We are happy to announce the publication of an International Journal of research in education entitled: ***Horizons of Holistic Education*** with International Standard Serial Number (ISSN). You are invited to send your original research papers and research articles for the publication in ***Horizons of Holistic Education.***

The Journal of *Horizons of Holistic Education* (HHE), published by the Children's University, is an International quarterly Interdisciplinary Journal which covers topics related to holistic development of children. HHE covers all the areas which deal with the children, such as Child education, Child psychology and Panchkosh development of children, children's literature and so on. It also includes intellectual efforts encompassing Sociology, Vedic Science, Medicine, Psychology, Drawing, Music, History, Geography, Home Science, Philosophy, Economics, Commerce and Literature concerned with Children. The researches based on such topics shall be given priority.

Aim and Scope — an International journal of ***Horizons of Holistic Education***(quarterly) aims to publish original research papers, related to the theory and practice of various disciplines of Humanities. We invite you to contribute your fulllength research papers, short communications and Review articles and Articles concerned with holistic modern development in the area of liberal sciences pertaining to the children's studies.

FROM THE VICE CHANCELLOR'S DESK

Holistic education is an effort to cultivate the development of whole human being. On the contrary conventional schooling use the child as a passive receiver of information and rules, or at most a computer-like processor of information. For holistic development a growing child needs to develop his intellectual skills along with physical, psychological, emotional, interpersonal, moral and spiritual potentials. The child is not nearly future citizen or employee in training, but intricate and delicate web of vital forces and environmental influences.

Holistic education reflects a spiritual sight rather than a mechanistic worldview. It recognizes that in the growth of every child, some mysterious life force is unfolded. A holistic approach to education respects this life force and seeks to nourish it. Clearly this worldview is very closely aligned with the impulse behind organic agriculture, natural medicine, ecological awareness, and other areas of the emerging "green" society.

Holistic education is usually characterized by several core qualities. It encourages experiential learning. There is more discussion, questioning, experimentation, active engagement in holistic learning environment, and a noticeable absence of grading, testing, labelling and comparing. Learning is more meaningful and relevant to student - it matters to their lives. Learning environment cultivates a sense of community and belonging, quality of safety, respect, caring, and even love.

It creates the feelings, aspirations, ideas and questions that each student comes closer to learning process. Education is no longer viewed as the transmission of information; instead it is a journey inward as well as outward into the world. It infuses a deep respect for the integrity biosphere for nature.

Holistic educators reject the current fascination with educational uniformity: rigid standards, never changing style of testing and authoritarian control of learning process. Holistic education is essentially a democratic education, concerned with both individual's freedom and social responsibility. It is education for a culture, peace, sustainability, ecologic literacy, development of humanity's inherent morality and spirituality.

Holistic approach to education appreciates and enables children to have the environment in which they can construct the new knowledge by connecting existing idea with new ideas. This is what “constructivism” is. In constructivist perspective, learning is a process in which knowledge is constructed rather than assimilation of ideas. Constructivism professes that there should be a movement from concrete experiences to complex reasoning in different task which involves abstraction, planning and dealing with end outcomes which are not in view. Therefore, we have to incorporate constructivism in our day to day teaching learning process, because every child is different in his interests, needs and dreams. To help every one of them realize their full potential, every teacher must strengthen the education system by introducing greater diversity and customization into the curriculum.

Mr. Harshad P. Shah
Vice Chancellor
Children’s University

FROM THE CHIEF EDITOR'S DESK...

In the new millennium, we see the emergence of society which could appropriately be called as "Knowledge Society" wherein unlike the yesteryears, the emphasis would be laid not on one's tangible assets but, on the contrary his intangible assets of knowledge and information which would determine and define his social standing. In the changing world of science and technology it is only education which will groom individuals according to the demands of future. In the present era of rapid changes society would be categorized into three parts i.e. knowledge users, knowledge communicators and knowledge generators and its latter who would be responsible for generation of new knowledge, expanding the horizons of existing understanding of concepts and thereby improving the quality of life.

There is a drastic change in the globe due to the Information and Communication Technology revolution. The change had affected to each and every sphere of life. It has changed the life style of each and every individual. Though the agricultural revolution and industrial revolution have stabilized the global society in terms of eradication of poverty and economic stability, the third wave change (Information Technology revolution) changed the society in totality. It has transformed the world into a "global village" and has made the society an information loaded. Being at any place on the globe one can access to the kind of information one requires. It has changed the 'paper nightmare office' to 'paperless office'. Traditional system of education has changed into high tech schools. Computer and internet have reached to each and every corner of society. Information and Communication Technology has brought lots of change in the field of education.

Before coming to ICT for capacity building of teachers it is essential to understand the word "Capacity". Oxford dictionary defines capacity as the ability or power to do something. Ability, acumen, capability, intelligence, skill, and talent are Synonym to capacity. To build the capacity for any kind of task one has to adapt to changes. Even the theory of evolution tells that to adapt the change one has to change. Teachers in higher education are having all these qualities in them it means they have capacity to adapt the changes. Butunfortunately, they believe that they have all capabilities and they do not have to learn anything. Present day methodologies followed by teachers in India are conceived by western world which is a multi-learning system.

Each teacher must be looked at generating his own blue print and this can only be done by individual's interest. What is needed is training in understanding. Can teacher teach without being thinker? This instigates the need to adopt and evolve methodology by using modern ICT tools. ICT brings life into education, excitement in classroom and it liberates teachers from constrains of classrooms. In a way optimizing the self is indeed needed and hence one must strive hard to put into practice and thoughts which one learns.

A knowledge-based society is globally connected and creating, using and trading information and knowledge for global markets. Converting existing information into knowledge, managing and utilizing it is the major challenge for the knowledge-based society. Technology based rapid changes must be adopted by the knowledge-based society to remain in trend of internationalization / globalization. It is indeed the need of developing country like India to build knowledge-based society which can only be done by producing the good human resources. The human resource development is mainly done through the education i.e. thorough schools and universities. Thus, to see changes in the knowledge-based society one must expect changes at the places where human resources are catered.

Dr. Jignesh B. Patel

Editor in Chief
Associate Professor and
Controller of Exam (I/C)
Children’s University

EDITORIAL BOARD

Chief Academic Advisor (In Alphabetical Order)

Prof. Dilip Betkekar
National Vice President,
Vidyabharti Akhil Bharatiya
Shiksha Shanthan, New Delhi.
Mo: 7972351208/ 8806580307/
9422448698
Email: dilipbetkekar@gmail.com

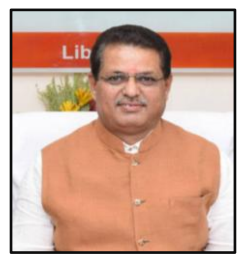
Shri Mukul Kanitkar
Organizing Secretary,
BharatiyaShikshan Mandal,
Nagpur, Maharashtra.
Mo:94057 74820
Email: bsmrfoffice@gmail.com

Prof. Rajesh Kotecha,
Shri Vaidya Rajesh Kotecha
Secretary, Ministry of AYUSH,
Government of India, Bharat.
Tel. : 24651950
Email: secy-ayush@nic.in

Prof. Manoj Soni
Member,
Union Public Service
Commission,
New Delhi.
Tel :23381098

Prof. Shashi Vanzari
Hon. Vice Chancellor,
SNDT University,
NathibaiThackersey Road,
Mumbai, Maharashtra - 400 020.
Mo: 98503 99818 / Tel. :91-22-
22031881
Email: vc@sndt.ac.in

Dr. Nitin Pethani
Hon. Vice Chancellor,
Saurashtra University,
Rajkot, Gujarat.
Mo : 90999 51909
Tel. : (0281)2577633/
(0281) 2576802
Email: vc@sauuni.ac.in



Prof. Shashi Kant Sharma
Professor,
Department of Journalism and Mass Communication,
Himachal Pradesh University, Shimla, PIN 171 0050
Ph:- 91-177-2833731, Telephone:- 91-177-2833731
Email:- shashikanthpu@gmail.com

Editorial Board (In Alphabetical Order)

Prof. Kamal Mehta
Professor & Head,
Department of English, &
Comparative Literary Studies,
Saurashtra University,
Rajkot-360005
Mo: +91 9099939499
e: khmehta@sauuni.ac.in

Prof. Keshav Bhandarkar
Former Principal, Director and
Dean, Faculty of Education,
RTM Nagpur University,
Nagpur.
Mo: +91 9823297750
e: kmbhandar@gmail.com

Dr. MadhushreeSaoji
National Co-secretary,
Vidyabharti Akhil Bharatiya
Shiksha Shanthan, New Delhi.
Mo:9822029332
e: saojim57@gmail.com

Prof. Nilima Bhagabati
Professor and HoD (Rtd.)
Department of Education
Guwahati University,
Guwahati-781014
Mo. :9864066459
e: nilimabhagabati@gmail.com

Dr. Narottam Sahoo
Advisor & Member Secretary
Gujarat Council on Sci. & Tech.,
Department of Sci. & Tech.,
Block : B, 7th Floor,
M.S. Building,
Sector-11, Gandhinagar - 10.
Tel : 079-23259362
e: narottam.sahoo@yahoo.co.in

Dr. Pragnesh Shah
Department of Accounting and
Financial Management,
The Maharaja Sayajirao
University of Baroda,
Pratapgunj, Vadodara.
Mo:987956 7178
e: pragneshmsu@yahoo.com

Prof. Shefali Pandya
Head, Department of Education
Mumbai University, Mumbai.
Mo:9820688683
e: srpandya@rediffmail.com

Venkata SubbaRao.V.
Director of InnoTeachLearning
Solutions
Pvt. Ltd. and Smart Cerebrum
Pvt. Ltd.
Mo: +91 80 2632 1822
e: smartcblr@gmail.com

INDEX

Sr. No.	Title & Authors	Page No.
1	**Understanding Inclusion of Children With Disabilities In School From The Eyes of Parents' of Children Without Disabilities** - Dr. Bharati	75-85
2.	**Documenting The Lives of out-of-School Adolescents – A Study From Surat City Slums** - Dr. Rekha Mistry, Anuj Ghanekar, Dr. Vikas Desai	86-95
3	**Productive Thinking Model (Fiesi): To Make Science Education More Scientific And Innovative** - Kamakshi Raipure	96-103
4	**Constructivism And Its Need In Present Scenario** - Dr. Seema Sharma	104-112
5	**A Critical Analysis Of Teacher Education Question Papers : Implications And Suggestions For Reforms** - Dr. Rajan Welukar, Shefali Pandya, Dr. Prerna Dahiwade Smt. Prachi Swan	113-122
6	**A Grade Seven Science Teacher's Discursive Interactions in Developing Common Knowledge: Question Types, Discourse Patterns, and Communicative Approaches** - Shamarion Grace, Jazlin Ebenezer	123-154

Horizons of Holistic Education
April-June-2020, 7 (2), 75-85

p ISSN : 2349-8811
eISSN : 2349-9133

Understanding Inclusion of Children with Disabilities in School from the Eyes of Parents' of Children without Disabilities

Dr. Bharti
Associate Professor, DEGSN, NCERT
tarubharti1@gmail.com

Received : 16-04-2020 Accepted : 01-06-2020

ABSTRACT

Schools reflect the attitudes, stereotypes, cultural and social practices prevalent in the society at large. As a miniature society, school may be perceived as representing what exists or may be lacking in the larger society. As a learning community, school has students, parents, educational administrators, teachers, non-teaching staff and local significant adults as its members. The most active and contributing members of this learning community i.e. school are everyone listed earlier, except the parents and the local significant adults. The parents are rarely asked their opinion about the practices and policies adopted in the school, despite them being the major financial contributors, in school, except for government run schools, complying RTE Act 2009. Within the communities of parents and students, the students with disabilities and their parents were the most marginalized. The parents of children without disabilities may or may not be aware of the situations faced by them. In an inclusive society, distribution of resources and opportunities should be equity based and each member should be active partner and collaborator in the progress of the other members.

With this background the present paper studies the perception of parents of children without disabilities towards the inclusive schools and their willingness to make their child attend the same class as the child with disabilities. The data was collected through survey and parents opinion with respect to inclusion of children with disabilities in the school, was studied keeping in mind their educational status, gender and profession. The findings indicated that more mothers as compared to fathers were involved in the education of children, majority of the responding parents were in favor of inclusive schools, a small percentage of parents opined that they will drop the idea of getting their child admitted to nearby inclusive school and majority of the respondents were found to be aware that special needs may arise due to disabilities as well as disadvantages.

Key Words: *Children with Disabilities, Children without Disabilities, perception of parents*

INTRODUCTION

The scenario of education at present, is witnessing a gradual shift in the consciousness of educational planners, administrators and policy makers towards realizing that special needs may not always be caused by the individual attributes of the child with disabilities rather the genesis of special needs may lie in the social and environmental factors, on which children with disabilities have little or no control. This conscious realization has acted as foundation for inclusive education (Narumnachi & Bhargava 2011)[1]. Inclusive education means a system of education wherein students with and without disability learn together and the system of teaching and learning is suitably adapted to meet the learning needs of different types of students with disabilities[2].

For an inclusive school working under inclusive education system catering to the needs of children with and without disabilities, the most important stakeholders in education are the parents. The group of parents constitutes both the parents of children with disabilities and parents of children without disabilities.

In various countries, inclusive education was advocated and started by parents of children with disabilities with the expectations and hope that presence of their children in the regular schools along with children without disabilities may gradually lead to their social inclusion, within the peer group (Anke de Boer, 2010)[3]. The research has indicated that children with disabilities in inclusive education settings face issue of acceptance by their peers without disabilities which might be influenced by parents' perception of children with disabilities and other factors related with disability conditions (Duhaney & Salend, 2000)[4].

Peck et.al. (2004)[5] studied parents' perception on the impact of inclusion on their children without disabilities and found that significant number of parents had unfavorable attitude towards inclusive education and expressed concern about loss of teacher time. Anke et. Al. (2010)[3] studied the available literature review on parental perception and found that majority of the parents had either favorable or neural attitude towards inclusive education. The factors like age, gender, socio-economic status, education level, experience with inclusive education and nature of disability influence parents' attitude and perception towards inclusive education. Hilbert (2014)[6] studied perception of parents of young children with and without disabilities attending inclusive preschool programs and found that parents of children with disabilities were less likely to favor the inclusive education wherein children with severe disabilities such as behavior disorders and autism study along with children of other disabilities and children without disabilities.

Aim of the study

The present paper studies the perception of parents of children without disabilities towards the inclusive schools and their willingness to make their child attend the same class as the child with disabilities.

Methodology

Survey was used to gather opinion of parents, whose children were attending an aided primary school in Delhi. The parents were carefully chosen by the regular teachers without any interference by the researcher. These were not necessarily the parents of children who had child with disability in his/her class.

No. of survey sent=25

No of survey received back=17

General Information

The survey began with the collection of some general information like who was the responding parent (Father/Mother), educational qualification of parents, student's name and class etc. the tables below summarizes the general information collected.

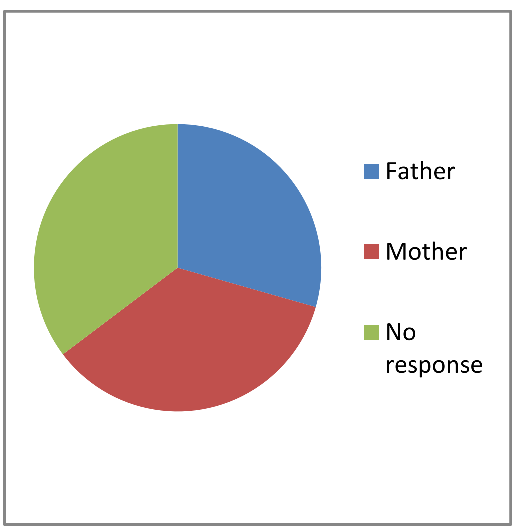


Figure 1: Responding Parent

The figure above indicates that 35 percent parents forgot to answer who was responding to the survey. The number of mothers and fathers responding to the survey was found to be almost equal.

Parent's Qualification

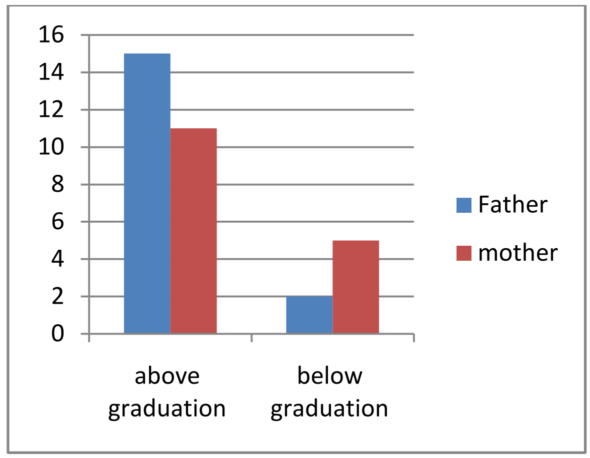


Figure 2: Responding parent's qualification

The figure above revealed that number of non-graduate mothers was more than the fathers. The educational status of mother had a significant role in the education of child. Research has proved that educated mothers are more equipped to help in completing homework as well study for examinations, reducing behavior issues, having better attitude towards school and studies (Sutherland 2015[7]; Carneiro, Meghir, &Parey 2011[8]; Corwyn & Bradley, 2003[9]; Davis-Kean, 2005[10]; Halle, Kurtz-Costes, & Mahoney, 1997[11]). Hence this information was sought from the parents.

Working Status of Parents

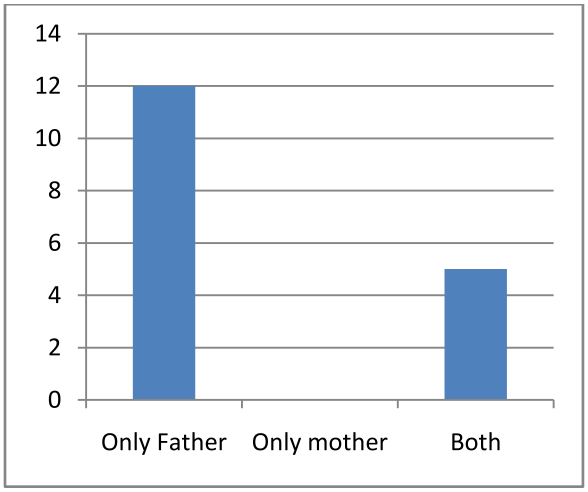


Figure 3: work 'to earn money' status of parents

This information was provided by every respondent. The majority mothers were house mangers and didn't work outside the house, as in to earn money. No household with only mother working was reported.

Family Status

S. No.	Family Status	Frequency
1	Joint	5
2	Nuclear	12
3	Any other	--
4	No response	--

Table 1: Nature of Family

The school reflected society's trend of increasing nuclear families. The data analysis revealed that majority of children belonged to nuclear family. This reiterated the fact that responsibility of looking after the kids was predominantly with the parent at home i.e. the mother. This involved the responsibility of academics also despite the fact that mothers might not be educationally very well off. Five out of 17 mothers were found to be non-graduate whereas only two fathers out of 17 were non-graduate.

Inference - The general information indicated that the survey forms were fairly distributed across the existing primary classes and their sections in the school, which in turn may be linked to the distribution of resources. As far as the involvement of parents in students look after was concerned mother's domination was apparent which might be due to their work status i.e. more mothers as compared to fathers were reported to stay at home.

The paragraph's below presents the item wise analysis of the parent's survey regarding their awareness about the general issues involving Inclusive education.

1. One day your child come back from school and tells you about a new admission in his/her class of a child who is visually impaired / speech and hearing challenged / Mentally challenged / uses crutches or calipers / from below poverty line. You will (choose as many as you like, and please number your choices)

S. No.	Response Options	Frequency
1	Appreciate the schools efforts to bring diversity in the classroom	14
2	Be worried about something "wrong" with the management/principal	3
3	Be afraid about the influence/effect on my child	2
4	Like to keep your child staying away from the new child	--
5	Not tolerate such nonsense and write a complaint letter to the principal	--
6	Make a decision to with draw your child from the school, if possible immediately	--
7	Any other (please Specify)	--

Table 2: Response analysis, survey item 1

The majority (82%) parents responded that they would appreciate the schools efforts to bring diversity in the classroom. The 12 percent of the responding parents were afraid that it would influence their children negatively whereas 18 percent parents opined that they would be worried about something being wrong with schools management. This indicated that the parents had positive attitude towards Inclusive Education.

2. You are researching about various schooling options available for your child and you find a good school near your home which is like the dream school. You make up your mind to get your child admitted to that school; suddenly someone tells you about the schools policy to keep the children with special needs and other children together. You will(choose as many as you like, and please number your choices).

S. No.	Response options	Frequency	Remarks
1	Will try to find more information about the whole thing	11	Decision will not get affected(1)
2	Drop the idea of getting your child admitted to that school.	5	
3	Decide to have a talk with the school personal	3	
4	Get the child admitted to the school but will request the teachers to keep the child with special needs away from your child.	1	No relation of it with admission
5	Feel cheated, frustrated and shocked about the schools policies		
6	Any other (please Specify)		

Table 3: Response analysis, survey item 2

Parents chose more than one option but they didn’t number their choices despite of clear instruction regarding this. A small percentage (29%) of parents responded that they would drop the idea of getting their child admitted to that school whereas 65% parents responded that they would try to find more information about the whole issue. Only one parent remarked that the decision about admission would not get affected whereas another parent opined that though admission decision would not get affected but he would request teachers to keep his child separate from child with challenges.

The data analysis for the first and the second question revealed a contradiction. If such an initiative was taken by the child’s existing school, the parents appeared to be very supportive whereas if the situation occurred at the time of admission of the child to a formal school than the support became very thin. The data analysis for the second item revealed that majority parents would try to find more information about the entire issue.

3. A child with special needs is

S. No.	**Response options**	**Frequency**	**Remarks**
1	Mentally Challenged	12	
2	Visually Impaired (VI)	11	
3	Speech and Hearing Impaired(handicapped)	10	
4	Slow Learner	8	
5	Learning Disabled	7	
6	Attention Deficit Hyperactive Child	6	
7	Having problem in learning	6	
8	Talented/gifted/creative/intelligent	5	
9	Disadvantaged section of society	5	
10	From economically weaker sector	3	
11	None of the above	--	
12	Any other please specify	--	
13	No response	1	

Table 4: Response analysis, survey item 3

59 % to 70% of the responding parents identified VI, speech and hearing impaired and MR as special child. 29% parents had identified children belonging to disadvantaged section of the society as well as talented/gifted children as a child with special needs. The response spread across all category of the CWSN indicated that parents had more or less some degree of awareness about the concept of child with special needs.

This was very interesting as despite being not very educated the parents had shown awareness about the concept.

4. I think it is a ***good/bad*** idea to keep children with special needs and other children together in the same class.

S. No.	Response Options	Frequency	Remarks
1	Good	10	
2	Bad	4	
3	Any other	1	Can be both good as well as bad
4	No response	2	

Table 5: Response analysis, survey item 4

The analysis of response justification had been done by content sifting. The table below presented the same -

S. No.	Response Justification	Frequency
1	Will facilitate becoming part and parcel of society	3
2	Opportunity to interact with diverse group	3
3	Other children will feel neglected	2
4	Equality in education will be achieved	2
5	Except for MR	1
6	My child may get distracted	1
7	Both group may get affected	1

Table 6: Response justification analysis, survey item 4

5. The 59 % of the responding parents opined that it was a good idea to make the children with and without challenges study together. Only one parent was indecisive about the whole issue whereas only 2 (12%) chose not to answer this question. Only 24% parents thought it was a bad idea to make the children with and without challenges study together in the same class.

The justification for favoring Inclusion involved the ideas that this would help them become part of society, children without challenges would get opportunity to interact with diverse group, and educational equality would be achieved. On the other hand the opinion against were based on the fear that children without challenges may--get affected, felt neglected or situation would be of no benefit to both the groups. Only one parent expressed that as far as MR children were not included the situation was acceptable. This might be due to the prevalent myth about MR and their portrayal in the media. Most of the laymen could not distinguish between mental impairment and mental illness.

5. Have you heard of any school which is teaching children with special needs and other children together in the same classroom(***Y/N***) if yes; please mention the name of the school along with the place i.e. whether it is in Delhi or outside Delhi?

S. No.	Response Options	Frequency	Remarks
1	Yes	2	Gyan Dham High School Vapi Gujraat
2	No	15	
3	Any other	--	
4	No response	--	

Table 7: Response justification analysis, survey item 5

The majority (88%) parents hadn't heard of any school which was practicing Inclusion, only two parents heard about such schools; from a friend who informed about one such school located outside Delhi, whereas other parent hadn't mentioned the details in this regard.

6. I have some experience of interacting with persons who are (You can choose more than one response).

S. No.	Response options	Frequency	Remarks
1	Slow Learner	6	
2	Talented/gifted/creative/intelligent	5	
3	Visually Impaired	4	
4	Speech and Hearing Challenged	4	
5	Mentally Challenged	4	
6	Learning Disabled	4	
7	Having problem in learning	4	
8	From economically weaker sector	3	
9	Attention Deficit Hyperactive Child	2	
10	Disadvantaged section of society	1	
11	None of the above	3	
12	Any other please specify	--	
13	No response	3	

Table 8: Response justification analysis, survey item 6

Responding parents had opportunity to interact with almost all of the categories mentioned above yet the data table revealed that the majority had the opportunity to interact with the slow learners followed by talented/gifted. Equal number of parents had the opportunity to interact with the speech and hearing challenged, learning disabled, mentally challenged, visually impaired and with problem in learning. This opportunity to interact with persons with challenges might be the reason for responding parent's awareness about the concept of special needs.

7. The person mentioned above is/was

S. No.	Response Options	Frequency	Remarks
1	A neighbor	5	
2	An unknown person needing some assistance	5	
3	A friend	1	
4	A formal contact	2	
5	Any other (please specify)	3	Relative
6	No Response	6	

Table 9: Response justification analysis, survey item 7

The 35%of responding parents chose not to respond to this item which required them to provide detail about their interaction with the challenged person. 30 % parents had responded that the challenged person was a neighbor and equal number (30%) had informed that this was an unknown person in need of assistance.

8. If given a chance I would love to interact with persons who are

S. No	Response Options	Frequency	Remarks
1	Talented/gifted/creative/intelligent	7	
2	Visually Impaired	5	
3	Slow Learner	5	
4	From economically weaker sector	5	
5	Having problem in learning	4	
6	Speech and Hearing Challenged	3	
7	Mentally Challenged	3	
8	Learning Disabled	2	
9	Attention Deficit Hyperactive Child	1	
10	Disadvantaged section of society	1	
11	None of the above	--	
12	Any other please specify	--	
13	No response	2	

Table 10: Response justification analysis, survey item 8

As expected, if given a chance 41% of the responding parents would like to interact with the talented/gifted followed by visually impaired, economically weaker sections and slow learners (30%).

Inference : the parental perception survey aimed at judging parents awareness about the concept of special needs and their attitude towards Inclusive Education. The first was assessed through the item numbers 3, 5, 6 and 7 whereas the attitude was judged through item numbers 1, 2, 4 and 8.

The data analysis indicated that the parents had fairly good awareness about the concept of special needs despite of confusion about Inclusive Education. Responding parents were able to identify the children with special needs correctly from the list provided to them in item number 3 of the survey despite of their low educational status. Only two out of the 17 responding parents heard about a school in which challenged and non-challenged children were studying together. This showed that though the responding parents were familiar with the idea of special needs yet the majority were not aware of schools where both categories of children were studying together. Majority parents had some opportunity of interaction with the challenged persons, which had made them aware about special needs. This challenged person with whom the parents have had some opportunity to interact was not necessarily their relative or formal contact. From the data analysis it could be safely assumed that the parents had some degree of awareness about the concept of special needs though they had no idea of Inclusive Education.

The data analysis revealed a very interesting fact as far as responding parent's attitude towards Inclusive Education was concerned. The data analysis for item number one indicated that parents supported Inclusion if the challenged child got admitted to their child's existing class but in item number two the same parents responded that while searching for a formal school for their child they would avoid Inclusive School though they might try to gather more information about the whole issue from the school authorities. Data analysis showed that though the majority parents thought that Inclusive Education was a good idea yet the justification provided by them for their choice hinted at their fears that their child might get influenced, or feel ignored in the class. The justification in favor of Inclusive Education was inspired by the ideal of bringing equality in education and better future prospects for everyone. The parents would prefer to interact with talented/gifted persons if given an opportunity. The data analysis revealed that parents support the idea of Inclusive Education and had positive attitude towards Inclusive Education as far as they were involved and kept informed about the whole process.

Conclusion :

Schools reflect the attitudes, stereotypes, cultural and social practices prevalent in the society at large. As a miniature society, school may be perceived as representing what exists or may be lacking in the larger society. As a community, school has students, parents, educational administrators, teachers, non-teaching staff and local significant adults as its members. Parents are the least active members of this community as far as academic decision making and its implementation is concerned. In any inclusive school, the parents of children without challenges are in majority and hence in situation to make their voice heard.

From the findings of the present paper, which was focused upon studying the opinion of parents, of children without challenges, about inclusion of children with disabilities in the school it can be concluded that more mothers as compared to fathers were involved in the education of children, majority of the responding parents were in favor of inclusive schools and were found to be aware of the fact that special needs may arise due to disabilities as well as disadvantages.

References :

Amruta Narumnachi and Shruti Bhargava, Perceptions of parents of typical children towards inclusive education , Disability CBR and Inclusive Development, vol.22, no. 1, (2011), pp.120-130

Section 2m, chapter 1, Right of Persons with Disabilities Act 2016, GoI

Anke de Boer and Sip J Pijli and Alexander Minnaert, Attitude of parents towards inclusive education: Review of the literature, European Journal of Special Needs Education, vol. 25, no. 2, 2010, retrieved from https://www.tandfonline.com/doi/full/10.1080/08856251003658694?src=recsys on 2.07.2018

Laurel M. J. Duhaney and Spencer J. Salend, Parental perception of inclusive education placement. Remedial and special education, vol. 21, no. 2, 2000, pp. 121-128. retrieved from http://journals.sagepub.com/doi/pdf/10.1177/074193250002100209 on 2.07.2018

Charles A Peck and Debbie Staub and Chrysan Gallucci and Illene Schwartz, Parent perception of the impact of Inclusion on their non-disabled child, Research and Practices for persons with severe disabilities, vol.29, no.2, 2004, pp135-143. retrieved from http://journals.sagepub.com/doi/abs/10.2511/rpsd.29.2.135?journalCode=rpsd on 02.07.2018

Dana Hilbert, Perception of parents of young children with and without disabilities attending inclusive preschool programs, Journal of Education and Learning, vol.3, no.4, 2014, pp.49-59. retrieved from https://files.eric.ed.gov/fulltext/EJ1075787.pdf on 02.07.2018

Anna Sutherland, The Many Ways Mother's Education Matters. Institute for Family Studies, USA, (2015) retrieved from https://ifstudies.org/blog/the-many-ways-mothers-education-matters on 5th july 2018

Pedro Carneiro and Costas Meghir and Matthias Parey, Maternal Education, Home environments and the development of Children and Adolescents,(2011) retrieved fromhttp://www.ucl.ac.uk/~uctppca/MS2307_revised_manuscript.pdf on 5th July 2018

F. R. Corwyn and H. R. Bradley, Socioeconomic status, poverty status and childhood externalizing behaviors: Theoretical and methodological considerations within a Structural Equation Modeling framework, in Bengtson V and Acock A and Allen K and Dilworth-Anderson P, and Klein D, ed., Sourcebook of Family Theories and Methods: An Interactive Approach (Minneapolis: National Council on Family Relations, 2003)

P. Davis-Kean, The influence of parent education and family income on child achievement: The indirect role of parent expectations and the home environment, Journal of Family Psychology, vol. 19, pp. 294-304, (2005).

G. T. Halle and B. Kurtz-Costes and L. J. Mahoney, Family influences on school achievement in low-income African American children, Journal of Educational Psychology, vol. 89, pp. 527-537, 1997.

Horizons of Holistic Education
April-June-2020, 7 (2), 86-95

p ISSN : 2349-8811
eISSN : 2349-9133

Documenting The Lives of out-of-School Adolescents – A Study From Surat City Slums

Dr. Rekha Mistry
MSW Programme, Sociology Department,
Veer Narmad South Gujarat University, India,
Email- rekhanmistry@gmail.com

Anuj Ghanekar
Urban Health & Climate Resilience Centre of Excellence (UHCRC)], India.
Email-anujghanekar2@gmail.com

Dr. Vikas Desai
Urban Health & Climate Resilience Centre of Excellence (UHCRCE), India.
Email-psmvikas@hotmail.com

Received : 24-04-2020 Accepted : 05-06-2020

ABSTRACT

Education is the fundamental requirement for human development, broadening of employment opportunities and the progress of a nation. However, school dropout has remained a consistent phenomenon of education system in India. In urban areas, the adolescents from slum areas are more likely to drop out of school. Failure to complete high school not only produces negative outcome for the individuals but also widens the existing social and economic inequalities. This paper contributes to the understanding of lives of "out of school" urban adolescent boys and girls. The socio-demographic profile of out-of-school adolescents throws light on "who are they."

The field based cross-sectional study was conducted among the drop out adolescents (age group-10-18 years old, n=76) from urban slums, Udhana Zone, Surat city. The study was conducted with semi structured interview schedule. The quantitative and qualitative analysis directs various insights for improving the efficiency of education system, the educational planners need to understand and identify the social groups that are more susceptible to dropout and the reasons for their dropping out. The programme strategies should be designed taking into account the rural and urban differences for a successful implementation of multiple education and skill development schemes. More community-based studies are required to have an insight into the profile of students who drop out from schools, so that efforts can be directed to reduce their vulnerabilities and plan integrated interventions for them.

Key words - *Adolescents, Out of school, School Dropout, Surat city,Urban poor*.

INTRODUCTION

According to the National Survey on Estimation of Out of school children conducted by Ministry of Human Resource Development (MHRD-2014)6 million children in age group of 6-14 years are out of school in India (NSS, 2014).Out-of-school numbers consist of both the children who are dropped out and the children who have never attended schools.

Adolescence is the period in human growth and development that occurs after childhood and before adulthood, from 10 to 19 years. It is a period of dynamic brain development. However, the dropout from school also happens at adolescent age group and found more among girls than boys. For example, as the recent Annual Survey of Education Report - 2017 findings suggest, that on average the difference between enrolment levels of boys and girls at age 14 are declining, however, by the age of 18, 32% girls are not enrolled in school compared to 28% boys (Pratham, 2017)

Urban India has, 35.9 million (27.9%)early adolescents(10–14 years age group) and 29.6 million (23.1 %)late adolescents (15 –18 years age group) NIUA, 2016). Adolescents in slums are marginalized amongst them. As the base of city life itself is economy driven, most of the adolescents are school dropouts and working. Different factors are responsible for the life they live. The working and living conditions are not always good. Their vulnerability as children might make them prone to victims for different crimes. The conditions differ by gender. The girls also face greater social disadvantage. It is commonly observed that traditional gender norms push girls into helping with household chores and sibling care, leading to irregular attendance that eventually results in dropouts. Early marriage, lack of safety in schools and low aspirations related to girls' education also lead them to drop out.

In this context, the present study was taken to document empirically the lives of adolescents who are out of school, so that policies and programs can effectively be planned to address them.

2 Objectives & Research Questions

Keeping the above context in perspective, the present research was carried out with following specific objectives –

- To generate socio-demographic profile of adolescents who have been dropped out of school in urban slums.
- To throw light on their daily routine life and to document their perceptions, opinions and expectations.
- To determine the risk factors associated with school dropout among adolescents
- To assess the utilization of existing schemes for adolescents, with reference to Kishori Shakti Yojana by ICDS for the adolescent girls.

Research Methodology

Research Setting

The present field based cross-sectional study was carried out in three slums of Municipal Corporation of Surat city in Gujarat during period December 2017 to

February 2018. It is known as the fourth fastest growing city of the world (CMF, 2017), the city has a population of 44, 61 026 as per the Census 2011. The city shows 55.29% recent decadal growth rate and around 37% of the total population reside in slums and slum like areas (SMC, 2019). Surat is considered to be the city with highest in-migrant population across India (Santha, 2015). The administrative South zone [Udhana] has most vulnerable population (WRF, 2015) the three slums were selected with purposive sampling from this zone - Morarji Vasahat, Subhashnagar, and Vallabh Vasahat. The same slums were expected to be a part of future interventions hence, were selected. All three slums can be characterized as established informal settlements located in the textile area of the city, where people from several slum communities come to zone for work. Most residents have lived together for more than 30 years. Permission from Surat Municipal Corporation was taken before beginning of the study.

The paper addresses the following questions – How does the life of adolescents in urban slums who are school dropouts, and working look like? What are the different reasons they chose or had to choose dropout from school? What are their daily life struggles? What can be the possible ways through which they can be empowered and linked to existing services in better ways?

Sampling Procedure

Study population were adolescents who had been dropped out of school from more than a year. The list of school dropouts was not available. So, it was decided to do house to house survey for active search of dropped out adolescents in households of all three selected slums. The team of 4 surveyors collected the data. For each slum, a reference landmark was identified and each household was visited. The head of the family was asked two questions – i) if adolescent age group individual belongs to family ii) if yes, whether that individual is school going or not. Following criteria ensured the selection of respondents –

Inclusion criteria

- Age group of adolescence – 10 to 18 years old.
- The respondent must be dropped out from school from past 1 year.

Exclusion criteria

- If respondent is not willing to participate in research.
- If respondent has never attended the school.
- If respondent is uncertain about school dropping out process or if decision is not made.

Those households were marked and visited again which were having individual/s meeting inclusion criteria but were not present in house during identification round. If a household had, more than 1 dropped out adolescents, all were interviewed separately.

In all, n=76, (8.16 %) adolescents were found “out of school” from sampling universe n=931.

Tools and Data Collection

Informed oral consent was procured from parent/guardian after explaining them the purpose of study and ensuring anonymity of the respondent. Then, in-person interviews were conducted in vernacular Gujarati/ Hindi languages.

Research tools included semi-structured interview schedule. Each schedule had three sections – Common section for boys and girls, separate for boys and separate for girls. Interview schedule had different sections on socio-demographic profile, schooling experience, reason for dropout, current daily routine and aspirations of respondent. The girls were asked specific questions about Kishori Shakti Yojana. The schedule contained quantitative as well as open ended qualitative questions.

The schedule had been translated in vernacular language Gujarati and was pretested with 10 respondents residing in a slum different from 3 selected slums. Learning from pre-testing were incorporated and questions were modified accordingly.

Data Analysis

Data were entered, tabulated and analysed in Excel 2016. The analysis was done overall and with gender segregation. Qualitative questions were coded and analyzed in order to form the descriptive narrative.

Findings and Implications

Table no.1
Socio-Demographic Profile of (Respondents) out-of-school adolescents

Variable	N=76	%
Age		
11-14 years(Early Adolescents)	17	22.37
15-18 years(Late Adolescents)	59	77.63
Gender		
Boys	26	34.21
Girls	50	65.79
Religion		
Hindu	67	88.16
Muslim	9	11.84
First language		
Marathi	30	39.47
Hindi	20	26.32
Urdu	1	1.32
Gujarati	25	32.89

Family size		
<4	18	23.68
>5	58	76.32
Type of family		
Nuclear	38	50.00
Extended nuclear	37	48.68
Joint	1	1.32
Ownership of house by the family		
Owned	52	68.42
Rented	24	31.58
Possession of Mobile phone		
Smartphone	16	21.05
Regular phone	16	21.05
No mobile	44	57.89

The Right to Education (RTE) act guarantees free and compulsory education for children belonging to 6 to 14 years age group. However, present study reports 22.37 % adolescents from early adolescence age group (11-14 years) were dropped out from school.

Total 77.6% of adolescents between the ages of 15 and 18 years, that is, late adolescence phase were dropouts.The proportion of dropping out is higher during the age where secondary and higher secondary schooling is expected. The mechanisms to bridge out-of-school children to school operate during the elementary schooling, but it's absent for secondary education.

Majority of respondents(88.16%) belonging to Hindu religion and remaining (11.84%) were of Muslim religion. Majority(39%)used Marathi as primary language followed by Guajarati (32%)Hindi and Urdu for daily conversation.

Girls tend to drop out more (65.79%) as compared to boys. Further it can be noted, as shown in figure 1, that girls tend to be out of school at early age as compared to boys. One of the possible reasons is family size. The family size has a negative impact on schooling of the children. Higher proportion of nuclear and extended nuclear families(50% and 49% respectively), probably need to earn more and take care for siblings are possible "urban" specific barriers for schooling. As suggested by figure 2, the impact is higher in girls.

Fig: 1 Gender and Age Distribution

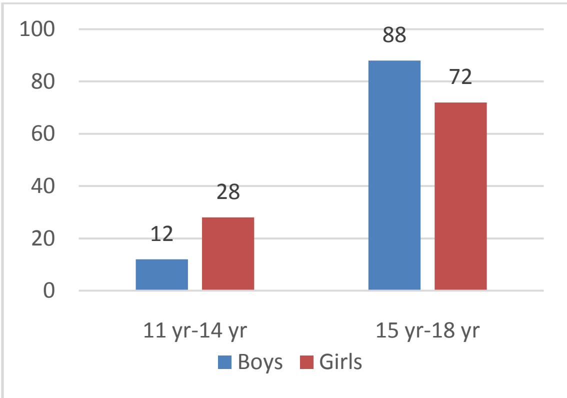
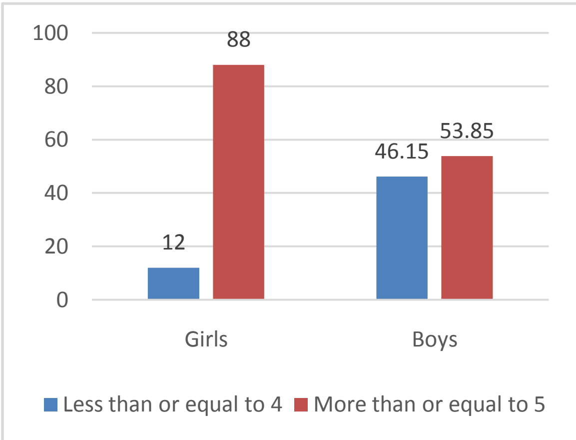


Fig.2 Family Size Distribution as per gender



In total, 68% adolescents lived in their own housing and 32% had to reside in rented household. No ownership of separate mobile phone was reported by 58% adolescents while among users, 21% reported having Smartphone.

Table no. 2

Schooling & daily routine profile of respondents

Variable	N=76	%
Standard of dropped out		
Dropped out during primary (1^{st}- 4^{th})	15	19.74
Dropped out during upper primary and secondary (5^{th}-10^{th})	61	80.26
Type of School		
Government	55	72.37
Private or trust	21	27.63
Education completed in		
Native	6	7.69
Surat City	70	92.31
Dropout since		
Recent dropouts (in last 3 years)	60	78.95
More than 3 years	16	21.05
% of last exam passed		
Below 60	46	60.53
60-80	23	30.26
Above 80	7	9.21
Occupation		
Unemployed	12	15.79
Self employed	8	10.53
Daily wage labourer	25	32.89
House work and helping parents in earning	30	39.47
Housewife	1	1.32

Most of them(80.26%) dropped out during upper primary or secondary stage of education. In total, 72.37% completed education in Government schools while 27.63% of them had studied in private or trust operated schools. Out of total, 92.31% had schooling in Surat city only while 7.69% had education at their native place and dropped out when their family migrated to Surat. Dropping out was recent (in last 3 years period) for almost 79% and remaining are out of school since more than 3 years. In last examination, majority, 60.53% scored below 60 percent marks, around 30% of them scored marks between 60 to 80 percent and around 9% had to dropout despite scoring more than 80 percent of marks.

Fig: 3 House hold level reasons for Drop Out

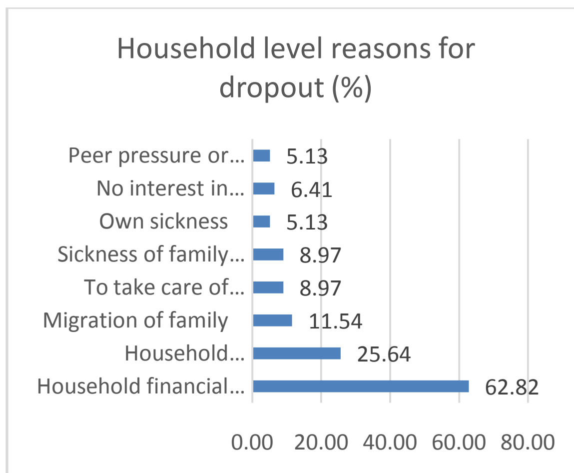
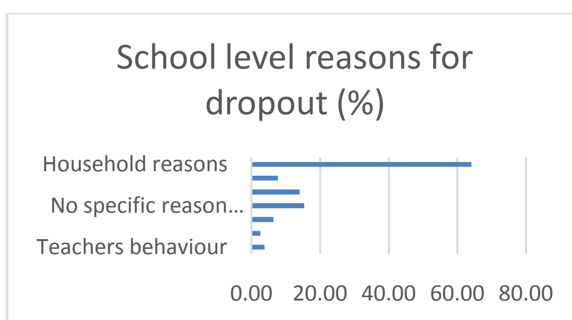


Fig: 4 School level reasons for drop out



The multiple responses were recorded at household level; poor financial conditions (62.82%), other household responsibilities than earning (25.64%), Migration of family (11.54%), Taking care of younger siblings (8.97%), Sickness (5.13%), Sickness of family members (8.97%), Willingness to earn money (6.41%), Other friends are earning money (5.13%). 79% reported no school level reason for dropout but only the household reason. The findings relate with national survey on estimation of out-of-school children where, poverty/economic reason is cited by majority of head of the household in households having an out of school child.

School related reasons for drop out were; School is far (68.75%), High fees (37.50%), Difficulty in subjects comprehension (31.25%), teachers behavior (18.75%), Classmates behavior (12.50%). Safety from crimes and personal protection issues restrict parents to continue education, especially in case of girls when the school is far. Multiple languages and lack of cultural competency might hinder in subject comprehension.

In case of schooling experience, 73% reported enjoyed their school. Majority respondents used to like play(56%), Friends (41%), followed by teaching, teachers support, and computer lab. Least reported were subjects, food and books. If given a chance in future, 55% reported that they would like to rejoin school.

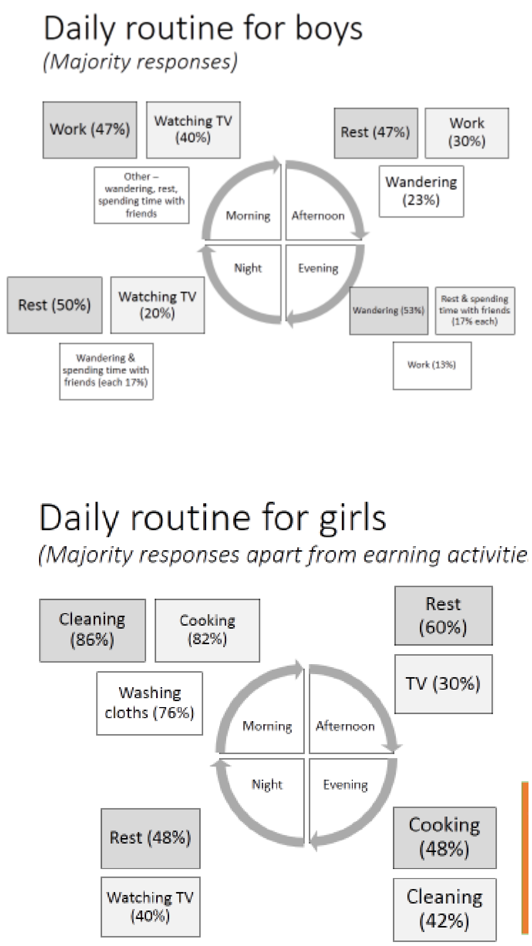
Occupational Status :

Out of the total respondents, 39% adolescents were neither in school nor in economic activity themselves but they were helping parents in household chores and earning. In all, 16% reported that they were unemployed and searching for work. 43% reported either they are self-employed or earning from the labour work.

Current work typology for boys was looms, waiter work in hotel, sari folding work, casual laborers, and sales in textile market, welding work, and working in factory. For girls, it was, Jari work (embroidery), housemaid, selling goods, tiffin service, work in factories, mahendi to brides.

Some observations about work nature were- Many were doing the seasonal jobs. All boys were working outside for earning money either themselves or with parents. Work pattern was changed as per need and household requirement. Many were engaged in two or more jobs during year. 42.5% don’t travel outside home, majority of them were girls, 35% use bus or auto for travelling. Dropouts in girls was also found linked to early marriage and child bearing.

Fig 5 - Daily routine mapping for boys & girls



As seen in the above figure, in case of boys, there was least time allocated to household chores and sports or play. 5 boys out of 26 were not working. 64% of working boys – work for 8 hours or more, 72% are new workforce (less than 3 years), 12% reported formal training for work. 92% were on daily wages.

Girls face duel responsibility of earning as well as household responsibilities. They help parents in earning activities, looking after siblings- is done throughout the day or as and when required. 26% of girl's respondent work outside home for earning as housemaids or in factories, mostly in afternoons. During formative field interactions many girls asked for opportunity of vocational training for them. So they were asked -Girls were specifically asked about willingness to attend skill based courses. 92% showed willingness. 74% could specify their interests. Computer (30%), Beauty parlor (30%), Sewing (20%)and other- , mahendi, spoken English.

Hobbies included watching TV (72.5%), cooking (36%,dominant in girls), Sports (36%, dominant in boys), Mobile phone use (21%) while driving, art and substance use were other reported hobbies. 16% of boys reported their active association with local voluntary group or mandal which is active during festivals or for sports.

Experience of Kishori Shakti Yojana among girls :

In case of Kishori Shakti Yojana run by ICDS, 84% of girls knew about existence and location of nearbyAnganwadi Centre (AWC); 60% of them had visited AWC and know their Anganwadi Worker. 24% were aware about "Kishori Shakti Yojana" which is meant for adolescent girls. However, for previous week of study, there was no reporting of consumption of iron folic acid tablet or attendance of meeting in prior week of survey by any of the respondent. Girls were asked questions related to early marriage. 22% heard case of early marriage in their neighborhood during last year. 58% not aware about effects of early marriage. 26% knew that “it is harmful” but couldn’t specify the reason. 16% could specify harmful effects in terms of maternal and child ill-health, malnutrition.

Discussions

Study is one of few urban specific studies in this arena. The study comprised of drop out adolescents, majority of respondents dropped out between the ages of 15 and 18 years i. e. late adolescence phase mainly during secondary stage of education. Further girls tend to drop out more as compared to boys. Study implied distance of school as a significant factor for discontinuation of schooling. The economic condition of family also found an influencing factor for drop out. The adolescences from poor financial background tend to dropping out. Hence, multi-dimensional reasons are inducing drop out among urban poor adolescence. Findings on the occupational status confirming the socio- cultural pattern of patriarchal society, boys allocated least time to household chores and more time to sports or play. Majority of working boys found working for 8 hours or more and mostly on daily wages this indicates the complex issue of child labor and exploitation. The findings also directed gender role, girls are found accomplishing duel burden of earning as well as household responsibilities. They help parents in earning activities and looking after siblings throughout the day or as and when required.

Out of the total respondents, approximate half of the adolescents were neither in school nor in economic activity themselves but they were helping parents in household chores and earning. In all, 16% reported that they were unemployed and searching for work.

Majority of girls knew about existence and location of nearby Anganwadi Centre (AWC) and also visited AWC and knew their Anganwadi Worker. Only few percentage of girls were aware about “Kishori Shakti Yojana” which is meant for adolescent girls. However, none of them reported the consumption of iron folic acid tablet or attendance of meeting in prior week of survey by any of the respondent.

Conclusion :

It can be stated briefly that researchers, academicians, policy makers, and program implementers need to perceive the lives of out - of - school adolescences from multidisciplinary perspectives – sociological, educational, economical, and psychological- to understandthe complexity of multidimensional influencing factors for their present lives.

There is an utmost need for Innovative approach to ensure integration of education, life skill education and vocational skill as an urban model in reaching out to this vulnerable group. Despite the government efforts through multiple schemes, lack of awareness among beneficiaries is the foremost reason for not reaching out to the needy.

More community-based, specific for urban poor, adolescents are required to developan insight into the profile of students who drop out from schools, the access andreach to education issues, socio economic contributors to drop out and aspirations of dropout childrenso that efforts can be directed to reduce their vulnerabilities and plan integrated interventions towards child friendly policy and programs.

References :

City Mayors Foundation (2017). "*The World's Fastest Growing Cities and Urban Areas from 2006 to 2020."*http://www.citymayors.com/statistics/urban_growth1.html. Accessed Jan 16, 2019.

National Institute of Urban Affairs, (2016). *Status of children in urban India,* Page 5. Published by National Institute of Urban Affairs, Delhi. https://smartnet.niua.org/content/70456c1b-03d5-4e20-a3e1-c6e53eb3c037last accessed on 20th December 2019.

NSS (2014). Social and Rural Research and EdCIL [India] Limited, *National Sample Survey of Estimation of Out-of-School Children in the Age 6-13 in India* [Sept 2014] Page no. 6. Available on https://mhrd.gov.in/sites/upload_files/mhrd/files/upload_document/National-Survey-Estimation-School-Children-Draft-Report.pdf accessed on 10/7/2019

PRATHAM, (2017). 12th *Annual Status of Education Report. (Beyond Basics) Published by ASER Centre, Delhi. http://www.asercentre.org/Keywords/p/315.html*Last accessed on 13th June 2019

Santha, Sunil D., SurinderJaswal, DevishaSasidevan, KaushikDatta, Ajmal Khan, and AnnuKuruvilla (2015). *"Climate Change, Livelihoods and Health Inequities: A Study on the Vulnerability of Migrant Workers in Indian* Cities." Working Paper 16, London: International Institute for Environment and Development.

Statistics for Surat Municipal Corporation (2019). https://www.suratmunicipal.gov.in/TheCity/Demographics (Last accessed on 20th November 2019).

World Resource Institute (2015). *"Prepared Communities"* Accessible on https://www.wri.org/publication/prepared-communities (Last Accessed on 1st December 2019).

Horizons of Holistic Education
April-June-2020, 7 (2), 96-103

p ISSN : 2349-8811
eISSN : 2349-9133

Productive Thinking Model (Fiesi): To Make Science Education More Scientific And Innovative

Kamakshi Raipure
UGC-JRF
Maharaja Sayajirao University of Baroda, Vadodara, Gujarat
kamakshidavv@gmail.com, Mobile no. 9427348873

Received :20-04-2020 Accepted : 08-06-2020

ABSTRACT

Science is not a set of facts and vocabulary to memorize rather it is an ongoing journey and a quest for knowledge about the natural world (Custraro, 2012). Science is a discipline that provide a lot of scope for analysis, synthesis, evaluation, decision making, critical thinking, creative thinking and logical reasoning. But a mismatch between curriculum objective and its transaction is observed (Sreehari, 2011). As emphasized by the National Policy on Education (1986) "Education should be visualized as the vehicle to train the child to think, analyze, reason and articulate logically". Putting light on recommendation given by advisory body we need to think of new ways to approach problems in science rather than relying on single correct answer. In this direction productive thinking is the construct which is the combination of higher order thinking components and it can be defined as "Productive thinking is a process involving in the creation of something new by applying higher order thinking skills". For this productive thinking model (FIESI) can be used in science teaching-learning process to make science education more scientific and innovative. It is a way by which students can think out of the box to strengthen body of knowledge of science. It is based on the principle of evaluating creative thinking by critical thinking to make it productive. This model consist of five steps: Foundation, Ideation, Evaluation, Stabilization and Implication. This paper will put light on this model, how it can be integrated in classroom instruction to teach science in innovative way, how to avoid functional fixedness and how to give emphasis on ideational fluency. This is the area which need to be introduced in teacher training programme also so that teachers can use it efficiently in the classroom instruction.

Keywords: *Productive thinking, creative thinking, critical thinking, functional fixedness, ideational fluency*

Introduction :

Growth of science and technology supported by innovation decides growth of a nation therefore education is one of the focus of government from the independence. India's development can be better met by our scientists and this can be done by introduction of work experience as an integral part in science teaching (Kothari commission, 1964-68). Local knowledge and children's experiences are essential components that can be used in the classroom for better learning of science (NCF, 2005). We are in 21st century and we have so much challenges in the field of science education. It demands reform in curriculum and examination system by moving away from lower order thinking components to the critical understanding by inculcating higher order thinking components (National Knowledge Commission, 2009). It laid stress on the need for a radical construction of the education system to improve its quality at all stages and gave much greater attention to science and technology (NPE, 1968). Quality is one of the major issue facing our country today. Quality in science education can be met by changing teachers' attitude towards science, changing school and classroom environment, by using child centered and activity centered teaching methodology (NPE, 1986).

In this direction, thinking is the major concern which is lack in the classroom. It is the concept without which progress in science and technology or in any subject cannot be imagined. It cannot be done by simply reproducing already existing facts. We need to train our children to think divergently, consider multiple perspective and generate something new which will be beneficial for the society.

In Vision 2020, J.S. Rajput reported that there is a wide spread decline in demand for higher education in basic sciences. This may affect the scientific advancement in this field. This low demand is due to either curriculum and teaching-learning processes or the attraction towards professional courses. In order to attract and retain the bright minds in basic sciences we need to improve our instructional strategies at school level. Having achieved near universal access at the primary level (by SSA), the focus is now on quality improvement and enhancing student learning (World Bank, 2014). For qualitative change from the present situation, science education in India must undergo a paradigm shift where rote learning will be discouraged and schools will give greater emphasis on co-curricular and extracurricular elements aimed at stimulating *investigative ability, inventiveness and creativity* (position paper NCERT, 2006). Similarly, according to OECD, we should improve our practices of teaching science, that lead to foster creativity and thinking skills because thinking is an integral part of the teaching-learning process. NCF (2005) who is the operational guide of the school education provides the direction for the teachers to choose the content and methods of education to teach in the school.

Present instructional strategy for knowledge management in India must be examined for its adequacy to develop thinking skills required for higher education. In the higher secondary examination questions are knowledge oriented whereas in the admission tests more weightage is given to the cognitive skills (Sreehari, 2011). Many students fail to secure ranks in admission tests conducted for professional courses, arts and sciences. It indicates we need to introduce pedagogy that gives emphasis over cognitive abilities of the students and to change their level of the learner from knowledge level to that of knowledge generating. As we have entered in the new millennium we cannot neglect the need of the hour i.e. individual must gain the capacity to be creative, having ability for critical thinking, reflective thinking, logical thinking and producing knowledge rather than receiving and reproducing it. The problem which we are facing today is "how to make students capable of generating new knowledge or ideas, planning and problem solving." It can be done by inculcation of productive thinking among students. Gini-Newman and Case (2015) emphasized inappropriate use of Bloom's taxonomy of the cognitive domain in the classroom. The proposed model is an attempt to give emphasis over the higher levels of Bloom's taxonomy along with the lower levels. As Tsai, Chen, Chang & Chang (2013) emphasized that critical thinking in science classes make instruction fruitful. Chine (2006) and Wardrop et al (1969) developed productive thinking by self-instructional lesson and found positive result in elementary school. Present model is beneficial for the students to learn science through developing productive thinking.

Productive Thinking :

Gestalt psychologists were the first to provide a description of productive thinking. They identified two processes: reproductive thinking and productive thinking. **Reproductive thinking** is consisting of a mechanical application of chains of associations which have already been learned and reinforced by experience and habits. It is associated with repetition, conditioning, habits or familiar intellectual territory. **Productive thinking** is a process involving in the creation of something new by applying higher order thinking skills. Productive thought covers a variety of forms of cognitive activity: deduction; understanding and causal reasoning; creative thinking and problem solving; evaluative or critical thinking; and decision making and wise thinking (Newton, L., 2013). Higher order thinking, through the combination and integration of information, enables the construction of meaningful and more comprehensive ideas that go beyond the information presented. The practice of productive thinking in academic contexts is often directed at reasoning, understanding, creative thinking, evaluative thinking and decision making. Romiszowski (1981) also applied the term productive thinking to Bloom's (1956) higher level thinking – the analysis, synthesis and evaluation processes. According to him productive thinking is what can successfully generate ideas, develop plans, guide decision making and problem solving, and lead to actions. It is a valuable asset for people setting out to engage with and survive in the world and is the kind of thinking that has the potential to generate actions that can change minds and lives.

Considering the definitions given by the researchers, productive thinking can be define as "*the cognitive ability to plan, reason logically, analyze, synthesize, evaluate, and make decision to reach at the solution of the problem"* where newton (2013) focused on deduction, understanding, reasoning; creative thinking, problem solving, evaluative thinking, decision making and wise thinking, Cunningham & Macgregor (2014) consider Productive thinking as mechanism of shifts in perspective to solve a problem, Craig Rusbult (1997) describe it as combination of critical and creative thinking , Tim Hurson (2007) define it as problem solving approach.

Conceptualizations Of Productive Thinking In Science Teaching :

Productive thinking is not a new concept in the teaching-learning process rather it is an indispensable part of it as it combines higher order thinking components. In science teaching our prime focus is to develop analysis, synthesis and evaluation capacity in the students because science provides tremendous scope for these elements. In science teaching, productive thinking is the area which provides a balance between these elements to have something new rather than relying on drill and practice. As fig I showing opposite nature of creative thinking and critical thinking and it is also believed that persons who are creative will be comparatively less critical or vice-versa. In science we require both the skills. As fig I showing, it is the combination of creative thinking with critical thinking in such a synchronized manner having a wonderful product called productive thinking.

In science we need higher order thinking components and these components are integral part of the research and technology. Science is dead without creative and critical thinking. Productive thinking is an element where all the higher order thinking components can be enriched in the students in specifically science subject. It is the combination of creative thinking with critical thinking in a synchronized manner to make creativity wonderful and to make something new and valuable also.

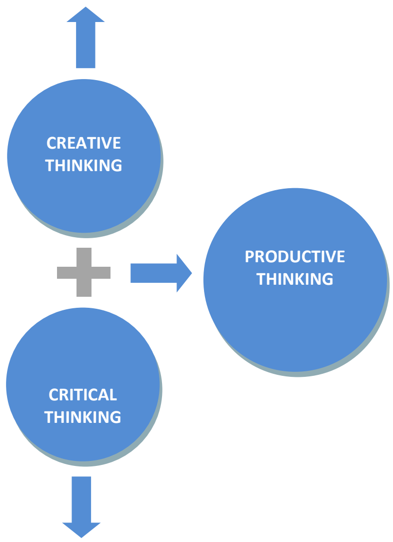


Fig I showing combination of creative and critical thinking (opposite nature) to result productive thinking

SCOPE FOR FIESI MODEL

Development of productive thinking among students through science teaching is very important aspect. It is the way by which we can achieve the expected objectives. It has its scope in the following area :

- Productive thinking give value to the creative thinking by evaluating through critical thinking.
- It provides a platform upon which creative thinking and critical thinking go hand in hand.
- It enhances scientific temper among students and develop the tendency of inquiry based learning.
- It is the foundation of science as it require the critical use of reason in experimentation and theory configuration.
- Students with productive thinking never rely on teachers and classroom time for instruction and guidance rather they are more independent and self-directed learners.
- Analytical reasoning, logical reasoning and ability to think critically are the basic component of today's entrance examination and productive thinking make them prepare for these type of examination.
- Productive thinking is the important component of research and development in science and technology.
- It provides scope to the students to develop research aptitude.

FIESI Model

The proposed model is developed by considering the other existing models of productive thinking, creative thinking and critical thinking. Rusbult (1997) gave emphasis on the implementation of the ideas in the model given by him but in the classroom it is not possible to implement all the ideas therefore in FIESI model emphasis is given over implication of the ideas. Similarly, Hurson (2007) also gave model ThinkX for productive thinking but it is for management studies. Therefore, presenter has developed model for productive thinking (FIESI) by considering the available models and adding the needed component.

This model can be integrated with the syllabus to teach the content of science. The productive thinking model (FIESI) is having the following steps as mentioned in the fig II :

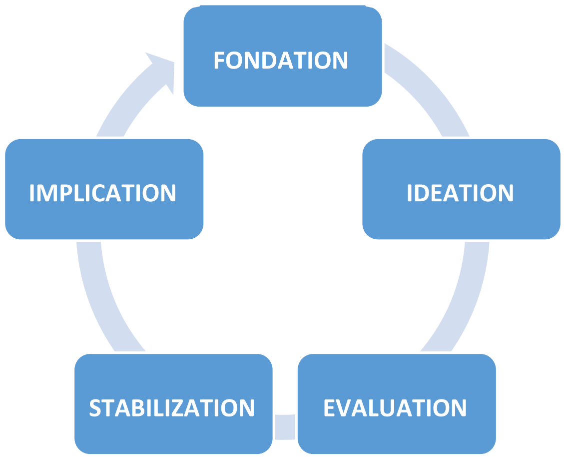


Fig. II Model of productive thinking (FIESI).

A.Foundation

This step is based on the principle that *creativity never comes in vacuum*, for this we need to provide a knowledge foundation upon which productivity can be drawn. As productive thinking is the combination of motivation, memory, creative thinking and critical thinking, a foundation stage is necessary in which teacher motivate students to get engaged in the content by manipulating their prior understanding and teach them with the help of student centric strategies like: activities, demonstration and teaching with technology.

B.Ideation

This step emphasizes over creative aspect of productive thinking where ideational fluency is emphasized. Ideation is based on the following principles:

- Quantity precedes over quality.
- Functional fixedness inhibits novelty.
- Criticism is the barrier in the way of creativity.

By keeping in mind above discussed principles, students are allowed to think out of the box by considering multiple perspectives. Here the role of a teacher is to present a problem in such a challenging way that disturb the equilibrium and engage students in idea generation. For this we need to minimize criticism i.e. self-criticism or criticism by others as it hinders creativity and avoid giving emphasis on drill, skill and rote learning. In science teaching using this model SCAMPER, forced connection, brainstorming, creative free writing and cognitive questioning can be used in this step.

C.Evaluation

This step is the critical thinking aspect of the productive thinking. It involves evaluation of the creative thinking through critical thinking to modify the concept to make it feasible. As critical thinking provides value, strength, potential, usefulness and appropriateness to the embryonic ideas by considering the criteria of domain. In classroom science teaching peer evaluation and presentation are the strategies that can be used to evaluate the immature ideas.

D.Stabilization

This phase is to stabilize the concept. Students may have developed some doubts on their developed ideas. This step will allow them to clear all the doubts related to their creative ideas and taught content to make it stabilize.

In classroom science teaching concept map and conclusion writing are two strategies can be used.

E.Implication of the concept:

Success of the productive thinking process depends upon the link between creativity and implication of the creative ideas. In creative thinking generation of ideas are more prevalent than its implication whereas in this, usefulness is necessary criteria for ideas to be considered as productive. Thus, this step is to satisfy the usefulness criteria for the productive thinking. At this step students are allowed to imply the generated ideas logically. In this component concept map and foresight can be used in the classroom science teaching.

Conclusion:

Knowledge of science and scientific ways of thinking both are necessary for the students to contribute to nation's growth. This start from the school science education. Today there is a mismatch between the curriculum objectives and curriculum transaction. This results in the disparity between the standard of the science education achieved by the students and the expected one. To achieve the expected objectives and draw our students' attention towards research we need to introduce productive thinking in the classroom instruction. Productive thinking allow the students to think creatively and at the same platform critically evaluate it to provide value and strength to the creative idea. This is the component which is to be included in teacher training programme, as teachers use this component in the classroom to make it feasible.

References :

Chine, C. (2006). Teacher questioning in science classrooms; approaches that stimulate productive thinking. Journal of research in science teaching. Volume 44, Issue 6, Pages 815–843, August 2007

Cutraro, J. (2012). How creativity powers science. Retrieved from https://www.sciencenewsforstudents.org/article/how-creativity-powers science. Dated 18 Aug 2018

Gini-Newman, G. & Case, R. (2015). Creating Thinking Classrooms. Vancouver:

Critical Thinking Consortium Ministry of Human Resource Development, National Policy on Education 1986, MHRD, New Delhi, 1986

Hurson, T. (2007). Think Better: An innovators' Guide to Productive Thinking.

New York: McGraw-Hill. ISBN 0071494936

Hurson, T. (2007). Think Better: An innovators' Guide to Productive Thinking. New York: McGraw-Hill. ISBN 0071494936

National Council of Educational Research and Training. (2005). National Curriculum Framework 2005. New Delhi: NCERT

Romiszowski, A.J. (1981), Designing Instructional Systems: decision making in course planning and curriculum design, London: Kogan Page.

Sharma D. (133976). Growth and Failures of India's Science Policy. Economic and Political Weekly. Vol. 11, No. 5, pp. 1969-1971. Retrieved from :https://www.jstor.org/stable/4365190. Dated 18 Aug 2018

Sreehari, S.V. (2011). Result analysis of higher secondary school examination and entrance examination. Trivandrum: university of Kerala.

Stewart, G. W. (1950). Can Productive Thinking Be Taught? The Journal of Higher Education. Vol. 21, No. 8 (Nov., 1950), pp. 411-414. Retrieved from https://www.jstor.org/stable/1976591.Dated: 20 Aug 2018

Third elementary education project (SSA III), 2014. To improve outcomes of elementary school children in India. World Bank. Retrieved from http:// documents world bank. Org/curated/en/583011468268510722/India-ThirdElementery-Education-Project-SSA-III. Dated 22 Jan 2018

Tsai, P., Chen, S., Chang, H. & Chang, W. (2013). Effects of prompting critical reading of science news on seventh graders' cognitive achievement. International journal of environmental and science. 8(1), 85-107.

Wardrop, et al (1969).The development of productive thinking skills in fifthgrade children. The journal of experimental education. Vol.37, No.4, 67-77, 1969

Horizons of Holistic Education
April-June-2020, 7 (2), 104-112

p ISSN : 2349-8811
eISSN : 2349-9133

CONSTRUCTIVISM AND ITS NEED IN PRESENT SCENARIO

Dr. Seema Sharma
Associate Prof. (Education)
Ravindranath Tagore University, Bhopal
Mo.: 8962462604, eMail: Sharma.seema23@gmail.com

Received :03-05-2020 Accepted : 11-06-2020

ABSTRACT

In present scenario of the 21st century, there will be a demand to equip students with Meta-competencies going beyond cognitive knowledge to develop individual potential with the help of constructivist learning. Advantage of constructivist learning, and criteria for its realization have been well determine through theoretical findings in pedagogy. Constructivist teaching is based on belief that learning occurs as learners are actively involved in a process of meaning and knowledge construction as opposed to passively receiving information. Learners are the maker of meaning and knowledge. Constructivist teaching fosters critical thinking and create motivated and independent learners. By creating a personal interpretation of external ideas and experience, constructivism allows student the ability to understand how ideas can relate to each other and pre-existing knowledge. A constructivist teacher and constructivist classroom are distinguished from traditional teacher and classroom.

The constructivism is basically a theory based on observation and scientific study. The constructivism assumes teacher as a facilitator of learning and students are active learner who construct their own knowledge with the help of help of their previous experience and varied learning experience provided by the facilitator..

Introduction :

Constructivism is basically a theory based on observations and scientific study about how people learn. It says that people construct their own understanding and knowledge of the world, through experiencing things and reflecting on those experiences. Constructivism is a theory to explain how knowledge is constructed in the human being when information came into contact with existing knowledge that had been developed by experience. Constructivism is a theory about knowledge and learning; of what "knowledge" is and how one "come to know". (Fosnot, 1996). According to the theory, human learning is constructed, and that learner build new ideas or concepts based on previous experiences or knowledge. This prior knowledge or experience influence the construction of new or modified learning. Constructivism suggests that human innately have certain physical “schemes” which they use to interact with the environment. Genetical and environmental factors play important roles in shaping one’s learning and development. (Heffron-????). Von glasersfed Ernst von Glasersfeld describes constructivism as a theory of knowledge with roots in philosophy, psychology and cybernetics. According to this theory, knowledge is being actively constructed by the individual and learning is an adaptive process based on the experience of individual (Mayer 1992; Hendry 1996).

CONSTRUCTIVISM LEARNING THEORY

Constructivism learning theory is a philosophy which enhance student’s logical and conceptual growth. The underlying concept within the constructivist learning theory is the role which experience or connections with the adjusting atmosphere play in student education. Learning theory of constructivism incorporates a learning process where in the student gain, their own conclusion through the creative aid of teacher as a facilitator. Instead of having the students relying on someone else’s information and accepting as a truth, the student should be exposed to data, primary, and the ability to interact with other student, so that they can learn from the incorporation of their experience. Hand on activities are the best for the classroom application of construct, critical thinking and learning.

Jonassen’s (1994) description of general characteristics of constructivist learning environment is a succinct summary of constructivist perspective. There are eight characteristics that differentiate constructive learning environment.

1- Constructivist learning environment provide multiple representation of reality.
2- Multiple representation avoids oversimplification and represent the complexity of real world.
3- Constructivist learning environment emphasises knowledge construction instead of knowledge reproduction.
4- Constructivist learning environment emphasises authentic task in a meaningful context rather then abstract instruction out of context.
5- Constructivist learning environment provide learning environment such as real-world setting or case-based learning instead of predetermined sequence of instruction.
6- Constructivist learning environment enable context and content-dependent knowledge construction.
7- Constructivist learning environment encourage thought full reflection on experience.
8- Constructivist learning environment support “collaborative construction of knowledge through social negotiation, not competition among learner for recognition”.

These characteristics support both social and cognitive constructivist.

PRINCIPLES OF CONSTRUCTIVISM

1- New ideas occur as we adapt and change our old ideas.

2- Learning involves inventing ideas rather then the mechanically accumulated facts.

3- Meaningful learning occurs through rethinking old ideas and coming to new conclusion about new ideas which conflict with our old ideas.

Constructivism represents a paradigm shift from educational based on behaviourism to education based on cognitive theory. Fosnot (1996) has provided a recent summary of these theories and describes constructivist teaching practice. Constructivist epistemology assumes that learners construct their own knowledge on the basis of interaction with their environment. Four epistemological assumption are at the heart of what we refer to as "constructivist learning".

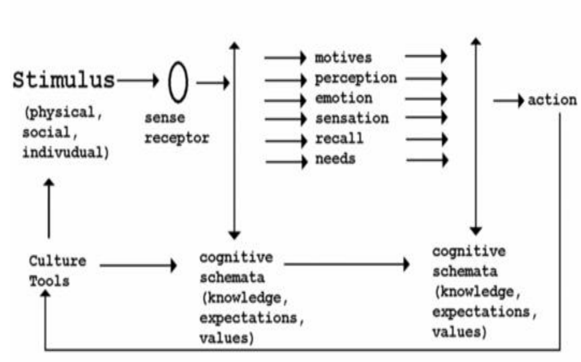
1- Knowledge is physically constructed by learner who are involved in active learning.

2- Knowledge is symbolically constructed by learners who are making their own representation of action.

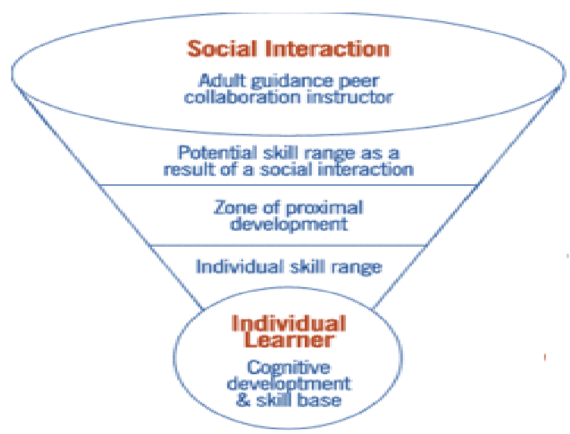
3- Knowledge is socially constructed by learners who convey their meaning making to others.

4- Knowledge is theoretically constructed by learners who try to explain things they don't completely understand.

Vygotsky (1978) believed that learning is also developmental but adds a socio-culture dimension to the theory. This theory combines the social environment and cognition in which he states that prior to cognitive development social interaction takes place first. Consciousness and cognition are the end products of socialization and social behaviour.

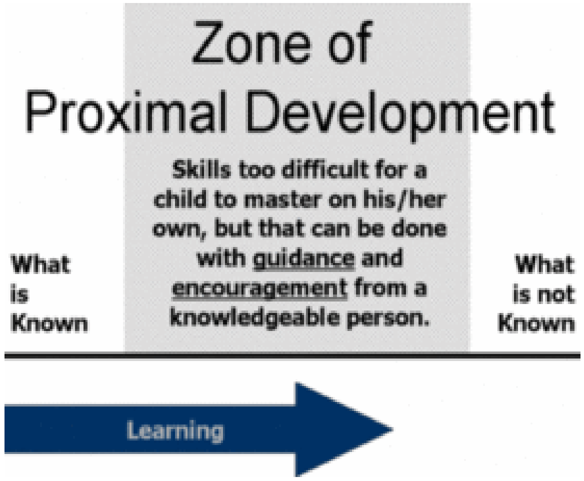


Vygotsky focus on social structures peer collaboration. He believes in the fundamental role of social interaction in the development of cognition. He stated that "community is the key in the process of making, learning comes from within (skill base) and from without society". This can be shown in given figure.



There are three ways in which a cultural tool can be transmitted from one person to another.

1. Imitative learning - The learner copies or imitates another person.
2. Instructed learning – Remembering instruction and using the instruction to self – regulate.
3. Collaborative learning – A learning which involves the collaboration with other individual in the effort of understanding each other and reach a common goal/ skill.



Humans use tools that develop from a culture, such as speech & writing to mediate their social environments. Initially children develop these tools to serve solely as social function, ways to communicate needs. Vygotsky believed that the internalization of these tools led to higher thinking skills "what a child can perform today with assistance she will be able to perform tomorrow independently thus preparing her for entry into a new & more demanding collaboration". (Vygotsky 1978; qtd from Bransford el.al. 1973)

EFFICACY AND ADOPTION OF CONSTRUCTIVISM

In this century, Jean Piaget and John Dewey developed theories of childhood development and education, what we call now progressive education, that led to the evolution of constructivism. Piaget believed that humans learn through the construction of one logical structure after another. He also concluded that the logic of children and their modes of thinking are initially entirely different from those of adult. The implication of this theory and how he applied them have shape the foundation for constructive education.

Dewey called for education to be grounded in real experience. He wrote "if you have doubts about how learning happens, engage in sustained inquiry: study, ponder consider alternative possibilities and arrive at your belief grounded in evidence". Inquiry is a key part of constructivism learning.

The constructivist spirit was symbolically expressed by the principle that was first proposed by the great Italian philosopher Giambattisla Vico(1668-1744) the "Vernam Factum principle". The other important philosophical source of constructivism themes is formulated by Immanual Kant (1724-1804). Kant argued that "cognition is not a passive reception of sensory data, but is rather the outcome of constructive process of active cognition.

Barron and Colleagues (1998) suggest that constructivist approaches remain under implemented and underutilized because constructivist teaching practices are foreign to student and teachers, and difficult to apply. A reviews by John & Carter (2007) suggested that wider implementation of constructivist approaches will require changes in teacher's attitude & beliefs in addition to educational reform. Abbort & Fouts (2003) found a significant correlation between constructivist teaching and higher achievement. Studies have shown that constructivist approaches have great potential but require authentic implementation in order to achieve that potential.

RESEARCH AND EVIDENCE SUPPORTING CONSTRUCTIVISM

Hmelo Silver, Duncan & Chinn site, several studies supporting the success of constructivist problem based and inquiry learning method. Hamelo Silver, et.al also cite a large study by Geier on the effectiveness of inquiry based science for middle school student. As demonstrated by their performance on high stakes standardized test. The improvement was 14% for the first cohort of students and 13% for the second cohort. This study also found that inquiry based training method greatly reduced the achievement gap for the American students (Hamelo Silver, Duncan & Chinn (2007).

Guthrie et al (2004) compared third grade reading. A traditional approach a strategies instruction only approach and an approach with strategies instruction & constructivist motivation techniques including students' choices collaboration, and hand-on-activities. The constructivist approach-oriented reading instructions resulted in better student reading comprehension, cognitive, strategies, and motivation. John suk kim found that using constructivist teaching methods for better student achievement than traditional teaching method. This study also found that students preferred constructivist methods over traditional ones, however Kim did not find any difference in student self-concept or learning strategies between those taught by constructivism or traditional method.

Dogru and Kalender compared science classroom using traditional teacher-cantered approaches to these using student- centred, constructivist method. In their initial test of student's performance immediately following the lesson. They found no significant difference between traditional and constructivist method. However, in the follow up assessment later, student who learned through constructivist methods showed better retention of knowledge than those who learned through traditional method. (Dongru; Kalender,2007).

THE CONSTRUCTIVE CLASSROOM

A constructivist classroom, the focus must tend to shift from the teacher to the students. The classroom is no longer a place where the teacher pours knowledge into passive students, who will wait like empty vessels to be filled. Students are actively involved in the learning process and given the opportunity to construct knowledge based on their own background. The constructivist teacher sets up problems and monitors student exploration, guides the direction of student inquiry and promotes new pattern of thinking. Classes can take unexpected turns as students are given the autonomy to direct their own explorations. In specific terms a constructivist classroom bears the following characteristics (Brooks & Brooks,1993).

Students are engaged in dialogue with the teacher and with each other.

Social discourse helps students change and reinforce their ideas. If they have the chance to present what they think and other's idea, student can build a personal knowledge base that they understand.

Students autonomy and initiative are accepted and encouraged.

By respecting student's ideas and encouraging own intellectual identify. Student who frames questions and then go about analysing and answering them, take responsibility for their own learning and become problem solver.

The teacher asks open-ended questions and allow wait for responses.

Reflective thought takes times and is often built on other's ideas and comments. The ways teachers ask question and the way student respond will structure the success of student inquiry.

Higher level thinking is encouraged.

The constructivist teacher challenges student to reach beyond the simple factual responses. They encourage students to connect and summarize concept by analysing predicting, justifying and defending their ideas.

Students are engaged in experience that challenge hypotheses and encourage discussion.

When allowed to make prediction, students often generate varying hypothesis, about natural phenomena. The constructivist teacher provides ample opportunities for students to test their hypothesis, especially through group discussion of concrete experience.

THE CONSTRUCTIVIST TEACHER.

Constructivist teachers encourage students to constantly how the activity is helping them gain understanding. By questioning themselves and their strategies, students, in the constructivist classroom become expert learner. When they continually reflect on their experiences, they develop increasingly strong abilities to integrate new information. One of the main roles of the teacher here is to encourage this learning and reflection process.

Contrary to criticism by some traditional educators, constructivist does not dismiss the active role of the teacher or the value of expert knowledge. Constructivism modifies that role, so that teacher helps students to construct knowledge rather then to reproduce a series of facts. The constructivist teacher provides tools such as problem solving and inquiry based learning activities with which students formulate and test their ideas, draws conclusion and inferences, and pool their knowledge in a collaborative learning environment.

The constructivist teachers perform the following roles:

- Encourage and accept student autonomy and initiative.
- Encourage student's inquiry by asking thoughtful, open-ended questions and encouraging students to ask question of each other.
- Seek elaboration of student's initial response.
- Engage students in experience that might endanger contradictions to their initial hypotheses and then encourage discussion.
- Provide time for students to construct relationship and create metaphors.

APPLICATION

Now a days, the classroom is no longer a place where the teacher (expert), pours knowledge into passive student, who wait like empty vessels to be filled. In the constructivist model, the student is urged to be actively involved in their own process of learning. The teacher function more as a facilitator who coaches, mediates, prompts and helps students he develops and assess their understanding, and learning. Here we discuss the significant difference in basic assumption about knowledge, student and learning. There is comparison between constructivist and traditional classroom conditions.

In traditional classroom, curriculum begins with the parts of the whole. Emphasizes basic skills, and teachers disseminate information to students; students are recipients of knowledge. Teacher's role is directive, rooted in authority. As knowledge is seen as inert and assessment is through testing, correct answers. Material are primarily textbooks and workbook and students work primarily alone as well as learning is based on repetition, while on contrary ,in constructivist classroom , curriculum emphasizes big concepts, beginning with the whole and expanding to include the parts, learning is interactive, building on what the student already knows. In this type of situation, teacher have a dialogue with student, helping student construct their own knowledge and teacher's role is interactive, rooted in negotiation. Assessment includes student, works, observation and points of view as well as tests. Knowledge is seen as dynamic, ever changing with our experience. Students work primarily in groups.

Constructivist teachers pose questions and problems, then guide student to help them find their own answers. Its important to realize that the constructivist approach borrows from many other practices in the pursuit of its primary goal; helping students learn "how to learn".

In a constructivist classroom learning is:

CONSTRUCTED- Students come to learning situation with already formulated knowledge, ideas and understanding. This previous knowledge is the raw material for the new knowledge they will create.

ACTIVE- The student is the person who creates new understanding for him/herself. The teacher coaches, moderate, suggest, but allows the students room to experiment, ask questions. Learning activities require the student's full participation. An important part of the learning process is that students reflect on and talk about their activities. Students also help set their own goals and means of assessment.

REFLECTIVE-Students control their own learning process, and they lead the way by reflecting on their experience. This process makes them experts of their own learning. The teacher should also create activities that lead the students to reflects on his or her prior knowledge and experience. Talking about what was learned and how it was learned is really important.

COLLABORATIVE- The constructivist classroom relies heavily on collaboration among students. The main reason it is used so much in constructivism is that student learn about learning not only from themselves, but also from their peers. When students review and reflect on their learning processes together, they can pick up methods and strategies and methods from one another.

INQUIRY BASED-The main activity in a constructivist classroom is solving problems. Students use inquiry methods to ask questions, investigate a topic, and use a variety of resource to find solutions and answers. As the students explore the topic, they draw conclusion, and exploration continues, they revisit those conclusions. Exploration of question leads to more questions.

EVOLVING-Students have ideas that they may later see were invalid, incorrect or insufficient to explain new experience. These ideas are temporary steps in the integration of knowledge .

The constructivist model says that the students compares the information to the knowledge and understanding she/he already has, and one of the three things can occurs:

* The new information matches up with his previous knowledge pretty well (it's *consonant **with*** the previous knowledge),so the students add it to his understanding. It may take some work, but it's just a matter of finding the right fits, as with a puzzle piece.

*The information doesn't match previous knowledge(it's *dissonant).* The student has to change her previous understanding to find a fit for the information. This can be harder work.

*The information doesn't match previous knowledge, and it is *ignored*. Rejected bits of information may just not be absorbed by the student. Or they may float around, waiting for the day when the students understanding has developed and permits a fit.

Constructivism became an influential current of thought in 1960's and 1970's as it converged with new approaches to understanding of constitutive rule of regulatory process that inform the frame work of social life. This was particularly important in so called "labelling theories of deviances" and the "new criminology" in debates about the symbolic sources of social identity.(in the symbolic interactionist tradition); in the study of prejudice, and authoritarianism in the field of ethnicity and race relation; in the renewed concern with the historical and political construction of sexuality and gender relation (associated, in particular, with feminist sociology)and in the emergence of more micro sociological inquiries into negotiated character of everyday social order.

REFERNCES :

Bransford, J.D., Brown, A.L & Cocking, R.R (1999) Box 4.1.Zone of proximal development,retreivedsept.26 2007 from http://wwwlearnc.org/glossary/scaffolding.

Dogru; kalender (2007). "Applying the subject cell through constructive approach during, science lesson & the teacher's view". Journal of environmental & science education 2(1):3-13.

Hmelo - silver; ducan; chin(2007). "scaffolding and achievement in problem based and inquiry learning. A response to kischner sweller and clark (2006)"

Gutherie; el.at (20040. "Increasing reading comprehension and engagement hrough concept oriented reading instruction." Journal of educational psychological 96(3).403-423.

Glaserfeld, E.(1989), constructivism in education.

Kim(2005). "The effect of a constructivist teaching approach on student academic achievement, self-concept & learning strategies". Asia pacific education review 6(1);7-19.

Learning theory knowledge(2007). Social development theory (vygotsky). Retrived sept. 25. 2007.

from http://www.nap.edu/htm/how people1/ch4.b1.html.

Piaget, J: (1977). The development of thought equilibration of cognitive structures. (A.rosim.trans), New york The Viking Press.

Scaffolding, retrived sept 26, 2007. from http://wwwlearnc.org/glossary/scaffolding.

Twomey, Fosnot; c.(1989). Enquiring teachers, enquiring learner; A constructivist approache for teaching. New York teacher collage press. www.thierteen.org/edoline/concept.2class/constructiviSsm/index_sub2html.

Horizons of Holistic Education
April-June-2020, 7 (2), 113-122

p ISSN : 2349-8811
eISSN : 2349-9133

A CRITICAL ANALYSIS OF TEACHER EDUCATION QUESTION PAPERS : IMPLICATIONS AND SUGGESTIONS FOR REFORMS

Dr. Rajan Welukar
Former Vice-Chancellor
University of Mumbai
rajanwelukar@yahoo.com

Dr. Shefali Pandya
Professor & Head
Department of Education
University of Mumbai
srpandya14@gmail.com

Dr. Prerna Dahiwade
Controller of Examination
G. H. Raisoni University
Chindwra
prerna.dahiwade@gamil.com

Smt. Prachi Swan
G. H. Raisoni University
prachi.swan@ghru.edu.in
Maharashtra

Received : 01-04-2020 Accepted : 12-06-2020

ABSTRACT

The world over, there is a paradigm shift in school as well as higher education with an emphasis on student learning, development of critical thinking skills, self-regulation, teacher commitment to life ling learning, reflective thinking and so on. This necessitates a paradigm shift in teacher education too. The quality of teacher education depends not only on professionally sound and pertinent curriculum and on the way the curriculum is developed and executed in Teacher Education Institutions (TEIs) but also on the evaluation system as well. The present study focused on analysing 19 question papers of B.Ed. syllabus of a State university in Western India using Bloom's Taxonomy. The study found that predominantly, the instructional objectives of the selected courses of B.Ed. programme included Knowledge and Understanding and to a much lesser extent Application. The same was observed in case of question papers. On the basis of this analysis, it is suggested that in-depth workshops need to be organised for imparting training to teacher educators on curriculum design and development, developing question paper especially suitable to constructivist teaching and learning.

Key words: *- Bloom's Taxonomy, Instructional Technology.*

Background

The world over, there is a paradigm shift in school as well as higher education with an emphasis on student learning, development of critical thinking skills, self-regulation, teacher commitment to life long learning, reflective thinking and so on. This necessitates a paradigm shift in teacher education too. The quality of teacher education depends not only on professionally sound and pertinent curriculum and on the way the curriculum is developed and executed in Teacher Education Institutions (TEIs) but also on the evaluation system as well. National Curriculum Framework (2005) emphasised and recommended adoption of constructivism and recommended active role of teachers as facilitators in the process of learning in terms of knowledge construction rather than knowledge transmission. These recommendations were meant for school education. However, the same would have significant implications for teacher education programmes. Thus, it is expected that TEIs would be bringing in reforms in the curriculum including the objectives of the programme, syllabus as well as in the methods of evaluation suitable to constructivism.

This rationale led to the present study which inquired into the objectives of the B.Ed. programme and some of its selected courses and the concerned question papers. In the present study, the following courses were examined with reference to (a) Objectives of the selected courses and (b) Question papers :

(1) Education Psychology, (2) Development of Educational System in India, (3) Educational Administration & Management, (4) Educational and Mental Measurement, (5) Computer Education and Information Technology, (6) Environmental Education, (7) Essentials of Educational Technology and Management, (8) Teaching in Emerging Indian Society, (9) English, (10) Biology, (11) Commerce, (12) Mathematics, (13) History, (14) Civics, (15) Economics, (16) Geography, (17) Chemistry, (18) Physics and (19) Home Science.

Conceptual Framework of the Study

The analysis of question papers in the present study is based on Bloom’s taxonomy. Bloom's taxonomy makes use of a multi-tiered scale to elucidate the extent of expertise required to attain each measurable student-outcome. Organizing measurable student outcomes in this way allows a teacher to choose suitable classroom assessment techniques for a particular course. Blooms’ taxonomy for cognitive domain classifies instructional objectives into six categories, knowledge, understanding, application, analysis, synthesis and evaluation. The categories follow the maxims of ‘from simple to complex’ and ‘from concrete to abstract’.

Review of Related Literature : A few pertinent studies conducted in the present decade have been reviewed here. Romanovs, Soshko, Merkuryev & Novickis (2011) conducted a case study of evaluation of engineering course content by Bloom's Taxonomy. The case study evaluated the engineering course "Logistics information system" content using the cognitive domain of Bloom's taxonomy model. The authors introduced experience in elaborating course content, including description on the course teaching methods, outcomes, activities and assessment system. In order to improve course quality, Bloom's learning outcomes model was found to a crucial element. Ulum (2016) conducted a descriptive content analysis of the extent of Bloom's Taxonomy in the reading comprehension questions of the course Book Q: skills for success 4 reading and writing. The researcher formulated the question "*To what extent do the reading sections of the EFL course book Q: Skills for Success 4 Reading and Writing cover the lower and higher order cognition levels of Bloom's taxonomy?*". EFL course book Q: Skills for Success 4 Reading and Writing by Oxford Publishing was analysed using descriptive content analysis method. Findings of the study suggested that the course book lacked the higher level cognitive skills involved in Bloom's Taxonomy. Chandio, Pandhiani & Iqbal (2017) adopted Bloom's Taxonomy and studied its role in improving assessment and teaching-learning process. The study applied Bloom's Taxonomy to the prevailing assessment system at the level of secondary education in Sindh. The data were collected from five years' question papers used by the Board of Intermediate and Secondary Education (BISE), Karachi, Hyderabad Sukkur at secondary level for the subject of English. The questions asked in these papers were classified and analysed using Bloom's Taxonomy to determine whether the present assessment system focuses on the lower degrees of learning like remembering, understanding, applying or it surpasses the higher degree such as analysis, synthesis, evaluation and creation. The data were quantitative necessitating the use of hence SPSS. 20 for analysing and drawing conclusions and results. The findings of this study are expected to improve both assessment and teaching-learning processes, which will enhance the learner to higher levels of analysis, evaluation and creativity from merely practising description, rote-learning and memorisation. Tabrizi & Rideout (2017) adopted Bloom's Taxonomy to analyse support to critical pedagogy in active learning. The study explored how Bloom's taxonomy could describe the activities involved in active learning and how those activities were necessary for critical pedagogy. Banage, Kumara, Brahmana & Paik (2019) conducted a study of Bloom's Taxonomy and rules-based analysis approach to questions for measuring the quality of examination papers. The study attempted to develop a suitable methodology to categorise final examination question papers based on Bloom's Taxonomy to analyse computer science related papers. The study was conducted to check whether examination questions complied with the requirements of Bloom's Taxonomy at various cognitive levels. Natural language processing techniques were used to identify the significant keywords and verbs which are useful in the determination of the suitable cognitive level. The derived model introduced a quantitative approach to categorise undergraduate examination papers.

Need of the Study : A review of related literature reveals that several studies have been conducted using Bloom's taxonomy in the present decade the world over in order to analyse question papers of different subjects. In most of the cases, weaknesses of the question papers have been identified. The present study too adopts Bloom's Taxonomy for analysing question papers of B.Ed. programme.

Statement of the Problem : The study intends to critically analyse question papers of B.Ed. with a view to ascertain its implications and make suggestions for reforms.

Objectives of the Study : The study was conducted with the following specific objectives :

1. To study the objectives of the selected courses of B.Ed. programme using Bloom's Taxonomy.
2. To study the question papers of the selected courses of B.Ed. programme.

Methodology of the Study : The study may be termed as descriptive action research since the study has focused its attention only on one university and the specific findings cannot be applied to other subjects, programmes or universities. Besides, the findings may be utilised for improving the examination system in the concerned university and programme. The study undertook an analysis of the instructional objectives and question papers of selected question papers of B.Ed. programme.

Sample : Its Nature and Size : The sample consisted of 19 courses (papers) of the B.Ed. programme offered by one state university situated in western India. It included core as well as elective courses including methodology of teaching school subjects. The study included 75% of the total number of courses offered by the university. These courses were selected using simple random sampling technique. Thus, 19 courses were selected for the present analysis. The question papers selected for analysis were those set for the examinations conducted by university.

Scope and Delimitations of the Study : The study is restricted to only one state university in Western India. It excludes other state, central, private or deemed in India. It includes question papers of selected courses only from the B.Ed. programme. It excludes other professional programmes from its purview.

Data Analysis : Data were analysed by the researchers keeping in mind Bloom's taxonomy of educational/instructional objectives.

A. Table 1 shows the percentage of educational objectives which fall into the six categories of Bloom's taxonomy of educational/instructional objectives, namely, knowledge, understanding, application, analysis, synthesis and evaluation. It also shows the percentage of questions which fall into the six categories.

Table 1 : Percentage of instructional objectives and questions under Blooms' taxonomy

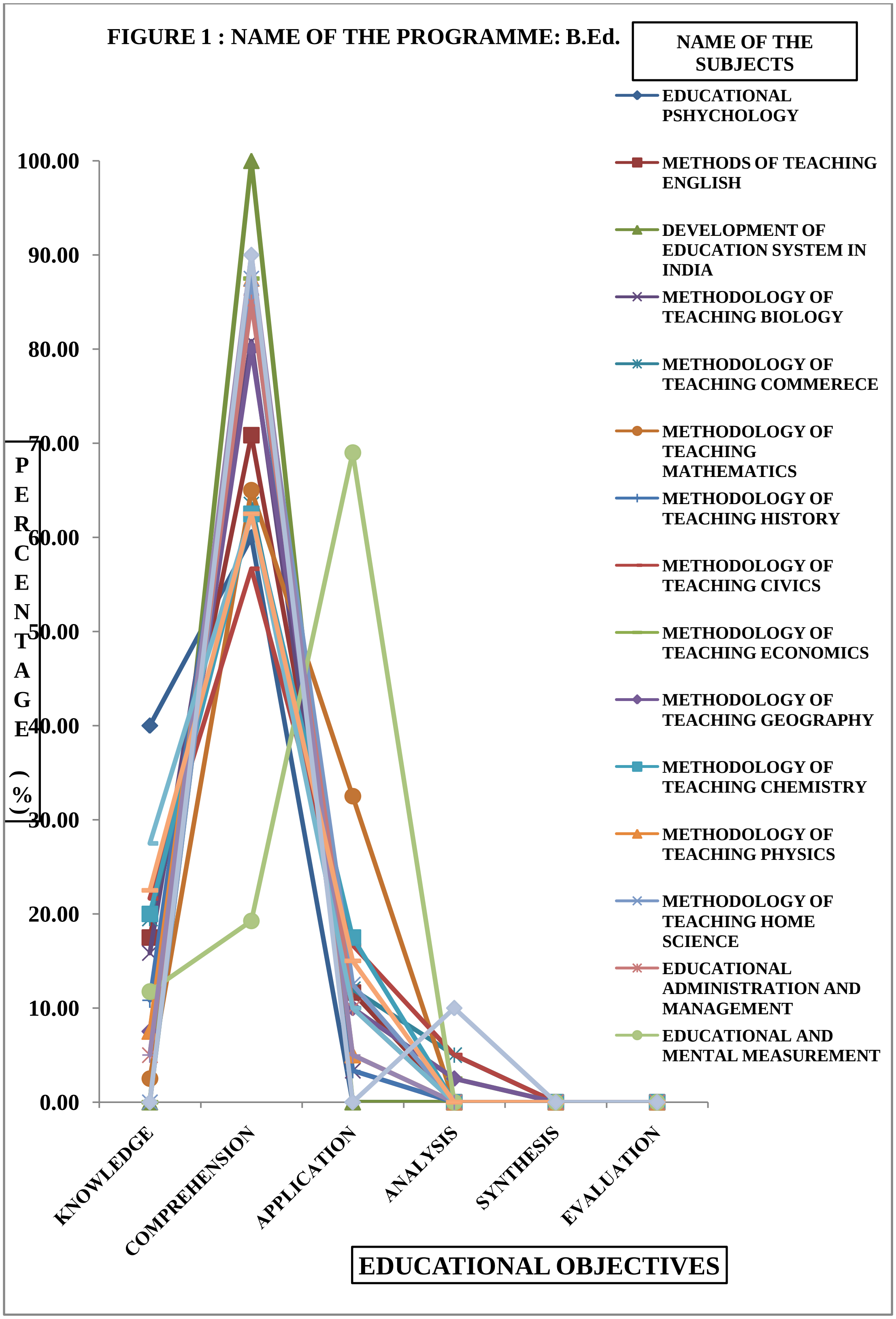
No.	**Subject**	**Instructional Objectives of the Course**						**Questions**					
		Kn	Un	App	Ana	Syn	Eva	Kn	Un	App	Ana	Syn	Eva
		%	%	%	%	%	%	%	%	%	%	%	%
1	Educational Psychology	63	35	2	--	--	--	40	60	--	--	--	--
2	Development of Educational System in India	38	62	--	--	--	--	--	100	--	--	--	--
3	Educational Administration & Management	25	75	--	--	--	--	5	85	10	--	--	--
4	Educational and Mental Measurement	42	58		--	--	--	11.75	19.25	69	--	--	--
5	Computer Education and Information Technology	35	55	10	--	--	--	5	90	5	--	--	--
6	Environmental Education	23	77	--	--	--	--	27.5	62.5	10	--	--	--
7	Essentials of Educational Technology and Management	31	69	--	--	--	--	22.5	62.5	15	--	--	--
8	Teaching in Emerging Indian Society	45	55	--	--	--	--	--	90	--	10	--	--
9	Methodology of Teaching English	63	37	--	--	--	--	17.49	70.82	11.66	--	--	--

No.	Subject	Instructional Objectives of the Course						Questions					
10	Methodology of Teaching Biology	48	52	--	--	--	--	15.83	80.83	3.33	--	--	
11	Methodology of Teaching Commerce	39	61	--	--	--	--	19.5	63.5	12	5	--	--
12	Methodology of Teaching Mathematics	37	73	--	--	--	--	2.5	65	32.5	--	--	--
13	Methodology of Teaching History	51	49	--	--	--	--	10.83	85.83	3.33	--	--	--
14	Methodology of Teaching Civics	65	35	--	--	--	--	21.66	56.66	16.66	5	--	--
15	Methodology of Teaching Economics	40	60	--	--	--	--	--	87.5	10	2.5	--	--
16	Methodology of Teaching Geography	31	69	--	--	--	--	7.5	80	10	2.5	--	--
17	Methodology of Teaching Chemistry	28	72	--	--	--	--	20	62.5	17.5	--	--	--
18	Methodology of Teaching Physics	33	67	--	--	--	--	7.5	87.5	5	--	--	--
19	Methodology of Teaching Home Science	30	60	10	--	--	--	87.5	12.5	--	--	--	--
	TOTAL	**40.37**	**59**	**1.16**	--	--	--	**20.13**	**69.57**	**15.40**	**5.00**	--	--

Observation : It can be seen from table1 that

1. On an average, 40.37% of educational/instructional objectives focus on imparting knowledge, 59% try to develop understanding about a concept in the students and 1.16% are aimed at developing the ability to apply concepts learnt amongst students. None of the educational / instructional objectives were seen to be aimed at developing the abilities to analyse, synthesise and educational / instructional objectives evaluate.
2. Similarly, 201.3%, 69.57%, 5.40% and 5% of the questions were aimed at testing acquisition of knowledge, understanding, application and analysis amongst students. None of the questions were aimed at testing acquisition of abilities to synthesise and evaluate i.e. higher order abilities.

Figure 1 shows these results graphically. The figure corroborates the observations through table 1.



A. Relationship between Instructional Objectives of the Course and the objectives of question papers

This was analysed using the non-parametric techniques of Chi-square and Cramer's V.

No.	Subject	χ^2	P	Cramer's V	Interpretation
1	Educational Psychology	13.71	0.0011	0.2618	Moderate Association
2	Development of Educational System in India	44.48	<0.0001	0.4843	Relatively Strong Association
3	Educational Administration & Management	23.96	<0.0001	0.3461	Moderate Association
4	Educational and Mental Measurement	105.78	<0.0001	0.7293	Strong Association
5	Computer Education and Information Technology	32.61	<0.0001	0.4038	Relatively Strong Association
6	Environmental Education	11.92	0.0026	0.2441	Moderate Association
7	Essentials of Educational Technology and Management	16.69	0.0002	0.2889	Moderate Association
8	Teaching in Emerging Indian Society	63.45	<0.0001	0.5632	Relatively Strong Association
9	Methodology of Teaching English	49	<0.0001	0.4962	Relatively Strong Association
10	Methodology of Teaching Biology	26.48	<0.0001	0.3648	Moderate Association
11	Methodology of Teaching Commerce	23.61	<0.0001	0.3436	Moderate Association
12	Methodology of Teaching Mathematics	63.68	<0.0001	0.5507	Relatively Strong Association
13	Methodology of Teaching History	40.26	<0.0001	0.4498	Relatively Strong Association
14	Methodology of Teaching Civics	49.39	<0.0001	0.4982	Relatively Strong Association
15	Methodology of Teaching Economics	56.73	<0.0001	0.5326	Relatively Strong Association
16	Methodology of Teaching Geography	28.6	<0.0001	0.3782	Moderate Association
17	Methodology of Teaching Chemistry	20.04	0.0002	0.3165	Moderate Association
18	Methodology of Teaching Physics	23.99	<0.0001	0.3463	Moderate Association
19	Methodology of Teaching Home Science	69.6	<0.0001	0.5899	Relatively Strong Association

Observations :

1. The Chi-square and Cramer's V are found to be statistically significant. This implies that there is a significant association between the percentage of educational objectives and the questions contained in the selected question papers. The magnitude of these associations are found to be in the range of moderate to relatively strong in all the cases (Rea & Parker, 1992).

Educational Implications of the Study

1. B.Ed. syllabus requires drastic changes and needs to incorporate educational/instructional objectives of developing abilities to analyse, synthesis and evaluate. This is the first step in the process of bringing reforms.
2. There is an association between educational/instructional objectives of the selected courses and the questions included in the question papers. The magnitude of this association ranges between moderate to relatively strong.
3. This is not surprising. Since the syllabus is aimed at predominantly imparting knowledge and developing understanding, the question papers too reflect the same and test these abilities. The other reasons for a large majority of question papers measuring the domains of knowledge and understanding could be the ease of setting such questions.
4. The National Curriculum Framework (2005) recommended constructivism more than a decade. However, B.Ed. curriculum and examination patterns have not yet adopted constructivist evaluation strategies in their syllabus implementation.

Suggestions for Improvement : Detailed workshops need to be conducted for teacher educators on curriculum design and development with a view to focus on developing higher order thinking skills and abilities in student-teachers. This would also include training in writing question papers. Workshops also need to be conducted on training teacher educators for adopting constructivist approach to teaching, learning as well as evaluation which could include training in use of authentic assessment and development and use of rubrics.

References:

Banage T. G. S. Kumara, A. Brahmana, and Incheon Paik. Bloom's Taxonomy and Rules Based Question Analysis Approach for Measuring the Quality of Examination Papers International Journal of Knowledge Engineering, Vol. 5, No. 1, June 2019.

Bloom, B.S. (Ed.). (1956). Taxonomy of Educational Objectives. New York: David McKay Company Inc.

Chandio, M. T., Pandhiani, S.M. & Iqbal, R. (2017). Bloom's Taxonomy: Improving Assessment and Teaching-Learning Process. Journal of Education and Educational Development. https://www.researchgate.net/publication/310494139

National Curriculum Framework (2005). National Council of Educational Research and Training.

Rea, L. M., & Parker, R. A. (1992). Designing and conducting survey research. San Francisco, CA: Jossey–Bass.

Romanovs, A., Soshko, O., Merkuryev, Y. & Novickis, L. (2011). Evaluation of Engineering Course Content by Bloom's Taxonomy: A Case Study. International Conference on Business Informatics Research. https://link.springer.com/chapter/10.1007/978-3-642-29231-6_13

Tabrizi, S. & Rideout, G. (2017). Active Learning: Using Bloom's Taxonomy to Support Critical Pedagogy. International Journal for Cross-Disciplinary Subjects in Education (IJCDSE), Volume 8, Issue 3, September 2017.

Ulum, O. G. (2016). A Descriptive Content Analysis of the Extent of Bloom's Taxonomy in the Reading Comprehension Questions of the Course Book Q: Skills for Success 4 Reading and Writing. .The Qualitative Report, 21(9), 1674-1683. Retrieved from https://nsuworks.nova.edu/tqr/vol21/iss9/7

Horizons of Holistic Education
April-June-2020, 7 (2), 123-154

p ISSN : 2349-8811
eISSN : 2349-9133

A Grade Seven Science Teacher's Discursive Interactions in Developing Common Knowledge: Question Types, Discourse Patterns, and Communicative Approaches

Shamarion Grace, grace.shamarion1@gmail.com

Jazlin Ebenezer, aj9570@wayne.edu

Received : 03-05-2020 Accepted : 15-06-2020

ABSTRACT

The purpose of this research is to characterize the nature of discourse between a middle school science teacher and her students as the teacher develops the physics concepts of "forms and transformation of energy" using a standards-based curriculum that promotes "dialogic discourse." The whole-class discussions between the teacher and her students are video-recorded and transcribed verbatim. Four instructional activities are analyzed using a discourse framework based on the consistency of students' completion of workbook lessons and references made by the teacher to these lessons as she developed common knowledge on the concepts of forms and transformation of energy. The teacher-posed questions portrayed the following characteristics: cued, second-order, descriptive, and explanatory. There are straightforward and a combination of discourse patterns based on the moves in the same lesson at various points. The communicative approach is predominantly interactive/authoritative where the teacher leads students with the aim of establishing the correct answer. The study implies the need for professional development on teacher-students' interactive/dialogic discourse that fosters common knowledge development in science.

Key words*: - dialogic discourse, sociocultural perspective, common knowledge.*

Introduction

Understanding the discourse between teachers and students that fosters the development of common knowledge in science is particularly crucial at a time when science curricula and pedagogical practices are shaped by national policies worldwide (Lai, Li, & Gong, 2016: Huang and Asghar, 2016; National Research Council, 2012) and informed by the sociocultural perspective of science learning (Vygotsky, 1978). Communicating in written or spoken form is a fundamental practice of science; it requires scientists to describe observations precisely, clarify their thinking, and justify their arguments (NRC, 2012). According to Achieve (2013), reasoning and argument in science are essential in science for identifying the strengths and weaknesses of a line of reasoning and for finding the best explanation for a natural phenomenon. Constructing and critiquing arguments are both a core process of science and one that supports science education. Interaction with others is the most cognitively effective way of learning**.** As stated by the Ontario Ministry of Education (2006), "communication is essential and students need to be able to communicate effectively" (p. 9). The Australian, Curriculum, Assessment, and Reporting Authorities (2014) observe that communicating scientific ideas and information for a particular purpose, including constructing evidence-based arguments and using appropriate scientific language, conventions, and representations is critical. Hong Kong science curriculum (Mullis, Martin, Goh, & Cotter, 2016) state that it is essential for students to become familiar with the language of science and be equipped with the skills to communicate ideas in science-related contexts. Norway's science curriculum, according to Mullis et al. (2016) emphasize the following:

> Listening and speaking in order to communicate knowledge and formulate questions, arguments, and explanations in natural science; adapting to different forms of expression, concepts, and examples to suit different objectives and recipients; progressing from simple experiences and observations to the ability to discuss progressively more complex themes, involving an increasing use of scientific concepts to express understanding, to form opinions, and to participate in academic discussions are key components in science. (p. 6)

England's science curriculum (Statutory Guidance, 2015) states that:

> The national curriculum for science reflects the importance of spoken language in pupils' development across the whole curriculum – cognitively, socially and linguistically. The quality and variety of language that pupils hear and speak are key factors in developing their scientific vocabulary and articulating scientific concepts clearly and precisely. They must be assisted in making their thinking clear, both to themselves and others, and teachers should ensure that pupils build secure foundations by using discussion to probe and remedy their misconceptions. (p. 4)

Common to various curriculum noted above point to the criticality of classroom discourse, adopting the Vygotskian sociocultural theory of learning that refers to the development of scientific knowledge and its cultural norms and tools by members of a classroom sharing knowledge. Language is at the core of a

Vygotskian sociocultural perspective, which affects individual and collective thinking. Based on Vygotsky's sociocultural perspective, science reforms promote "dialogic discourse" or "give and take" (Krajcik, Reiser, Fortus, & Sutherland, 2008). In practice, however, Mercer and Howe (2012) note that in whole-class settings, teacher-student interaction is dominated by "teacher talk"—a type of interaction in which teachers use closed questions to seek brief responses to ensure that at least some students repeat the right answers. This type of teacher-student interaction usually consists of the form "initiation-reply-evaluation" (IRE) (Mehan, 1979, p. 37), "initiation-response-feedback" (IRF) (Sinclair & Coulthard, 1975, p. 21), and "triadic dialogue" (Lemke 1990, p. 8).

Lemke (1990) argues the triadic dialogues referred to above can be beneficial for maintaining control over the direction of discussion and progression of the lesson content. However, Lemke also cautions that the overuse of triadic approaches does not provide students with opportunities to link their ideas to the course content. As well, Leshesvuori, Viiri, Rasku-Puttonen, Moate, and Helaakoski (2013) point out that the triadic approaches can create a learning environment that limits student participation, minimizes contributions, and inhibits critical reasoning because the questions posed merely elicit facts (Myhill & Dunkin, 2005) or the answer that students already know (Ahtee, Juuti, Lavonen, & Suomela, 2011). Krajcik et al. (2008) raise our awareness that the triadic forms put teachers at the center of the classroom experience while relegating students' questions and their ideas (and consequently their learning) to the background of the classroom experience. Thus, these authors recommend "give and take" discussion methods as a preferred form of classroom discourse for the development of "common knowledge"—the overlap of knowledge of the novice and expert (Author et al., Edwards & Mercer, 2013; Mercer & Howe, 2012) Common knowledge is based upon shared understanding as participants pursue common goals (Edwards & Mercer, 1987)

For common knowledge development, Eshach (2010) notes that whole-class teaching is the most common instructional approach, but the studies are few. Lehesvuori et al. (2013) recommend that to capture the essence of classroom communications between teachers and students, more micro-scale, moment-by-moment exploration is needed of classrooms in which teachers attempt to implement a standards-based curriculum. Although Polman (2004) addresses how dialogue develops between teachers and students through fine-grained analysis of transcripts, he also suggests that the way teacher-led, whole-class discussions constitute specific lesson sequence structural entities (e.g., question-types, discourse patterns, and communicative approaches) that are not fully understood. Thus, it is essential to know how the teacher in this study who most often focuses on whole-class teaching develops and establishes common knowledge on the physics concepts of *forms* and *transformation of energy* across activities through a fine-grained analysis of transcripts.

The study at hand thus focuses on a middle school science teacher, "Cathy," (pseudonym) because she received professional development on a standards-based inquiry science curriculum, namely, Investigating and Questioning our World through Science and Technology (IQWST). The IQWST curriculum for all learners specifically addresses inquiry processes that connect with technology. The IQWST curriculum builds science content and scientific practices through projects across content strands. It addresses requirements of the *National Science Education Standards* (NRC, 1996), *A Framework for k-12 Science Education* (NRC, 2012), and *The Next Generation of Science Standards (Achieve, 2013)*. More specifically, IQWST inquiries promote dialogic discourse involving event, claim, evidence, reason, and explanation, constituting argumentation. This in-depth discourse study on one teacher using the IQWST curriculum contributes to similar research with the pedagogical practice of reform-based curricula in other countries.

In her seventh-grade science classroom, Cathy uses the IQWST curriculum and the associated workbook to teach students the concepts of forms and transformation of energy and in this process helps students to identify claims and reasons for their arguments through teacher-students' classroom discourse. Cathy did not have small group peer discourse in the unit on forms and transformation of energy, although the workbook can be used in a small group setting. This study serves as a context to qualitatively analyze classroom discourse transcripts using well researched analytical tools (Mortimer & Scott, 2003) to understand the processes and mechanisms the teacher uses to create and develop common knowledge as she attempts to implement standards-based inquiry science curriculum within a sociocultural framework. This qualitative analysis provides insight into whether Cathy's classroom discourse aligns with the goals of IQWST enacted in this study. This classroom discourse study, although USA-based, is vital in an era of science education policies and reforms globally that advocate discursive interactions in science classrooms (Bansal, 2018) and professional development of teachers is happening worldwide. Montenegro (2017) supports the notion of “teaching as a discursive practice as a tool for improving teaching practices from a dialogical perspective” (p. 265).

An essential component of teacher professional development should include the study of the various roles that teachers can play when questioning for establishing dialogic interaction in argumentation (Chen, Hand, & Norton-Meier, 2017). An explicit focus on talk and discursive interaction is necessary if teachers are to understand and enact interacting moves, therefore knowledge of dialogic talk moves are critical (Edwards-Groves, 2018) This study seeks to characterize the nature of discourse between a middle school science teacher and her students by analyzing whole-class discussions between one teacher and her students. The contribution from this study to the field of science education research on classroom discourse is that it provides a glimpse of one teacher’s classroom discursive interaction in the context of world-wide reform.

Theoretical Frameworks

A Sociocultural Perspective of Learning

According to Vygotsky (1978), communication is both social and psychological that transforms students’ thinking. The social aspect develops and shares knowledge among members within a community, and the psychological part provides structure and content to the process of producing individual thoughts. The preceding statement appears construing a divide between social aspects and the psychological part of learning, but it is not. Both the social and psychological work together in developing knowledge. In line with Vygotsky, Prawat (1993) claims there is a dialectical relationship between knowledge that is constructed by reflecting (psychological) on an activity and by negotiating (discursive interaction) knowledge. This mediation of oral language is known as “dialogic discourse,” and it is consistent with teaching models that adopt the notion knowledge is co-constructed within a disciplinary sociocultural context that follows the norms and tools (Driver, Asoko, Leach, Scott, & Mortimer, 1994). In this process of knowledge construction, students are encouraged to question, evaluate, and challenge the ideas of others (Berland & McNeil, 2010). The statements of others are not merely accepted but undergo scrutiny through critical analysis, and in this process, students justify their views as well as support or refute the ideas of their peers (Mercer, 2009). Dialogic discourse aligns with the belief that the construction of knowledge through a social process fosters the development of shared experience (Edwards & Mercer, 1987).

Science Classroom Discourse

Scott et al. (2006) term the process of shaping students’ responses into scientific explanations "productive disciplinary engagement" because classroom discourse between teachers and students reflect a combination of "authoritative and dialogic interactions" (p. 606). The authors also caution that the use of teacher language in shaping students' conceptions will reveal a tension between "authoritative and dialogic interactions" (p. 606), mainly when authoritative language is used to reach scientific explanations. The use of authoritative or dialogic classroom language depends on the interactions between teachers and students through negotiating and adjusting the explanatory structure to the students' understandings. This adaptation, or shifting, between authoritative and dialogic approaches, is required to support meaningful learning that involves connections between students' evolving ideas and scientific knowledge (Scott & Ametller, 2007). Therefore, Scott et al. (2006), based on their 2003 study, provided "analytical frameworks with criteria used in identifying authoritative and dialogic communicative approaches" (p. 608). Scott et al. (2006) support dialogic inquiry in a classroom where learning is dialogically co-constructed, which characterizes the Initiation-Response-Feedback, Initiation-Response-Evaluation, and Initiation-Response-Feedback-Response-Feedback patterns of interaction, and discourse assumes various forms depending on the teaching purpose and goals of the activities. These authors have drawn attention to the tension between authoritative and dialogic approaches using the framework based on a sociocultural perspective of teaching and learning developed by Mortimer and Scott (2003). Scott et al. (2006) conclude that this framework can assist teachers in reflecting upon and developing their teaching practices in professional development sessions.

Engaging students in dialogic interactions requires teachers to be skilled in this type of instruction. It also needs teachers to possess insight and expertise in engaging students in dialogic discourse while at the same time linking communicative approaches and patterns of dialogue (Alexander, 2004; Scott & Ametller, 2007). Teaching decisions to "open up" or "close down" instruction in either a dialogic or authoritative way must take into consideration the content taught and the degree of difference between students' ideas and scientific explanations (Scott & Ametller, 2007). The insights of the studies above on classroom discourse can be translated into the implementation of Krajcik et al.'s (2008) standards-based curriculum that incorporates argumentation. This study, although with one middle school science teacher, is crucial when Krajcik's group has not yet studied the discourse that takes place in classrooms that use their curriculum while other notable work is underway (e.g., Geier, Blumenfeld, Marx, Krajcik, Fishman, Soloway, & Clay- Chambers, 2008; Krajcik, McNeill, & Reiser, 2008; Krajcik & Sutherland, 2010). The study at hand analyzes and interprets the discursive interactions that transpire as the teacher in this study develops common knowledge on the concepts of forms and transformation of energy.

International Science Classroom Discourse Studies

Analyzing discursive interactions during classroom discourse between high school students and their teachers in Brazil, Scott et al. (2006) observed that minimal shifting occurs between communicative approaches and that there was minimal dialogic teaching. Scott et al. (2006) reasoned that the problematic issues related to communicative approaches in science classrooms arise because teachers perceive their job to be providing information from a scientific perspective. Scott et al. (2006) suggested that teachers need to have insights into the everyday language conventions that students are likely to bring to their learning environment. They also pointed out that a combination of authoritative and dialogic discourse tools are particularly helpful in developing students' conceptual understanding of science concepts.

In their work on types of teacher questions and the development of argument structure during a lesson on ecology taught in a New England high school science classroom, McNeill and Pimentel (2009) indicated that more open-ended questions increased percentages of student talk, the use of evidence and reasoning to support claims, and dialogic interactions among students. McNeill and Pimentel (2009) have used a combination of Toulmin's (2003) argument pattern, a scheme for dialogic interactions, and Blosser's (1973) classification scheme for analyzing teacher questions to examine patterns of classroom discourse and the role of the teacher in promoting argumentation. Furthermore, McNeil and Pimentel (2009) argued that when questions with multiple answers are explored, interaction shifts from monologic to dialogic. The same authors emphasized that first establishing common knowledge within a monologic format and then introducing dialogic activities is key in an inquiry unit to prepare students to engage in dialogue and argumentation strategies. In this type of interaction, McNeil and Pimentel (2009) have pointed out that the emphasis should be placed on (a) teaching students social and discursive skills that lead to productive dialogue and (b) identifying effective discussion starters in the curriculum that help students make connections beyond the classroom. Because dialogic interactions among teachers and students rely on evidence and reasoning to support claims, McNeill and Pimentel (2009) have emphasized the importance of providing teacher support for students who struggle with this type of argumentation in science.

Aguiar, Mortimer, & Scott (2010) used Brazilian high school classroom episodes from different teaching sequences involving innovative teaching approaches to examine students' wonderment questions based on discourse between the teacher and students. These authors found that interactive discourse between the teacher and students influenced the teacher's explanatory structures and ongoing classroom discourse. Subsequently, Aguiar et al. have argued that there is a need for professional development that shows teachers how to deal with students' questions and how to take into account the role and purposes of all individuals during student-led argumentation and debates.

Mercer (2008) used data from a primary school in the United Kingdom to examine how the passage of time is embodied in classroom talk. He used transcribed discourse from a series of events and dialogue between a teacher and students as well as among students to discuss the processes and the challenges associated with conducting a temporal analysis. A temporal analysis describes the process by which classroom discourse is used to represent past shared experience and carry ideas forward from one occasion to another to achieve learning outcomes. Using temporal considerations of a dialogic approach, Lehesvuori et al. (2013) described a study in which high school students in central Finland experienced science lessons on the topic of energy in which the teaching sequences used by the teacher involved different communication structures that facilitated parallel visualization. A sociocultural discourse analysis was used with the teaching sequences and encompassed both historical and dynamic aspects at the episodic level of teacher-student exchanges. Conceptual change literature suggests that lessons should explore or elicit students' conceptions and address these conceptions in ways that will cause students to shift their thinking to adopt scientific explanations (e.g., Duit & Treagust, 1998; Ebenezer, J., Chacko, S., Kaya, O. N., Koya, S. K., & Ebenezer, D. L., 2010).

Within the same conceptual change inquiry lesson sequences, students might be set for argumentative discourse (Driver, Newton, & Osborne, 1994; Erduran, Simon, & Osborne, 2004). Lesson sequences that use scientific inquiry standards also advocate argumentation (NRC, 1996). One such curriculum design is the Investigating and Questioning Our World Through Science and Technology (IQWST) curriculum (Krajcik, McNeill, & Reiser, 2008). The IQWST curriculum is designed to provide teachers with tools/materials to help students learn science by engaging students in inquiry processes. These processes allow students to take an active role in their own learning and reflect on the ways in which knowledge is constructed within various scientific communities (Fogelman, McNeill, & Krajcik, 2011). Krajcik and Sutherland (2010) have proposed argumentation as an essential component of scientific discourse and of fostering inquiry in the classroom. Argumentative discourse, based on solving open-ended or ill-structured socio-scientific problems (Zeidler, Sadler, Simmons, & Howes, 2005) can also take on the character of argumentation—i.e., claim, evidence, reasoning, and explanation (McNeill & Pimentel, 2009). These authors have suggested that it is the role of the teacher through dialogic interactions to promote argumentation that employs a traditional argument structure. It is critical for teachers to provide students with opportunities to talk about science, to practice supporting their ideas with evidence, and to make arguments indicating why evidence supports one conclusion more than another (Krajcik & Sutherland, 2010).

Inquiry lessons, whether conceptual change, science, or ill-structured, provide opportunities for students to ask "wonderment questions" (Aguiar et al., 2010, p. 175), which are questions that focus on predictions, explanations, and causes. These wonderment questions are asked when students try to relate new knowledge and existing knowledge in their effort to understand science content. Wonderment questions might arise because of (a) comprehension, (b) prediction, (c) anomaly detection, (d) application, and (e) strategy planning (Chin & Brown, 2002). Based on an analysis of selected science lessons in which students posed many wonderment questions, Aquiar at al. (2010) concluded that such questions influence the teaching of explanatory structures and the development of ongoing classroom discourse. The IQWST curriculum extends student learning experiences beyond the classroom by posing driving questions in much the same way that wonderment questions situate science within issues that are of interest to students and the scientific community. Providing examples of questions and probes that help teachers foster connections between students' questions and the driving question helps teachers as well as students to establish meaningful discourse (Singer et al., 2000).

The insights of international studies on classroom discourse can be translated to the implementation of Krajcik et al.'s (2008) standards-based IQWST curriculum that incorporates dialogue into classrooms. The researchers mentioned above have provided analytical tools to characterize discursive interactions. Thus, this study analyzes and interprets the discursive interactions that transpire as the teacher in this study develops common knowledge on the topic of energy.

Research Question

The following research question guides this study:

> What is the nature of classroom discourse when one middle school science teacher teaches a class of seventh-grade students a unit on forms and transformation of energy?

The Significance of the Study

This study has world-wide significance for three primary reasons. First, understanding how the teacher in this study conducts whole-class discussions and how she develops students' conceptual understanding on the concepts of forms and transformation of energy to establish common knowledge provides insights into the nature of classroom discourse in the time of world-wide reform. Secondly, because the teacher implements a standards-based science curriculum from a sociocultural perspective of learning, it is important to know whether classroom discourse parallels the IQWST curriculum's intentions, which reflect reform-based curricula in other parts of the world. Thirdly, this study also provides a platform for global researchers on ways of developing common knowledge through classroom discourse. This platform allows teachers and administrators throughout the world to become aware of why and how such dialogue plays out in the reality of a classroom in ways that can transform teaching and learning in more meaningful ways. Finally, the study suggests the use of an analytical tool that assesses classroom discourse is highly valuable to improve teaching and learning everywhere.

Context of the Study

Research Site: The Science and Mathematics Academy

The Science and Mathematics Academy (SMA--pseudonym), a public charter school with students in grades seven and eight, is situated in the heart of a large urban city in a mid-western state. The total school population is 387, with 331 students living in a metropolitan city and 56 students living in the surrounding areas. Of the 387 students, 227 students are on free or reduced lunch. At the time the study was conducted, 161 students were in the seventh grade, which is the focus grade of this study; of these, 155 were African-American, three were Caucasian, two were Hispanic, and 1 was Arab-American. There were 94 boys and 67 girls in seventh grade.

Investigating and Questioning Our World through Science and Technology (IQWST)

At the time of this study, SMA adopted the Investigating and Questioning Our World through Science and Technology (IQWST) curriculum that promotes inquiry. The focus of this study is the Energy unit of the IQWST curriculum. The primary learning goals in the seventh-grade physics unit are to help students to understand that (a) there are different types of energy and that (b) energy can transform from one form to another. Through shared learning goals across units, inquiry processes are repeatedly revisited. The driving question in the unit is the following: “Why do some things stop while others keep going?” To answer this question, the investigations enable students to experience scientific phenomena and processes by allowing them to examine new information; ask new questions; plan experiments; and collect, analyze, and share data. The unit is divided into three learning sets. The first learning set attempts to answer the following question: “What determines how fast or high an object will go?” The first learning set is then divided into four lessons in which students investigate factors that determine the amount of kinetic energy possessed by an object and the connection between elevation and energy. The second learning set attempts to answer the following question: “Why do some things stop?” This learning set is divided into three lessons in which students investigate thermal and sound energy. The third learning set attempts to answer the following question: “Why some things keep going?” This learning set consists of four lessons, which introduce chemical, electrical, and light energy as well as how they can be converted into one another and into other types of energy. The main investigation includes falling objects, a pendulum, a bouncing ball, playground instruments, and springs. Energy conversion diagrams are introduced as a way to represent energy transformations.

Participants

The teacher for the study was selected based on her willingness to participate in the study and she was the head of the science department with the most experience with the IQWST curriculum. At the time of the study, the teacher had approximately three years of teaching experience. The teacher holds a Bachelor of Science in Elementary Education and an Associate of Arts in Liberal Arts. The teacher taught 68 students, ages 13-14, in four sections of seventh-grade science class. For this discourse study, we used one section consisting of 18 students. Ninety-six percent of the students were African-American. All participants in this study are referred to by pseudonyms.

Professional Development in IQWST

Along with her colleagues, the teacher participated in a five-day summer ~~institute~~ professional development program conducted by the University of Michigan professors and graduate students as well as a lead teacher. The professional development program included support strategies for teachers in the areas of science content, inquiry pedagogy, and contextualized learning focusing on Big Ideas using the

IQWST curriculum. The institute emphasized coherence (development of science ideas), deep and meaningful student understanding, concepts and explanations, and assessment of students. The sessions did not explicitly focus on classroom discourse because there was the assumption that teachers knew how to facilitate this type of conversation in the classroom.

Methodology

Research Design

This interpretive discourse study adopts notions advocated by Mortimer and Scott (2003). We explore in-depth teacher-students' classroom discourse in the common knowledge development of the concepts of forms and energy transformation of energy. We use an interpretive discourse analytical tool (Mortimer & Scott, 2003) that helps to explain how teachers use discourse to mediate students' conceptual understanding of science concepts. These authors also emphasize the importance of situating classroom discourse within a sociocultural perspective of learning to develop scientific knowledge, support student meaning-making, and maintain a narrative. Mortimer and Scott (2003) characterize patterns of discourse and communicative approaches in their framework that have been successfully used by Lehesvuori et al. (2011, 2013); Scott, Mortimer, and Aguiar, (2006), Viiri and Saari (2006) to enable teachers to help students construct meanings in science classrooms.

Data Collection

Federal regulations require that all research involving human participants must be reviewed and approved by an Institutional Review Board (IRB) before research activities can begin, therefore, IRB guidelines were followed and approval was granted in this study. Approval from participants and school administration was secured. The purpose of the study was shared with the teacher, students and legal guardians. The researcher observed 11 enactments of the four lessons on the concepts of forms and transformation of energy. Each lesson was 55 minutes long. The researcher used integrated circuit (IC) system and videotapes to record the large-group **whole** classroom discussion. The video recordings of teacher-students' discourse were transcribed verbatim. A sampling of student IQWST workbooks that contained activities on the forms and transformation of energy lessons were collected as evidence of the work completed in the classroom. The videotaped lessons occurred over a semester (approximately 5 months). The workbooks were sampled based students' who completed the assignment. The class consisted of 18 students. The lessons were video-recorded daily.

Data Analysis

An interpretive discourse analysis following the notions of Mortimer and Scott (2003) was used to analyze teacher-student classroom discourse transcripts that corresponded to the workbook lessons from the IQWST physics unit. The data analysis involved several steps. First, the researcher identified the details of who said what. The line-number denoted every turn of the conversation. Secondly, each discourse excerpt between the teacher and students was subjected to inductive analysis to identify the types of questions. Thirdly, Mortimer and Scott (2003) were used to determine the patterns of discourse and communicative approaches in the transcribed discourse excerpts. Mortimer and Scott's four criteria were used to discern the communicative approaches (see below). These steps yielded the characteristics of the teacher-students' classroom discourse which constitute the findings. Mortimer and Scott (2003) combined two planes, authoritative/dialogic and interactive/non-interactive, and advanced four communicative approaches:

a. Interactive/dialogic (I/D): Teacher and students consider a range of ideas. If the level of interanimation is high, they pose genuine questions as they explore and work on different points of view. If the level of interanimation is low, the different ideas are merely made available.

b. Noninteractive/dialogic (N/D): Teacher revisits and summarizes different points of view, either simply listing them (low interanimation) or exploring similarities and differences (high interanimation).

c. Interactive/authoritative (I/A): Teacher focuses on one specific point of view and leads students through a question and answer routine with the aim of establishing and consolidating that point of view.

d. Noninteractive/authoritative (N/A): Teacher presents a specific point of view.

Table 1. *Types of Teacher-Posed Questions and Examples*

Question Type	**Examples from Excerpts**
Fill-in-the-blank (cued)	"When something is moving… it has what kind of energy?" (4.1)
Affirmation	"But you started with the same size, right?" (3.7)
Second-order	"If I am changing the speed, how many things should you change in the experiment?" (2.9)
Descriptive	"How does speed affect what somebody is doing?" (2.9)
Explanatory	"Why do you think most people picked the bus as number one?" (1.4)

Reliability and Validity

Validity and reliability ensure rigor of research (Creswell & Clark, 2017). A complete, open account of the study's method and results justify the validity of this study. The judgment of credibility and trustworthiness then lies with the person reading the narrative. The validity of this research also consists of systematic data analysis, interpretation, and discussion based on Mortimer and Scott's (2003) teacher-student classroom discourse. We provide one interview excerpt as supporting empirical evidence from the data, thus ensuring validity. For member-checking, we e-mailed a draft of the entire article two times to the teacher and required her to read the data presented in the study. In establishing inter-rater reliability, we sent the research claims and the transcripts of teacher-students discussion excerpts to two researchers external to the study to check the fit. The inter-rater-rater reliability is 90% agreement.

Results and Discussion

The four activities listed in Table 1 cumulatively characterize several instances of (a) teacher posed questions, (b) teacher-initiated discourse patterns, and (c) teacher preferred communicative approaches. The data reveals four types of teacher-posed questions: (1) cued (Cue) elicitation to prompt students to provide her with correct responses, (2) second-order (SO) to elicit qualitatively different ways of student understanding, (3) descriptive (Des) to obtain information or facts, and (4) explanatory (Exp) to probe students for scientific explanations. Evidence reveals that the teacher adopted three patterns of discourse (IRE: Initiation-Response-Evaluation, IRF: Initiation-Response-Feedback, IRA—Initiation-Response-Affirmation) and combinations of the patterns; and two communicative approaches of the four communicative approaches described in the data analysis section.

Table 2. Classroom discourse on the forms and transformation of energy

Instructional Activities	**Question Types**				**Pattern Form**			**Communicative Approaches**			
	Cue	**SO**	**Des**	**Exp**	**IRE**	**IRF**	**IRA**	**N/A**	**N/D**	**I/A**	**I/D**
Linking Energy with Moving Objects		*3*		*3*						*1*	*3*
Predicting Kinetic Energy Variables	*7*	*3*	*5*	*2*		*1*	*2*			*4*	
Formulating Scientific Explanations on Kinetic Energy Variables	*15*	*9*	*4*	*3*	*3*	*1*	*1*			*2*	
Studying Forms and Transformation of Energy	*17*	*6*	*12*	*1*	*3*		*2*			*4*	
Cumulative	*39*	*21*	*21*	*9*	*6*	*2*	*5*	*0*	*0*	*11*	*3*

Note there were overlaps of questions types. There were several instances of combinations of cued and second-order questions as well as cued and descriptive questions. Combinations of discourse patterns were noted in the dialogue excerpts as follows: 1—IRIRA; 2—IRP (P stands for probe);

3 - IRElIRIRIRER; and 4--IIRRIIRIREIREERIREIRIRERA);

sItIRERIREREFIREEIRREREIRRE (s stands for student-initiated question, t stands for teacher response to student question). While the four excerpts based on all four activities were critically analyzed as represented in Table, we interpret and discuss only one teacher-students' discourse because of the importance of "scientific explanation" and the space it requires.

The students had completed Activity 2.2 (see Figure 1): Kinetic Energy Investigation. They had tabulated their data for analysis and writing their conclusions. The following example is one student's original work. The excerpt below suggests how Cathy helps students formulate scientific explanations.

[Insert Figure 1] See at the end of the paper

Excerpt 1: Teacher-Students' Dialogue Excerpt

1.1 Cathy : Let's look at this conclusion question. How does speed affect kinetic energy? (**Descriptive**) Did you guys figure out that squish is equal to kinetic energy? (**second-order**) (**Cathy starts by giving the answer to the problem)**

1.2 Darryl : Yes. (**IRE)**

1.3 Cathy : You need to write that on the top of that page. On the top of your page, write, "Squish equals kinetic energy." That's what you're measuring. So, somewhere up here, squish equals kinetic energy. As we're doing this conclusion question, you realize that what you were measuring was the amount of energy something had. We just wrote the sentence. As the speed goes up… kinetic energy does what…? **(cued)**

1.4 Darryl : Increases. (**Interactive authoritative)**

1.5 Cathy : Okay. Your evidence is, "When I increased the speed of the can, the Play-Doh squished more. Reasoning is going to be the hard piece. It always is. Talking about reasoning again. I'm going to leave this up for a few minutes. You've got to watch this demo to get it. I squished a little. I squished a lot. Which one took more energy? **(cued)** Watch again… I squish a little. I squish a lot. Which one took more energy? (**cued**) The littler one took more energy. Your reasoning is… Darryl, how could you write that so it makes sense? (**Cued Second-order)** How could you explain that so it makes sense to other people? (**Explanatory Second- order)** Squish a little and squish a lot… how could you explain that as reasoning? (**Explanatory, Cued, Second-order)** You have two things. It takes a lot to squish a lot. It takes a little to squish a little. How could that be tied into reasoning? **(Cued, second-order)**

1.6 Darryl : When you have the small clay and the big clay, it takes more to squish because the mass is smaller**. (Feedback IRF)**

1.7 Cathy : But you started with the same size, right? **(Cued, second-order)**

1.8 Carol : Yes.

1.9 Cathy : How could you tie that into reasoning of when you increased the speed of the Play-Doh, it squished more? (**Explanatory, Cued, second-order)** The reasoning is exactly what I said when I did this. The more the play dough squished, the more what does it have? (**Cued, descriptive)**

1.10 Aaron : Mass.

1.11 Cathy : **Not more mass. It's the same mass**. The more… what…? the more it squished, the more… what…? **(Cued, IREIRIRIRER, cued, descriptive)**

1.12 Chris : Kinetic energy…

1.13 Cathy : Chris, say it again, loud and proud… you were right. (**affirmative**)

1.14 Chris : Kinetic energy…

1.15 Cathy : The more kinetic energy it had. Claim, evidence, and reasoning: The claim is yeah, the speed does matter when it comes to kinetic energy… moving energy. When you increase the speed of the can, it's squished more. The more the Play-Doh squished, the more kinetic energy it had. The more I squish it with my fingers, the more energy it takes. It doesn't take a lot to just put my thumbs right in there a little bit. But to squish it takes a lot more energy. How could you answer question number two by looking at question number one? (**cued, second- order**) Read question number two to me please, Mateo.

1.16 Mateo : *How does mass affect the amount of kinetic energy?*

1.17 Cathy : Write that in the same context. Now, the question is… instead of speed, it is mass. How does mass affect kinetic energy? (**cued, descriptive**) Could you just change those words? (**cued, second-order**) How do we know that? (**cued, second-order)** It's the same reasoning?

(Classroom Video, 1-12-10)

Question Types. After students collect their data and record the data in a table in their IQWST workbooks, Cathy continues to post a question for initiating the talk. There are 31 teacher-posed questions, while there is only one student question. While teaching students the concept of reasoning within the scientific explanation triangle, Cathy uses 15 cued questions (e.g., 1.3, 1.5, 1.7, 1.9, 1.11, 1.17), nine second-order questions (e.g., 1.1, 1.5,1.7, 1.9, 1.15, 1.17), four descriptive questions (1.1, 1.9, 1.15, 1.17), and three explanatory questions (e.g., 1.5, 1.9).

Predicting Kinetic Energy Variables

Cathy guides students through an investigative activity designed to identify the factors that influence kinetic energy. The purpose of the entire investigation lesson was for students to learn that objects in motion have kinetic energy and that the amount of kinetic energy an object has is dependent on the object's mass and speed. Another purpose that directly connects to the goal of "questioning and designing investigation," which is a critical attribute of the IQWST curriculum, is to develop students' ability to recognize variables and design a fair test to isolate the effect of a single variable. Excerpt 2 reveals how Cathy develops students' understanding of kinetic energy.

Excerpt 2: Teacher-Students' Dialogue Excerpt

2.1 Cathy: Please read the purpose for this activity…

2.2 Bridget: The purpose of this activity is to determine which factors affect the amount of kinetic energy a falling object has. You will design a scientific experiment by changing one variable at a time.

2.3 Cathy: We have two findings, the independent and dependent. You are going to use Play-Doh to measure how much energy something has. How can you use Play-Doh to measure how much energy something has? I have a little, tiny piece of Play-Doh. And I have a medium-sized piece of Play-Doh. I have two pieces. If I put them in my fingertips and press—which one is going to squish first? (descriptive)

2.4 Tasha: The smaller one…

2.5 Cathy: Why? (cue,explanatory)

2.6 Tasha: It has less mass.

2.7 Cathy: If I take two cans, and this is what you're going to do… Corey, please read the instructions.

2.8 Corey: Use the table to record your data when investigating how the speed of the falling object can affect the change in thickness of the modeling clay.

2.9 Cathy: How does speed affect what somebody is doing? If I'm testing speed… and I'm going to use these two cans… To make it a fair test… this is the question… if I'm changing the speed, how many things should you change in the experiment? Listen to the question… how many things should you change in the experiment? (cue, second order)

2.10 Avery: One

2.11 Cathy: Avery said it. If I'm changing the speed, should I change anything else in the experiment? (cue)

2.12 Corey: No

2.13 Cathy: You're going to take a ball of Play-Doh. You're going to measure it to about two centimeters. You're going to take one can. You're going to put a piece of newspaper on the floor, and you're going to take your Play-Doh. You're going to take your ball of Play-Doh and put it on here. You're going to take one can and you're going to drop it onto that Play-Doh. First off, you're going to measure that Play-Doh. You're going to take a ruler and tell me how high is this Play-Doh? Right now, it's about two centimeters. You're going to take the can and drop it. You're going to measure the Play-Doh again. What do you think is going to happen when I drop it? (cue. second order, descriptive,)

2.14 Michael: It's going to get smashed.

2.15 Cathy: It's going to get squished. I dropped it. It squished. You're going to measure it again. You're going to take it and take it back to the same size. It was two centimeters before. If it was two centimeters before, how big are you going to make it again? (cue)

2.16 Michael: Two centimeters…

2.17 Cathy: Thank you! It's two centimeters again, and you're going to take the same can… instead, this time, you're going to not throw it hard enough so I have open cans of food in my room. You're going to throw it down at the Play-Doh. After you throw it, what do you think you're going to do? You're going to measure it again. From now until 10:30, you should be independently

> writing your predictions. You can actually write in your books your predictions. What do you think is going to happen with that Play-Doh when you drop it versus throwing it? What's going to happen and why? When you are finished with the predictions, go ahead and use the equipment. The great things about predictions are that you don't have to be right. (second order, descriptive, explanatory)
>
> {Classroom Video, 1-8-10}

Perhaps this is the first-time students have been asked to conduct an investigation with variables. Excerpt 2 reveals that Cathy is again following the IRE pattern of interaction (Mehan, 1979), or triadic dialogue (Lemke, 1990), by constantly asking questions to guide her instruction on scientific investigation. There are 11 teacher-posed questions and no student questions. Cathy asks four types of questions: (a) fill-in-the-blank, requiring one-word answer; (b) second-order; (c) descriptive; and (d) explanatory. Of these types of questions, there are three cue questions, requiring brief oral responses from students (2.5, 2.9, 2.11, 2.13, 2.15); four second-order questions (2.9, 2.13, 2.17); four descriptive questions (2.3, 2.13, 2.17); and two explanatory questions (2.5, 2.17).

While attempting to adopt a new way of teaching, Cathy falls into the trap of repetitive talk as a method of ensuring that students clearly understand what she is trying to teach them. Rather than probing for students' deeper understanding, Cathy continues to give long-winded instructions about what her students need to complete (2.13, 2.17). For example, immediately after asking a question, she gives specific instructions to students about how to answer that question (see 2.3). Cathy demonstrates the procedure for the students before allowing students to conduct the investigation (2.13, 2.15). For example, Cathy explains to students how to design and conduct a fair scientific test that enables them to assess the influence of one variable on another variable while all other variables are held constant (2.9). As well, Cathy wants students to understand the importance of multiple trials to establish the validity of a constant answer (2.15).

Cathy uses explanatory questioning to guide students to respond in writing (2.17). Besides questions that elicit obvious answers (2.4, 2.5, 2.10, 2.12, 2.14, 2.16), she asks "Why?..." questions (2.5, 2.17) to elicit explanations and "What do you think?" (2.17), a second-order question (Ebenezer et al., 2010), to probe their predictions.

A mixture of questioning types constitutes "authoritative" teaching that may be identified as teacher modeling, and then

Cathy allows her students to conduct the investigation as they construct meanings for themselves. This type of teaching simulates what Scott et al. (2006) have described as “productive disciplinary engagement” (p. 607) although there is much show and tell on Cathy’s part. Although Cathy uses the IQWST workbook lessons that foster classroom discourse as an essential component of inquiry through experimentation and argumentation (Krajcik & Sutherland, 2010), only a few questions are explanatory.

Studying Forms and Transformation of Energy

The lesson on energy transformation is conducted after Cathy takes her students to visit the energy exhibits at the science center. The purpose of this lesson is to explore the topic of conversions of chemical energy into other forms of energy. Cathy guides students to complete a chart that describes various forms of energy, energy conversions, and energy transfers. Students are expected to write an explanation for each conversion. During the discourse, Cathy refers to the giant engine at the science center that illustrates energy conversions, which the students observe. The giant engine is a model of a four-cylinder, four-stroke engine and demonstrates the relationships of the major parts of an engine and how they function together. There is an electric motor that keeps it going at a slow speed. Cathy makes a connection between the concept of energy transfer and conversion and the processes of the giant engine. Excerpt 4 characterizes teacher-student discourse on energy transfer.

Excerpt 3: Teacher-Students’ Dialogue Excerpt

3.1 Cathy : At the science center, they have on the top floor the pistons that move up and down, right? That’s what gasoline does with the spark plugs. It pushes your pistons up and down. When something is moving… it has what kind of energy? (cue)

3.2 Sheldon : Kinetic energy.

3.3 Cathy : Kinetic energy… So, when you start exercising, you are doing what? (cue)

3.4 Sheldon : Moving…

3.5 Cathy : Okay, as you start exercising more and more… what happens to your body, Kia?

3.6 Kia : Elastic energy.

3.7 Cathy : Some people in my first hour also had this in there… it’s not in the textbook answer. Why would you put elastic energy in there, Kia? Jalen? Think back to that reading about the human body and elastic energy. Henry, what was that connection? Jalen, you said it now. Go ahead and say it now, Jalen. (explanatory)

3.8 Jalen : Your muscles and things in your body are stretching out.

3.9 Cathy : Okay. So your muscles and things in your body are stretching out. I would take either one of those. The third one was the quartz watch. This chemical energy—and this is a tricky one—the chemical energy that's in the battery turns into… what? What do batteries provide? (cue

3.10 Jalen : Energy.

3.11 Anthony : Heat.

3.12 Cathy : Some batteries provide heat, but what type of energy? We haven't talked about this one yet, which is why it's tricky. What kind of energy do batteries provide? (cue

3.13 Darryl : Electric.

3.14 Cathy : So they don't provide sound. They provide…? (cue)

3.15 Darryl : Electric.

3.16 Cathy : Electric energy. When you have a battery… if I were to take a plug and plug it into the wall and not use a battery, what kind of energy am I getting? (cue)

3.17 Mark : Electric energy.

3.18 Cathy : I'm getting electric energy. Just like the battery provides the same type of energy, electric energy, right?

3.19 Mark : Electrical energy.

3.20 Cathy : What does that electrical energy turn into? (cue)

3.21 Tracy : Thermal energy.

3.22 Cathy : It doesn't turn into thermal. So what is it? (cue)

3.23 Tracy : Kinetic energy.

3.24 Cathy : What happens on the watch when the electricity hits the dials on the watch? (descriptive

3.25 Amber : It turns to kinetic energy.

3.26 Cathy : Okay. It turns into kinetic energy. If you said, sound, I would take sound energy. Because sometimes you can hear… like if you put your hand up and you can hear a tick, tick on that type of watch.

3.27 Bridget : Electrical.

3.28 Cathy : Good point! Yep. Electrical… elastic…

3.29 Robert : What's sound energy?

3.30 Cathy : Sound, fireworks… we've talked about fireworks a lot. What do you think is one type of energy that's in there? Jalen? (second order)

3.31 Jalen : Kinetic energy.

3.32 Cathy : There is kinetic energy.

3.33 Bridget : Thermal.

3.34 Cathy : There's definitely also thermal. What comes at the very end of the fireworks? (cue)

3.35 Tasha : Gravitational.

3.36 Cathy : Not gravitational.

3.37 Avery : Chemical.

3.38 Cathy : Not chemical… chemical is in the beginning. There's sound energy. And there's another type of energy that we haven't talked about. How do you know that a firework has been lit?

3.39 Aaron : Smell.

3.40 Cathy : It's not smell. It's not heat. What do you see? (descriptive)

3.41 Michael : Colors.

3.42 Darryl : Light energy…

3.43 Cathy : There is also light energy.

{Video of Classroom Discourse, 3-22-10}

The exchange between Cathy and her students as revealed in Excerpt 3 is a classic example of IRE (3.38-3.43). For example, Cathy is looking for another form of energy in the students' responses and provides clues when the students do not respond as expected. Four major points are evident in the dialogue represented in Excerpt 3: teacher-posed questions, teacher-explanations, teacher responses, and teacher references to past learning.

There are 18 teacher-posed questions, while there is only one student question. Cathy asks five types of questions: (a) 12 cue questions (3.1, 3.3, 3.9, 3.12, 3.14, 3.16, 3.20, 3.22, 3.34), (b) one second-order question (3.30), (c) two descriptive questions (3.24, 3.40), and (d) one explanatory question (3.7). For example, Cathy reminds her students about an exhibit with pistons and elicits their response about the type of energy that is involved when something is "moving," which requires a fill-in-the-blank response (3.1). Cathy affirms the correct answer from Mark as he moves away from the idea that the battery has chemical energy and focuses on the idea that batteries provide electrical energy (3.18). The second-order questions reveal the following: After talking about chemical energy, electrical energy, kinetic energy, and sound energy, Cathy wants to know whether

Jalen will be able to identify the form of energy with respect to the watch (3.30). As a descriptive question, Cathy asks, “What happens on the watch when the electricity hits the dials on the watch?” But students respond with very few words. There is one explanatory or “Why?...” question (3.7). Cathy prompts Jalen to provide an explanation by thinking back to the reading about the human-body and elastic energy.

Other behaviors are obvious in Cathy’s classroom. Cathy provides positive responses when her students are correct (3.32, 3.34) and negative responses when they are incorrect, followed by additional prompts and questions to advance their thinking (3.38). For example, Cathy confirms Jalen’s and Bridget’s responses regarding the forms of energy, kinetic and thermal energy, respectively, while continuing to probe for the correct answer. During the discussion about the fireworks, Cathy is looking for another form of energy in the students’ responses because she says “no” to chemical energy although she acknowledges that there is chemical energy in the fireworks.

Cathy references past learning in the context of student experiences at the science center and in the classroom (3.1, 3.7, 3.12, 3.30, 3.38). For example, Cathy prolongs the conversation until the right answer comes forth based on a previous discussion. Later, Cathy does not give Robert a direct answer but uses fireworks as an example of sound energy that was discussed in a previous lesson. She provides a clue to students by asking the following question: “How do you know that a firework has been lit?” Research by Mercer, Dawes, and Staarman (2009) supports Cathy’s attempts to link prior learning to the present. These authors have suggested that this connection provides a way of understanding how participants draw on past text and/or practices to construct present texts and/or implicate future ones; however, Lehesvuori et al. (2013) have acknowledged that developing common knowledge through joint construction or in a meaningful manner takes time.

Cathy’s classroom discourse is akin to Mercer and Howe’s (2012) observation of whole-class settings in which teacher-student interactions are dominated by teacher talk and in which teachers use closed questions simply to seek brief responses in order to ensure that at least some students repeat the right answers. Teachers therefore need to apply less authoritative and more dialogic dialogue to help students construct their own knowledge--in this case, knowledge about the concept of energy. Thus, the predominant fill-in-the-blank-type questions should be sparse and be replaced with questions that encourage students to put main ideas into their own words and press students to elaborate on these ideas. For example, asking, “How did you know that?”

or "Why do you think that?" develops students' understanding (Wolf, Crosson, & Resnick, 2006). The art of questioning is important in developing students' knowledge and understanding of scientific concepts.

Cathy moves her lesson forward with continued questioning. Mercer (1992) argues for the necessity of constant questioning for teachers to monitor students' learning and make their teaching as effective as possible. But the type of question asked counts depending on the purpose of the lesson. Cathy cues her students so that they might come up with the right answers (e.g., 9-10). According to Mercer and Edward (1987, p. 142), the use of cued elicitation to create "common knowledge" is a prevalent practice among teachers, but used more than necessary is a problem. A second-order question such as "How could you explain that so it makes sense to other people?" (5) can guide students' learning and their use of language as a tool for reasoning (Mercer & Howe, 2012) and promote productive discussions (Michaels & O'Connor, 2012). Unlike second-order questions, a descriptive question such as "How does mass affect kinetic energy?" (17) asks for facts of a phenomenon and not its meaning.

Although Cathy uses the IQWST workbook lessons that foster classroom discourse as an essential component of inquiry through experimentation and argumentation (Krajcik & Sutherland, 2010), only a few questions are of the explanatory-type. Asking why questions and ways of explaining by students can involve and promote dialogic interactions between a teacher and students (Scott et al., 2006). Teachers often link prior learning to the present for an explanation that provides a way of understanding how participants draw on past text and practices to construct contemporary books and implicate future ones (Mercer, Dawes, & Staarman, 2009).

Discourse Patterns. Cathy uses IRE, IRF, IRA, and IRElIRIRIRER patterns as she directs her students to formulate scientific explanations by triangulating claims, evidence, and reasoning based on the conclusion question (1) and the IQWST standards. When students mistakenly answer (7, 9), Cathy points out that it is not the constant variable (mass). Cathy keeps probing until she gets the correct answer or the answer she is looking for (e.g., 11). She even goes as far as providing students with the majority of the answers, only allowing for a one-word response (7-10). In other words, Cathy probes until she receives the correct response (11-14). The IRE triad is evident in her evaluative feedback to the students. There is one IRF discourse pattern (5-7). There are two IRA discourse patterns (11-13) in which the teacher states, "Chris, say it again, loud and proud… you were right.” There is also a discourse chain indicating IRElIRIRIRER (11).

At times, Cathy asks questions that challenge more than one student to answer. However, the discourse chain should be a bit longer with more R (student response) links, which would give more students the opportunity to offer their explanations. Rather, Cathy’s discourse with students reflects repeating and rephrasing. She neither expands upon students’ contributions nor allows them to elaborate their answers (Lemke, 1990). To achieve her desired goal, Cathy, like most teachers, maintains control of the content, interactions, and discussion (Edwards & Furlong, 1978; Mishler, 1975). In this control process, Cathy assumes the role of the knower, initiator, and approver of knowledge (Shepard, 2010). Even in long dialogue sequences focusing on a single idea as exemplified in excerpts two and three, the initiation-reply-evaluation pattern dominates (Mehan, 1979).

Communicative Approaches. Cathy repeatedly makes the cultural tools of science available to her students and supports their construction of the ideas through discourse about shared physical events (1.5, 1.9, 1.15, 1.17). However, her communicative approach is interactive/authoritative according to two sequences of talk (1.5, 1.15). She also comes to closure rather quickly when she hears the correct scientific response she wants to hear. This sort of premature closure to the discussion suggests that Cathy carries out a question-answer routine aiming at a specific answer and when it surfaces she establishes it. Mortimer and Scott (2003) classify this closure as interactive/authoritative, and this sort of communicative approach abounds in Cathy’s lessons.

Activity three as shown in the Table 2 could have set the stage for argumentative discourse (Driver et al., 1994) and the ability to solve open-ended problems through argumentation--e.g., claim, evidence, reasoning, and explanation (McNeill & Pimentel, 2009). Classroom discourse in the context of scientific inquiry depends on the use of data as evidence for explanation and argumentation (Krajcik & Sutherland, 2000). The preferred form of classroom discourse in the IQWST curriculum is a give-and-take exchange of ideas in which classroom discussion is centered on engagement and thoughtfulness (Krajcik et al., 2008). Although Cathy makes some attempt to engage her students in classroom discourse using the give-and-take strategies and pursues lines of questioning by probing her students to discuss their reasoning, she continues to use closed questions that lead to brief, accurate responses from a few students. In some instances, Cathy demonstrates discourse that leads to scientific explanation (e.g., 1.5-1.6), but she heavily cues students to the point that she elicits one-word, correct answers from them (e.g., 1.9-1.12).

According to Kyriacou and Issitt (2008), good learning results when teachers use questions not only to seek right answers but also to elicit reasons and explanations. As seen in 1.5, asking students specifically to provide their evidence and reasoning encourages students to justify their responses and make their thinking visible to the teacher and their peers in the classroom (McNeill & Krajcik, 2012). However, while Cathy attempts to triangulate the scientific explanation with a claim, evidence, and reason, the teacher-student interactions tend to be dominated by the interactive / authoritative communicative approach in which she uses "closed" questions to seek brief, accurate, confirmation answers (Mercer & Howe, 2012). The educative components of the IQWST curriculum include example questions and probes to help teachers understand ways of fostering connections between student wonderment questions and the driving question of the lesson (Singer, Marx, Krajcik, Clay, & Chambers, 2000). These authors advocate the need and importance for teachers to elaborate and reformulate the contributions made to classroom dialogue by students as a way of clarifying earlier statements for the benefit of others and like Mercer (2008) puts it to make connections between the content of students' utterances and the technical terminology of the curriculum.

Implication

Cathy struggles to implement the ideas she had learned during the IQWST professional development, and although she reverts, her attempt to carry out interactive discourse with students by asking questions is commendable. Teachers like Cathy should be encouraged to use "interactive/dialogic communicative approach (Mortimer & Scott, 2003) to check for student conceptual understanding (Alexander, 2004). Lehesvuori et al. (2013) acknowledge that developing common knowledge through joint construction in a meaningful manner takes experience and time. In this sense, teachers need to supplant authoritative with more dialogic interaction to help students construct their knowledge (Aguiar, Mortimer, & Scott, 2010; Mercer & Howe, 2012). The predominant cued questions should be sparse and replaced with questions that encourage students to put main ideas into their own words and press students to elaborate on these ideas. Asking, "How did you know that?" or "Why do you think that?" develops students' understanding (Wolf, Crosson, & Resnick, 2006).

The results of this discourse study reflect only a fraction of a sociocultural perspective of learning advocated by discourse researchers. The reasons might be because professional development is just one week-long and it may not have included the art of dialogic communication. As well, it is Cathy's first attempt at implementing the IQWST curriculum with its discourse practice. One way of improving the IQWST professional development program is to develop teacher training videos that embed different possible branch points in a classroom discourse that might be very useful in the type of communication it aspires in its teachers. This video approach might provide more insights into the classroom communication for implementing standards-based curriculum such as the IQWST.

Even though Cathy participated in professional development focused on how to implement the unit on energy and attempted to engage her students in interactive discourse, this study revealed the need to provide additional professional development on how to develop student understanding and common knowledge using dialogic discourse. It is useful both for teachers and administrators to understand the various classroom discourse tools and how they should be used to develop common knowledge and conceptual understanding of difficult-to-learn science concepts, such as forms and transformation of energy. The tools provided in professional development should include learning how to achieve more in-depth knowledge of the essence of classroom communications through micro-scale, moment-by-moment exploration with teachers (Lehesvuori et al., 2013). Because whole-class instruction is the most common instructional approach (Eshach, 2010), especially in urban classrooms, these tools should encompass strategies to help teachers navigate, mediate, and co-construct knowledge with their students. Professional developers and mentors themselves should use dialogic discourse as they attempt to move teachers toward various discourse patterns and when to use them. It is essential to understand that learning mediated through dialogue happened over time and observed over time with the goal of conceptualizing the interactive cognitive development and education of the teacher (Mercer, 2008).

Administrators and researchers who observe the implementation of science lessons from a sociocultural perspective should be intellectually empathetic as teachers struggle to move towards dialogic discourse because it takes time to develop proper language use. As well, being empathetic with the time needed to create dialogic discourse, teachers who are willing and genuinely trying to implement dialogic discourse need to be supported, monitored in their use of this type of communicative approach, and not left to their discretion during implementation. Follow up from colleagues, administrators, and researchers regarding how teachers are progressing over a specific period should be consistent and a part of job-embedded professional development to ensure that teachers are implementing dialogic discourse where appropriate, particularly as the Next Generation Science Standards (Achieve, 2013) and other reforms are taking root.

References :

Achieve (2013). *Next generation science standards*. Washington, DC: The National Academies Press.

Aguiar, O. G., Mortimer, E. F., & Scott, P. (2010). Learning from and responding to students' questions: The authoritative and dialogic tension. *Journal of Research in Science Teaching*, *47*(2), 174-193.

Ahtee, M., Juuti, K. Lavonen, J. & Suomela, L. (2011) Questions asked by primary student teachers about observations of a science emonstration, *European Journal of Teacher Education* 34:3, 347-361, DOI: 10.1080/02619768.2011.565742

Alexander, R. J. (2004). Still no pedagogy? Principle, pragmatism and compliance in primary education. *Cambridge Journal of Education*, *34*(1), 7-33.

Alexander, R. J. (2006, 3rd Ed.). *Towards dialogic teaching: Rethinking classroom talk*. University of Cambridge: Dialogos.

Bansal, G. (2018). Teacher discursive moves: conceptualizing a schema of dialogic discourse in science classrooms. *International Journal of Science Education, 40 (15),* 1891-1912.

Berland, L. K., & McNeill, K. L. (2010). A learning progression for scientific argumentation: Understanding student work and designing supportive instructional contexts. *Science Education*, *94*(5), 765.

Chen, YC., Hand, B. & Norton-Meier, L. Res Sci Educ (2017). Teacher Roles of Questioning in Early Elementary Science Classrooms: A Framework Promoting Student Cognitive Complexities in Argumentation **47: 373 https://doi.org/10.1007/s11165-015-9506-6**

Chin, C., & Brown, D. E. (2002). Student-generated questions: A meaningful aspect of learning in science. *International Journal of Science Education*, *24*(5), 521-549.

Creswell, J. W., & Plano Clark. V. L. (2017 3rd. Ed.). *Designing and conducting mixed methods research*. California: Sage Publications, Inc.

Driver, R., Asoko, H., Leach, J., Scott, P., & Mortimer, E. (1994). Constructing scientific knowledge in the classroom. *Educational Researcher*, *23*(7), 5-12.

Duit, R., & Treagust, D. F. (1998). 1.1 Learning in Science-From Behaviourism Towards Social Constructivism and Beyond.

Ebenezer, J., Chacko, S., Kaya, O. N., Koya, S. K., & Ebenezer, D. L. (2010). The effects of common knowledge construction model sequence of lessons on science achievement and relational conceptual change. *Journal of Research in Science Teaching*, *47*(1), 25-46.

Erduran, S., Simon, S., & Osborne, J. (2004). TAPping into argumentation: Developments in theapplication of Toulmin's argument pattern for studying science discourse. *Science education*, *88*(6), 915-933.

Edwards, A. D., & Furlong, V. J. (1978). *The language of teaching: Meaning in classroom interaction*. Heinemann Educational Books.

Edwards, D., & Mercer, N. (2013). *Common Knowledge*: *The development of understanding in the classroom*. New York, NY: Routledge Revivals. Routledge Taylor & Francis Group.

Edwards, D., & Mercer, N. (1987c). *Common Knowledge (Routledge Revivals): The Development of Understanding in the Classroom*. Routledge.

Eshach, H. (2010). An analysis of conceptual flow patterns and structures in the physics classroom. *International Journal of Science Education*, *32*(4), 451-477.

Fogleman, J., McNeill, K. L., & Krajcik, J. (2011). Examining the effect of teachers' adaptations of a middle school science inquiry-oriented curriculum unit on student learning. *Journal of Research in Science Teaching*, *48*(2), 149-169.

Gay, A. & Duzor, V. (2012) Evidence that Teacher Interactions with Pedagogical Contexts Facilitate Chemistry-Content Learning in K-8 Professional Development, Journal of Science Teacher Education, 23:5, 481-502, DOI: 10.1007/s10972-012-9290-3

Geier, R., Blumenfeld, P. C., Marx, R. W., Krajcik, J. S., Fishman, B., Soloway, E., & Clay- Chambers, J. (2008). Standardized test outcomes for students engaged in inquiry- based science curricula in the context of urban reform. *Journal of Research in Science Teaching*, *45*(8), 922-939.

Huang, Y. & Asghar, A. (2016). Science education reform in Confucian learning cultures: policymakers' perspectives on policy and practice in Taiwan. *Asian-Pacific Science Education.* 3.

Kyriacou, C., & Issitt, J. (2008). What characterizes effective teacher-pupil dialogue to promote conceptual understanding in mathematics lessons in England in Key Stages 2 and 3. *EPPI-centre report no. 1604R.*

Krajcik, J., Czerniak, C., & Berger, C. (2002). *Teaching science in elementary and middle school classrooms: A* *project based approach*. (2nd Ed.) Boston, MA: McGraw-Hill.

Krajcik, J., McNeill, K. L., & Reiser, B. J. (2008). Learning- goals- driven design model: Developing curriculum materials that align with national standards and incorporate project - based pedagogy. *Science Education*, *92*(1), 1-32.

Krajcik, J., Reiser, B. J., Fortus, D., & Sutherland, L. (2008). *Investigating and questioning our world through science and technology*. Ann Arbor, MI: Regents of the University of Michigan.

Krajcik, J. S., & Sutherland, L. M. (2010). Supporting students in developing literacy in science. *Science*, *328*(5977), 456-459.

Lai, C., Li, Z. & Gong, Y. (2016). Teacher agency and professional learning in cross-cultural teaching contexts: accounts of Chinese teachers from international schools in Hong Kong. *Teacher and Teacher Education*, Vol. 54, 12-21.

Lehesvuori, S., Viiri, J., & Rasku-Puttonen, H. (2011). Introducing dialogic teaching to science student teachers. *Journal of Science Teacher Education*, *22*(8), 705-727.

Lehesvuori, S., Viiri, J., Rasku- Puttonen, H., Moate, J., & Helaakoski, J. (2013). Visualizing communication structures in science classrooms: Tracing cumulativity in teacher- led whole class discussions. *Journal of Research in Science Teaching*, *50*(8), 912-939.

Lemke, J. L. (1990). *Talking science: Language, learning, and values*. Norwood, NJ: Ablex Publishing Corporation.

McNeill, K. L., & Pimentel, D. S. (2010). Scientific discourse in three urban classrooms: The role of the teacher in engaging high school students in argumentation. *Science Education*, *94*(2), 203-229.

Mehan, H. (1979). *Learning lessons: Social organization in the classroom*. Cambridge, MA: Harvard University Press.

Mercer, N. (2000). *Words and minds: How we use language to think together*. New York, NY: Routledge, Imprint of Taylor & Francis Group.

Mercer, N. (2008). Talk and the development of reasoning and understanding. *Human development*, *51*(1), 90-100.

Mercer, N. (2009). Developing argumentation: Lessons learned in the primary school. In Argumentation and education. In N. M. Mirza & A. N. Perret-Clermont (Eds.), *Argumentation* and *education* (pp . 177–194). Dordrecht, Netherlands: Springer.

Mercer, N., Dawes, L., & Staarman, J. K. (2009). Dialogic teaching in the primary science classroom. *Language and Education*, *23*(4), 353-369.

Mercer, N., & Howe, C. (2012). Explaining the dialogic processes of teaching and learning: The value and potential of sociocultural theory. *Learning, Culture and Social Interaction*, *1*(1), 12-21.

Michaels, S., & O'Connor, C. (2012). Talk science primer. *Cambridge, MA: TERC*.

Mishler, E. G. (1975). Studies in dialogue and discourse: II. Types of discourse initiated by and sustained through questioning. *Journal of Psycholinguistic Research*, *4*(2), 99-121.

Montenegro, H. (2017). *Teaching as a discoursive practice: new perspectives for teacher education.* Spain: Ediciones Universidad de Salamanca.

Mortimer, E., & Scott, P. (2000). Analysing discourse in the science classroom. In, R. Millar, J. Leach and J. Osborne (Eds.), *Improving science education*: *The contribution* of *research*, pp.126–142. Buckingham: Open University Press.

Mortimer, E., & Scott, P. (2003). *Meaning making in secondary science classrooms*. Maidenhead: McGraw-Hill International.

Myhill, D., & Dunkin, F. (2005). Questioning learning. *Language and Education*, *19*, 415-427.

National Research Council. (2012). *A framework for K-12 science education*. Board on Science Education, Division of Behavioral and Social Sciences and Education. Washington, DC: National Academies Press.

National Research Council. (1996). *National Science Education Standards*. Washington, DC: National Academies Press.

Polman, J. L. (2004). Dialogic activity structures for project-based learning environments. Cognition and Instruction, *22*(4), 431-466.

Prawat, R. S. (1993). The value of ideas: Problems versus possibilities in learning. *Educational Researcher*, *22*(6), 5-16.

Scott, P., & Ametller, J. (2007). Teaching science in a meaningful way: striking a balance between 'opening up'and 'closing down' classroom talk. *School science review*, *88*(324), 77.

Scott, P. H., Mortimer, E. F., & Aguiar, O. G. (2006). The tension between authoritative and dialogic discourse: A fundamental characteristic of meaning making interactions in high school science lessons. *Science Education*, *90*(4), 605-631.

Shwartz, Y., Weizman, A., Fortus, D., Krajcik, J., & Reiser, B. (2008). The IQWST experience: Using coherence as a design principle for a middle school science curriculum. *The Elementary School Journal*, *109*(2), 199-219.

Sinclair, J. M., & Coulthard, M. (1975). Towards an analysis of discourse: The English used by teachers and pupils. Oxford: Oxford University Press.

Singer, J., Marx, R. W., Krajcik, J., & Clay Chambers, J. (2000). Constructing extended inquiry projects: Curriculum materials for science education reform. *Educational Psychologist*, *35*(3), 165-178.

Toulmin's (2003

Viiri, J., & Saari, H. (2006). Teacher talk patterns in science lessons. Use in teacher education. Journal of Science Teacher Education, *17*, 347-365.

Vygotsky, L. S. (1978). *Mind and society: The development of higher mental processes*.

White, R., & Gunstone, R. F. (2008). The conceptual change approach and the teaching of science. In S. Vosniadou (Ed.), *International Handbook of Research on Conceptual Change* (pp. 619 - 628). New York: Routledge.

Wolf, M. K., Crosson, A. C., & Resnick, L. B. (2006). *Accountable talk* in *reading comprehension instruction* (CSE Technical Report 670). Los Angeles : National Center for Research on Evaluation, Standards, and Student Testing (CRESST).

Zeidler, D. L., Sadler, T. D., Simmons, M. L., & Howes, E. V. (2005). Beyond STS: A research- based framework for socioscientific issues education. *Science Education*, *89*(3), 357-377.