

STUDY OF STUDENTS' APPLICATION ABILITY OF PHYSICS CONCEPTS IN THE CONTEXT OF INFLUENCING FACTORS

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ABSTRACT. Secondary school students finds science contents as an organized body of knowledge. They mostly memorize the facts, laws, principles and concepts and recall it in examination. **This study is aimed to** assess the extent to which the secondary school science students can apply physics concepts in problem **situations, everyday life and natural phenomenans**. Influencing factors such as home facilities, parent's education, occupation, and family demographic variables of the secondary school science students were also investigated through a Questionnaire survey. Relationship was explored between the physics concept application abilities of the secondary school science students and the influencing factors. The students' application abilities of physics concepts measured on concept application ability test were found as 33 %, a significantly low performance. The private sector secondary school science students performed remarkably better than the public sector students and no significant **differences were** found between the performance of boys and girls students of the same level among both the sectors. Comparatively, the private sector students and girl students in both sectors were found in better position with respect to their home facilities, **parental support**, education and occupation and some other demographic variables. Positive causal relationship was explored between students' physics concept application abilities in terms of **scores** on concept application ability test and the mentioned influencing factors.

Keywords: **Students** conception in Physics, application abilities in Physics, influencing factor

1. **Introduction.** The science education makes efforts to adopt science as a method of study, a hands on as well as mind on activity which may warm up the development of conceptual understanding, concept application ability, scientific literacy, science process skills, scientific thinking and scientific attitude, and as a result they would make sense of the physical world . The factors contribute to learning and quality of achievement of students are parent education, occupation, support and expectation, number of siblings, socio-economic status, home environment, culture , demographic variable, school factors, students perception, attitude, study habits, thinking skills, time for additional study, home work, self concept, interest, learning style, gender differences,motivation,attitude toward the subject, nature of science(yuce1,2007; Dalgety, Coll & Jones, 2003;Covington,2000; Schibeci & Riley, 1986; Reid, 2006; **Kirmani, 2008**; Friedel, Gabel & Samuel, 1990; yildirim & Eryilmaz, 1999). Family factor, students' characteristics and school environment affect performance of students in science (Bloom, 1976). School management, family involvement and students' characteristics were the aspects related to students' achievements, where students' characteristics included " additional study time, critical thinking, science process skills, family variables such as parental support and expectation" (Knungnit, Ngamnrit, Kongsak & Preechak, 2004).Examination system, factual nature of teaching,quality of text and curriculum are also the hurdles in the way of conceptual

understanding (siddiqi,2007;EdQual,2007;; Hillel, 2005; Malik, 2002; Afolabi & Akinyemi, 2009) There are wide variety of interacting factors **that** give input to the acquisition of learning outcomes, for example, the student **brings** intellectual, social and emotional frame of thoughts from home and the surrounding environment to the school environment of certain peculiar attributes just as a product of interaction of students, teachers, management and activities (UNESCO, 2002). The parents' education positively improves the students' achievements (Govt. of Pakistan, 2002). Improved learning environment, method and characteristics of teacher proved helpful in promotion of critical thinking among students (Balsiri, 2010).

Concept is defined as: a set of rules to categorize and group events, an abstraction of series of experiences (carol ,1964), an idea of an object or event (Huitt, 2003,Boune,1966), the characteristics which classify together or set apart two things(Dresel,1960).Concept formation is: to make mental classes(Bruno 1986),a consciously applied plane(Goodnow and Austin, 1956),taking place in sequence (Garone,1960),insured when one can apply it (Robello&zolman ,2005 ;Safder, 2010) ,depending on the capacity to learn and can be affected by environment(Huitt,2003),a result of interaction with society,home,and community(woolfolk,2008),foundation in learning achievement(Collette &chiappetta,1989).When the student can apply the concept in a varying context, then it is claimed that the student has understood the concept. Misconception is the flawed view of how the world works (Rebello & Zolman, 2005). The information can be recalled but cannot be applied, and cannot relate the real and model, named as “inert knowledge” (White, 1998). Concept as unit of knowledge in science has a unique role to explain natural phenomenon” (Nedim, 2010)

Physics interpret the world around us in a specifically known language at three thought levels, the macro, the micro, and the symbolic. Sometime it becomes difficult for students to work at the three levels simultaneously, and hence, they are compelled towards memorization. The main thing in the study of Physics is the concept development. In the context of Physics, by concept we mean the contents which make Physics distinguishable. Students are mostly based on intuitive knowledge and alternative conception as well as misconception towards the facts of Physics, contrary to the expert view and true image. Therefore, students should be given the opportunity to construct their knowledge themselves regarding the interpretation of Physics' inventions and facts. Conceptual understanding is very rare when the instructions in Physics focuses on drilling a standard problem in fixed order, the sign is learned instead of the concept and a gap is produced between scientific practice and science as a subject of formal nature (Dayal, Bhut & Ray, 2007).Student get Physics and the world between their own way of thinking and what the teacher as well as the text say (Brian, 2009)

Method and Procedure

This was a descriptive, evaluative, comparative as well as causal comparative study. Multistage random sampling was used to choose sample of SSSS(N=1840)from all the secondary level public and private , girls and boys secondary schools in the sampled 5 districts out of 25 districts of Khyber Pakhtunkhwa, Pakistan. Medium of instruction, text and examination is in English in the private schools while the same are in Urdu in the public schools. The students' physics application abilities were measured on concept application ability test (CAA test) which included 30 items of MCQ, information grid type and short answers supply type Questions. About 50% of the items of the CAA test were adopted by Al- Ahmadi (2008) and the remaining items were developed by the researcher. The test was validated by experts' judgment and its Cronbach's alpha reliability coefficient was 0.7. The test was personally administered by the researcher among all the randomly chosen schools, sixteen from each district in the sampled five districts, Malakand, Mardan, Peshawar, Kohat, and DI Khan. The score for each item on CAA test was not uniform and was converted into one for analysis. Questionnaire was distributed among 50% of SSSS participated in the test in order to investigate the influencing factors related to their home facilities, parents' education and occupation, and other demographic variables. The CAA test score was analyzed by mean and independent sample two-way t-test. The students' related influencing factors were analyzed by percentage and significance of percentage differences (Garret, 1966). The students' questionnaire data codes were considered as score for the exploration of relationship between CAA test score and the influencing factors. Multiple regression analysis was used to explore the relationship between students' physics concepts application abilities score and their home facilities, parents' education, occupation, and number of siblings.

Results

Table 1 Score of Secondary School Science Students on CAA test

N	Total Test score	Mean	Std. Deviation	T	P
1846	30	10.1	3.4	-60.75	< 0.01

The major purpose of the study was to assess the students' concept application abilities in Physics at secondary stage. The SSSS mean score performance, 10 out of 30 on C & T test shown in table 1 reveals that the students can apply the Physics concepts in problem situation up to 33 percent which is significantly less than the average.

Table 2: Sector and gender wise score of SSSS on Concept application ability test

Sector	N	Mean	Std. Deviation	Mean Difference	P
Public	910	9.4	3	-1.5	< 0.01
Private	936	10.9	3.7		
Boys	1401	10.2	3.7	0.27	n.s
Girls	445	9.9	2.6		

With reference to educative facilities and administrative setups, the public and private sector schools are two different systems. According to table 2 the comparison **between** the SSSS' score obtained on C & T test reveals significantly better performance in favor of private school systems. The boy SSSS comparatively show better performance on the C & T test and the difference is non significant. It is highly appreciable that the girl students can apply Physics concepts in the capacity comparable to boy students.

Table 3: Facilities available at home to Secondary School Science Students

All as % (NPublic = 566, NPrivate = 508, NBoys= 829, NGirls = 245)	Total	Public and Private					Boys and Girls				
		Public	Private	Standard Error	Critical Value	P	Boys	Girls	Standard Error	Critical Value	P
Room for study	65	60	70	2.92	-3.42	0.01	64	68	3.47	-1.15	n.s
scientific calculator	53	43	64	3.05	-6.88	0.01	52	54	3.63	-0.55	n.s
TV	53	44	64	3.05	-6.56	0.01	24	29	3.15	-1.58	n.s
dish antenna	11	6	16	1.89	-5.29	0.01	16	23	2.77	-2.53	0.05
computer	50	44	57	3.06	-4.25	0.01	17	21	2.79	-1.43	n.s
science dictionary	25	16	36	2.66	-7.51	0.01	48	70	3.63	-6.06	0.01
parents support in Physics	17	16	19	2.32	-1.29	n.s	10	14	2.27	-1.76	n.s
science textbook	71	73	69	2.77	1.44	n.s	25	17	3.07	2.61	0.01

time for homework	77	80	77	2.51	1.20	n.s		48	56	3.64	-2.20	0.05
tuition facilities	23	14	34	2.59	-7.72	0.01		68	82	3.29	-4.25	0.01
Internet	18	10	28	2.37	-7.58	0.01		73	90	3.07	-5.54	0.01
physics dictionary	15	12	18	2.17	-2.76	0.01		15	14	2.58	0.39	n.s

The table 3 shows that majority of the facilities at home are available to the students who study in the private sector schools. The only two things; possession of science textbooks and availability of time for home work are on credit to the students in public sector schools and the difference is non significant. The public sector students had the time for study at home but they are not utilizing it properly as they could not show better performance on CAA test as compared to private sector students. This may be due to lack of parents support in Physics. Availability of the facilities indicate that the private sector students belong to high income class ,may be one of the reasons of better performance of private sector students on C & T test of this study. Significantly high percentage of girls students with reference to facilities reflect the cultural climate of the society, where the girls education ratio is low distinguishably in the low income classes, it also shows that the girl students come to schools mostly belong to high income class.

Table 4 Causal relations between facilities available to SSSS and their score on CAA test

Predictors	Std. Error	Beta	t	Sig.	R	R-Square	F	Sig.
Room for study	0.24	-0.05	-1.35	0.18	0.26	0.07	5.42	0.000
scientific calculator	0.23	0.17	5.03	0.00				
TV	0.23	0.04	1.15	0.25				
dish antenna	0.37	0.01	0.17	0.87				
Computer	0.24	-0.02	-0.49	0.62				
science dictionary	0.29	0.05	1.30	0.19				
parents support in Physics	0.30	0.07	2.05	0.04				
science textbook	0.25	-0.10	-2.86	0.00				
time for homework	0.27	0.02	0.70	0.49				
tuition facilities	0.27	0.05	1.45	0.15				
Internet	0.30	0.08	2.28	0.02				
physics dictionary	0.35	-0.09	-2.56	0.01				

Dependent Variable: Test Score (30)

Table 4 indicates that the R-Square of 0.07 implies that the mentioned 12 predictors accounted for 7 percent in the variation of students' score on C & T test. $F(12, 1074) = 5.42, p = 0.00$ means that the overall facilities available to SSSS significantly contributed to students' achievements in terms of concept application abilities in Physics. The availability of science textbooks and Physics dictionary and room for study negatively affect the score on C & T test of SSSS. The science textbooks are almost available to all students but all of them are not good to comprehend. Majority of the students do not possess separate room for study, computer and physics dictionary and they are not good in studies.

Table 5 Family demographics of Secondary School Science Students

All as % (NPublic = 566, NPrivate = 508)		0	1	2	3	4	>4
How many Brothers and Sisters do you have?	Public	5	2	4	7	18	65
	Private	2	3	7	13	28	48
	Total	3	3	5	10	22	57
How many older brothers and sister do you have?	Public	22	20	20	13	9	17
	Private	27	22	18	13	9	11
	Total	24	21	19	13	9	14
How many are at university?	Public	74	17	7	2		
	Private	57	30	10	4		
	Total	66	23	8	3		
(NBoys = 829, NGirls = 245)							
How many Brothers and Sisters do you have?	Boys	4	3	5	10	22	56
	Girls	2	2	4	8	24	59
	Total	3	3	5	10	22	57
How many older brothers and sister do you have?	Boys	26	19	20	12	9	15
	Girls	20	24	17	16	10	13
	Total	24	20	19	13	9	14
How many are at university?	Boys	68	22	6	3		
	Girls	58	27	14	2		
	Total	65	23	8	3		

Table 5 makes it clear that the percentage of students in public sector schools with no siblings as well as with reference to number of brothers and sisters more than four is higher as compared to private sector students. The overall percentage of both sector's students regarding the number of **siblings more than 4 are the highest of all**. This may be one of the major reasons about lacking of quality in education in the rapidly growing populous country like Pakistan. The percentage of students with respect to no **siblings** and single brother and sister is higher for private sector students. The number of elder brothers and sisters more than four is again in favor of public sector students. The percentage of the SSSS whose brothers and sisters **studies** in universities are significantly high in the private sector students. The number of brothers and sisters of girls students are greater as compared to boys. The percentage with no brothers and sisters is also greater in girls students. Consistently, girls students have more number of brothers and sisters who study in university and it again proved their high status.

Table 6 Parents' education and occupation of Secondary School Science Students

All as % (NPublic = 566, NPrivate = 508)	Total	Public and Private					Boys and Girls				
		Public	Private	Standard Error	Critical Value	p	Boys	Girls	Standard Error	Critical Value	p
Did your father study at university?	23	13	34	2.57	-8.17	0.01	20	32	3.05	-3.94	0.01

Did your mother study at university?	6	3	10	1.49	-4.71	0.01	6	9	1.82	-1.65	n.s
Father Occupation											
Teacher	10	8	14	1.90	-3.16	0.01	10	12	2.23	-0.90	n.s
Engineer	2	1	2	0.74	-1.36	n.s	1	3	0.87	-2.30	0.05
Govt. Service	14	10	21	2.19	-5.01	0.01	11	27	2.57	-6.22	0.01
Private Job	3	2	4	1.03	-1.94	n.s	3	2	1.19	0.84	n.s
Farming	11	14	9	1.96	2.55	n.s	14	4	2.34	4.28	0.01
Business	6	1	13	1.53	-7.87	0.01	5	10	1.75	-2.86	0.01
Unemployed	1	1	1	0.61	0.00	n.s	1	0	0.64	1.57	n.s
Doctor	3	1	6	1.10	-4.54	0.01	2	7	1.27	-3.94	0.01
Other	44	62	31	3.05	10.16	0.01	51	36	3.63	4.13	0.01
Mother Occupation											
Teacher	5	2	11	1.48	-6.08	0.01	4	10	1.64	-3.66	0.01
Other	4	13	6	1.81	3.87	0.01	3	10	1.52	-4.60	0.01
Housewife	73	95	84	1.85	5.95	0.01	93	80	2.18	5.97	0.01

Table 6 illustrates the percentage of university education among the parents of SSSS is discouragingly small, particularly in case of the parents of students studying in public sector. Like facilities and family demographics with reference to university education of brothers and sisters, the girls students are on significantly better position on the basis of father's university education. Keeping in view the overall picture we see that the percentage of parents' in better occupation favor the students who study in the private school system. The percentage of students whose parents are teachers is significantly greater in the private sector schools, a considerable fact. The percentage of mother occupation of secondary school students in general and that of public sector students is specifically low. The percentage of father's occupation of girls students remained higher in doctor, engineer, business and government service while that of boy students is better in farming, unemployed and other categories. The percentage of girls students with respect to mother's education is higher as compared to boy.

Table 7 Causal relations between family demographics, parents' education and occupation of SSSS and their score on Concept application ability test

Predictors	Std. Error	Beta	t	Sig.	R	R-Square	F	Sig.
No of Brothers and Sisters	0.11	-0.02	-0.56	0.58	0.19	0.04	3.71	0.001
No of elder Brothers and Sisters	0.08	0.04	0.88	0.38				
No of Brothers and Sisters in university	0.18	0.01	0.17	0.86				

Father University Education	0.31	-0.02	-0.58	0.57				
Mother University Education	0.52	0.02	0.42	0.67				
Father Occupation	0.10	0.14	3.74	0.00				
Mother Occupation	0.25	0.10	2.62	0.01				

Dependent Variable: Test Score (30)

Table 7 portrays that the increased number of brothers and sisters negatively while number of elder brothers and sisters, and the number of brothers and sisters studying in university are positively related with students' score on CAA test. The father's university education negatively and mother's university education positively affect students' achievement on CAA test. The parents' occupation showed significantly positive effects on their children achievements on CAA test. According to R-Square of 0.04, collectively all the predictors shown in table 7 accounted for 4 percent in variation on achievements in terms of concept application abilities. $F(7, 1074) = 3.71$, $p = 0.001$ means that all these predictors contributed significantly in the concept application abilities of the students in terms of score on CAA test.

Discussion

The secondary school science students' performance regarding application abilities of Physics concepts in problem situation, every day life or natural phenomena was found 33% on CAA test. The implemented National curriculum (2000) for Physics grade 9&10 reserved 10% contents for the development of application abilities and 55% for knowledge contents (Tahir&ullah). Al-Ahmadi (2008) concluded that scientific thinking is not possible to develop at the secondary level even in higher classes with out targeted teaching. The results of the study in hand reveal that private sector students obtained remarkably better score on CAA test as compared to public sector students and there was no significant difference between girls and boys students with respect to their score on CAA test gone against the finding, the Knowledge of Physics concepts of boys is significantly lower than girls (Adeoye, 2010). The private sector students and girl students of both sectors belong to such families who possess more facilities at their homes and comparatively, the percentage of private sector students with reference to number of brothers and sisters study in university is significantly high. Apart from the high status of parents with reference to university education and occupation the private sector students, study sciences including Physics in English medium which is a foreign language for them. The private sector school teach grade 9 sciences including Physics in tow years, start it in 8th grade while the public sector schools complete that courses in Urdu medium, only in grade 9, in one year. The findings of this **study are** that home facilities, parents education and occupation status, number of brothers and sisters and number of brothers and sisters study in university significantly affect students' performance in terms of Physics concepts application ability is agreed with the results of the previous studies which related these factors with learning (yucel,2007;Schibeci&Riley,1986;Valanlons,Fonsece&Esocares,2004;Kirmani,2008;Friedel,gabel and Samuel,1990;Linna,Malin & Tanbe,2004;Yildirim & Eryilmaz.1999;Govt of Pakistan,2002 ;Demir Kilic & Depren,2009 ;Akhtar & Niazi ,2011;Kiamanesh &Kheirich,2001).

Conclusion. The secondary school science students particularly public sector students showed significantly low performance when their abilities, to which they can apply Physics concept in problem situations, were tested on Concept application ability test conducted by the researcher. In gender wise comparison, mean score on the Concept application ability test was in favor of boy students, with no significant difference. The private sector Secondary school science students and the girl students in both sectors were found in better status with reference to the influencing factors, home facilities, parants education and occupation, and the number of brothers and sisters study in university. According to multiple regression analysis, the influencing factors as predictors significantly contributed to students application abilities of physics concepts in form of score on Concept application ability test. So, it is concluded that home facilities, parants education and occupation, no of brothers and sisters, no of brothers and sisters study in university affect students' conceptual understanding which is ensured when the students can apply the concept in problem situation.

Recommendation. Looking into the results of the study with reference to the lack of education and nature of occupation of the parents of SSSS particularly of public sectors students, it is mandatory to train the parents through parent-teacher council in the matters they deal and motivate their children toward study, related to importance of education and population dynamics .The essential facilities like books, calculators and dictionary should be provided to students who need it, by Govt or school. The public sector Teachers and heads of schools should be made more responsible and resourceful to ensure the quality and conceptual understanding in education.

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