variables. This finding can also be explained in terms of Eccles and Harlod' findings (2000) that parents, whether educated or not gradually less participated in their children's studies as in their senior classes their school works had become more difficult. Another reason would be that a majority of parents were found with ten years or less than ten years of education in this study, so these can be the possible reason of this important revelation.

Another aspect of socioeconomic status, income level of parents were also measured in this study. It was postulated that the test scores of students having parents with income would be better than the student having parents with no income. The result of this study to some extent supported the hypotheses in case of fathers' income. The groups of students having fathers with income were found better in their test scores. This result is similar to many studies (Rhea & Otto, 2001; Jeynes, 2002; Mitchell & Collom, 2001; Ma & Klinger, 2000). However the post hoc analysis didn't show visible difference in the test scores of students whose fathers' income was found under the categories of lower, middle and higher income group whereas in case of mothers' income, students whose mothers had not any income were found to be scored higher than any other income group in this study. These results were conflicting with the findings of previous many studies conducted in other countries in which the academic performance of students from higher income group were found better than other groups (Garzon, 2006; Kahlenberg, 2006; Kirkup, 2008) whereas this somehow related to the finding of Beblo and Lauer (2004). The most possible cause of this finding would be that in Pakistan, especially in the Punjab Province education in public schools is almost free compared other developed countries where the public schools' education cost is considered very high. As getting education from public schools in the Punjab is not costing much to parents, so that might be the possible cause behind this. Beside socioeconomic status of family, the variable of siblings was also measured with the test scores of students in the present study. It was proposed that the number of siblings can impact the test scores of students. This finding supported this hypothesis and significant differences were found in the test scores of students across the number of siblings, which is parallel to the findings of other studies (Blake, 1989, and Coleman, & Hoffer, 1987). However the post hoc analysis showed that students with 7 to 9 siblings were found to be better in test compared students who had 16 to 18 siblings. Thus, it can be said that the parents in large size families might find difficulties to

manage all their resources and time for the education of all their children. The result somehow supported the literature evidence that students from small size families perform academically well compared to larger families (Devi & Kiran 2002, Suleman, et al, 2012). However the number of siblings might be considered debatable in this study, which can further be explored in future researches.

The results reinforced the hypothesis and previous studies and showed that the performance of student living in nuclear families was found to be better in SCAT than students living in joint/extended families (Suleman, et al, 2012). The possible reasons behind this result would be as in extended families it would be difficult for parents to give proper attention to their children especially in their studies. Other possible reasons could be the risk of domestic issues in extended families and lack of quality time availability for students to study at home

The next hypothesis of this study was that the students taking private coaching would be higher in SCAT scores than the students without taking private coaching. The findings of this study found opposite and showed that students without private coaching of science subjects scored higher. This result is also consistent with other studies (Zhang, 2012, Cheo and Quah, 2005) and inconsistent with numerous studies (Kay N C & Goh C, 2010). The possible explanation of this result could be parental involvement in studies which was found in the study conducted in Pakistan. This study reported that there is a noteworthy effect of parental involvement instead of private coaching in the academic achievement of class 10th students in schools (Atta, et al, 2011).

In next hypothesis, correlation was performed to measure the relation between study hours and students' test scores. The finding showed no relation exist between the study hours and test scores of students and supported the findings of Kember, et al., (1995) and Schuman et al., (1985). The most possible explanation of this result would be possible error in the given categories of study time which can further be explored in future researchers. Other possible reason would be the ability of quality time management as highlighted by numerous researchers (Macan et al., 1990, Britton & Tesser, 1991, Trueman & Hartely 1996).

To measure the negative correlation between domestic working hours and TV watching hours with students' test scores, correlation was applied. The findings showed the expected negative correlation between domestic working hours and TV watching hours with test scores of students. So the finding of negative relationship between TV watching hours and students test score are similar to the findings of William and Haertel (1982), Potter (1987 and Ridley-Johnson et al., (1983) & Zavodny (2006) and opposed to the finding of Khan (2012) in the context of Pakistan. The negative relationship found in this study between domestic working hours and test scores is also supported by Heady (2000); David Post & Suet-ling Pong (2000). So the results possibly verify the general observation and the results of above mentioned studies that TV watching hours and domestic working hours were found in negative relation with the academic performance in science at least for this sample.

Conclusion

Regarding demographic variables, students living in nuclear families and with unemployed mothers were found better in test scores whereas, the differences in performance of students were not found with employed fathers. Students with seven to nine siblings scored higher than the category of sixteen to eighteen siblings.

Mothers' education had not shown any significant influence on students' performance, whereas differences were found in the students' performance whose fathers had less than ten years of education compared with sixteen to above years of education. Fathers' income also had an impact on the SCAT scores of students, however, students whose mothers had no income were found to score higher. At the end significant negative relations were found between the TV watching hours and domestic working, however, no relation was found between the study hours with the students' test scores in this study.

Limitations

The generalization of this study might be limited to public schools, because of time and resource constraints the sample was restricted to the students of public schools only. The results of this study could be different in the case of including students studying in private school systems with diverse socioeconomic background.

Implications

In the future, researchers can investigate this study on other provinces of Pakistan with other variables related to family, school, teacher (qualification, experience and etc.) and students' personal characteristics. Predictors of the students' achievement in the science test can also be explored. The role of mothers is found important in this study. So it is suggested that the voice of mothers should be heard and involved in planning the course content and activities for students in the schools. The mother may increase the performance of students in the science subject by teaching them at home. Overall Parents should make efforts to provide a conducive environment for their children at home for study. This study has policy inferences by emphasizing on more collaboration of schools and parents. Schools ought to consume more energy in advising parents about how they can contribute at home in improving the understanding of scientific concepts.

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