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Identification of Misconceptions Related to Astronomical Beliefs at Primary Stage and Intervention Strategies
- A March Towards School Effectiveness

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1. INTRODUCTION :

Inspite of the fact that curriculum at the primary level has to be contextual, some amount of regimentation still persists in its core frame work. Astronomy is viewed as an important and essential part of this core component of any primary science curriculum (sharp. 1996). In the above perspective, concepts of astronomical objects and astronomical events are taught at the primary stage. Analysis of primary curriculum and text books reveals that in India, the pupils at primary stage are exposed to such concepts in astronomy as Earth, Sun, Moon and Stars. The children have a natural tendency to observe the sky and not only wonder about it but also construct concepts about these concepts. This self conceptualization of the concepts may act as a "critical barrier" (Hawkins, 1978) for what he/she reads from the text books or learns in the class room. This "critical barrier may lead to misconceptualization. Studies do indicate several of these misconceptions of the children (Nussbaum & Novak, 1976; Mati & Howe, 1979; Vosnidou & Brewer, 1990, 1992). Let us consider a very simple example — A child on observing the night sky sees the stars to be very small compared to the moon. However in the class the teacher tells that the stars are very large compared to the moon. This initiates a cognitive conflict. A child wonders which one is true ? To overcome this dilemma which leads the child to misconception, two possible ways may be suggested

- To help the pupil, the teacher has to find out some teaching strategies centered around child's experiences.

- The text books may be written as a self learning material with all possible explanations, focussed on contextualities.

The purpose of the present study is based on the basic problem.

- How to identity the misconceptions.

- How to design/formulate strategies to overcome misconceptions, there by improving the achievement level of the pupils which will enhance the school effectiveness.

The conceptual model of the work is given in Fig.1

Space for Fig. 1

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2. OBJECTIVES :

- To design a diagnostic tool for identification of misconceptions related to astronomical concepts.

- To prepare teaching strategies for remedial teaching in the intervention areas and to see the effect of remedial teaching.

- To identify misconceptions of the prospective teachers about astronomical concepts basing on which training programmes and text book preparation may be suggested.

3. METHODOLOGY :

3.1. Sample :

The sample for the present study consists of 129 pupils at primary stage reading in D.M. School Bubaneswar and 22 prospective teachers from RIE, Bhubaneswar. Table.1 presents demographics of the sample.

> Space for Table I.

For knowing the effect of remedial teaching class-V pupils were considered. Due to absentism, those who were present during administration of tests and under gone remedial teaching were considered for the study. The BSc, BEd IV year students i.e. the prospective teachers were taken as the sample because

- Of the availability of a such a sample of prospective science teachers.

- They had already completed a six weeks practice teaching in schools and ,

- in few months time they will be ready to take up teaching jobs.

3.2. TOOLS :

Before preparing the tool to know the ground realities, a personal interview of 20 pupils reading in class IV and V were conducted. The pupils were selected randomly, ten from each class reading in DM School, Bhubaneswar. The personal interview gave a clear picture of their conceptualization about astronomical beliefs. MLL curriculum along with science text books published by NCERT were analysed to know the astronomical concepts the pupils of primary

class reading in class IV and V are supposed to know. MLL curriculum was taken for analysis because this curriculum is followed in D.M. Schools. Basing on the responses and curriculum analysis a pencil-on-paper test was designed. The tool was reviewed and refined by a group of experts so as to maximise its context validity. The reliability of the tool was assessed by using the split-half technique. The reliability coefficient was obtained to be .86 and can be graded as highly reliable.

The tool consists of ten items. The item No.1,2,3,5,6,7 are with pictorial presentation and the rest are without pictures. The questions are related to - (1) Shape of Earth (2) Position of people on the Earth (3) Relative size of Moon Earth, Sun and Stars (4) What is sky (5) Position of clouds above Earth surface (6) Shape of Sun (7) Shape of stars (8) Cause of day and night (9) Natural sattelite of Earth (10) Shape of Moon.

As an example let us consider question number 2 of the tool.
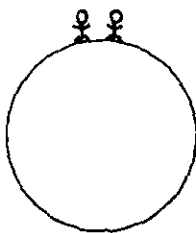
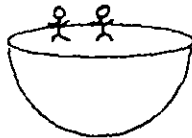Question : On which portion of the Earth people live.
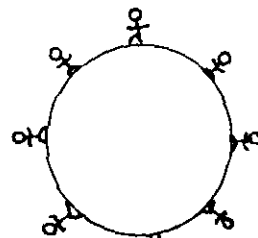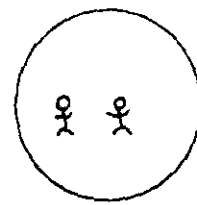

Fig 1.   Fig. 2.   Fig. 3.   Fig. 4.

(a)   people live on the north pole of the Earth as shown in Fig.1   ☐

(b)   People live on a flat upper surface of the lower hemisphere as   ☐
       shown in Fig.2.

(c)   People live on the surface of the Earth as shown in Fig.3   ☐

(d)   People live inside the Earth as shown in Fig.4.   ☐

The pupils are supposed to give a tick mark in the box for the right answer.

3.3.   ADMINISTRATION :

The developed tool was administred on the whole sample. The maximum time allowed to complete the test was 35 minutes.

3.3.1. INTERVENTION :

The data was analysed to see the misconceptions. Basing on the result, a remedial teaching lesson was prepared. Class V pupils were taken for remedial teaching. An activity based child centered teaching strategy was adopted so as to stimulate the thought process of the child and enable the child to seek and discover knowledge. For this purpose, a model containing Earth. Moon and Sun was used. The following concepts were demonstrated.

- Shape of Earth

- Shape of Sun

- Shape of Moon.

- Rotation and revoltion of Earth and Moon

- How day and night occur.

- What are the position of people and clouds on Earth.

- Relative size of Sun, Moon and Earth.

- Appearance of changing shapes of Moon.

The following concepts were explained using diagrams.

- The diagram for star, sun given in the books and the real shapes.

Only explanation were given for the following :

- What is sky

- Why stars appear so small

- Man made satellites and natural satellites.

A time gap of fifteen days was allowed between the remedial teaching and administration of the post test.

During the remedial teaching, the pupils were enthusiastic and interacted with the test administrator freely. During the interaction the following interesting questions were put by the students.

- Sun and Moon exhibit rotational motion like Earth or not ?

- If Sun will die what will happen ?

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- Why we are not falling from earth surface ? If we fall where will we go ?

- What is horizon ?

- What makes the Sun glow ?

- What is a rainbow and how it is formed ?

- What will happen if Earth will not have gravitation ?

All these questions were properly explained and discussed.

3.4.   ANALYSIS :

Class wise the mean score(M) and standard deviation are tabulated in table.2 for the whole sample. For Class-V the mean score and stand deviation before and after remedial teaching are tabulated in table.3. The percentage of correct response questionwise for different classes is given in table.4 and using the data of table.4 the percentage of correct response question wise is depicted in fig.2. Table.5 represents the percentage of correct response of class-V pupils before and after remedial teaching. The same data is depicted in fig.3.

Space for Table 2,3,4 & 5

Space for Fig. 2 & Fig. 3

Form table.2 it is clear that mean score of the pupils increases with increase in chronological age. It also can be concluded from table.2 that prospective teachers also have misconceptions as the mean score is only 6.36 out of ten. An interview was conducted to assess the poor performance. The prospective teachers were of the opinion that neither these concepts are written clearly in the text books nor the teacher had given an adequate explanation. Misconception like stars have five pointed projection like a star fish prevails with the BSc. BEd. students. 30% of the BSc. BEd students have the idea that moon is not having a definite shape. Table 3 depicts that mean score increase considerably after remedial teaching. From table.4 and Fig.2 it can be concluded that for question number 6 & 7 i.e. about the shape of sun and star maximum number of pupils have misconception. For question No.6, 73% and for question No.7, 68% of the BSc. BEd./students have the misconception. The symbol or the diagrams used in the text books to represent sun and stars are thought to be the real shapes. Maximum number of correct responses are noted for question no.9 which is a knowledge based one. To know the

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effect of remedial teaching the 't' value was calculated. The t value is 3.70 which is significant at .01 level. The high 't' value predicts that the remedial teaching has tremendous effect on the achievement level of the pupils.

3.5. Major out comes :

- Pupils at primary stage have misconceptualization of astronomical concepts.

- Teachers have misconceptions related to astronomy.

- By following innovative remedial teaching stategies in the intervention area, the achievement level can be enhanced.

3.6. Suggestions for school effectiveness :

The necessity of appropriate text books are very high. The teachers have a marked tendency to relay on textbooks hence books should contain pictorial presentation along with tips to demonstrate specific concept in a class room situation. Pictorial presentations for the following may be given in the text books

- Exact shape of Earth, Sun, Moon and Stars

- Position of the people on a model of Earth.

- Relative size of different astronomical objects.

- position of clouds above the Earth surface.

For demonstration of astronomical events models may be prepared. It is pointed out by Evans (1996) that teachers are untrained and ill prepared to meet their responsibilities. In this perspective the teachers may receive proper training to demonstrate and present the facts clearly. Peterson (1993) emphasises that teachers should know their students prior knowledge and levels of understanding in order to improve pupils achievement. In this perspective the misconceptions of the pupils may be identified and the teacher by knowing the pupils misconceptions may follow innovative teaching strategies to ensure effective teaching - learning process leading to quality improvement of primary education.

3.7. Potential area of research

- In the present investigation the misconceptions related to astronomical concepts are considered. Similarly studies on other concepts can be carried out taking large sample.

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- Designing of remedial teaching in the intervention areas to help the teachers.

- Designing of self learning materials to encourage child centered learning.

- Cross-cultural study may be undertaken to know the astronomical concepts among the pupils.

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3.   Mali, G.B. and Howe, A. (1979) Development of Earth and gravity concepts among Nepali children. Science Education, 63(5), 685-691.

4.   Nussbaum, J. and Novak, J. D (1976). An assessment of children's concepts of the Earth utilizing structured interview. Science Education, 60(4), 535-550.

5.   Peterson, P.L.(1993). Towards an understanding of what we know about school learning Review of Educational Research Vol, 63, No.3, pp. .319 - 326.

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TABLE - 1 : DEMOGRAPHICS OF THE SUBJECTS :

Sl. No.	School/Institution Name	Class	Boys	Girls	Total
1.	D.M.School	IVA	24	10	34
2.	D.M.School	IVB	22	10	32
3.	D.M.School	VA	22	11	33
4.	D.M.School	VB	20	10	30
5.	RIE	BSc. BEd IV year	10	12	22

TABLE -2 :   MEAN SCORE AND STANDARD DEVIATIONS CLASS WISE :

Sl.No.	Class	Mean Score	Standard deviation
1.	IV	2.939	1.487
2.	V	3.761	2.613
3.	BSc. BEd.	6.363	2.479

TABLE - 3 : MEAN SCORE AND STANDARD DEVIATIONS FOR CLASS V BEFORE AND AFTER REMEDIAL TEACHING :

	Mean Score	Standard deviation
Before	3.76	2.61
After	7.03	2.57

TABLE - 4: PERCENTAGE OF CORRECT RESPONSE QUESTION WISE FOR THE TOTAL SAMPLE :

Question	Class	Percentage
1.	IV	16.9
	V	34.9
	BSc. BEd.	72.7
2.	IV	44.6
	V	69.8
	BSc. BEd.	72.7
3.	IV	32.3
	V	31.7
	BSc. BEd.	72.7
4.	IV	23.0
	V	30.1
	BSc. BEd.	68.1
5.	IV	40.0
	V	38.0
	BSc. BEd.	77.2
6.	IV	9.2
	V	15.8
	BSc. BEd.	27.2
7.	IV	13.8
	V	14.0
	BSc. BEd.	31.8
8.	IV	33.8
	V	34.0
	BSc. BEd.	90.9
9.	IV	56.9
	V	71.4
	BSc. BEd.	72.7
10.	IV	26.15
	V	38.0
	BSc. BEd.	50.00

TABLE-5 : PERCENTAGE OF CORRECT RESPONSE QUESTION WISE FOR CLASS V, BEFORE AND AFTER REMEDIAL TEACHING :

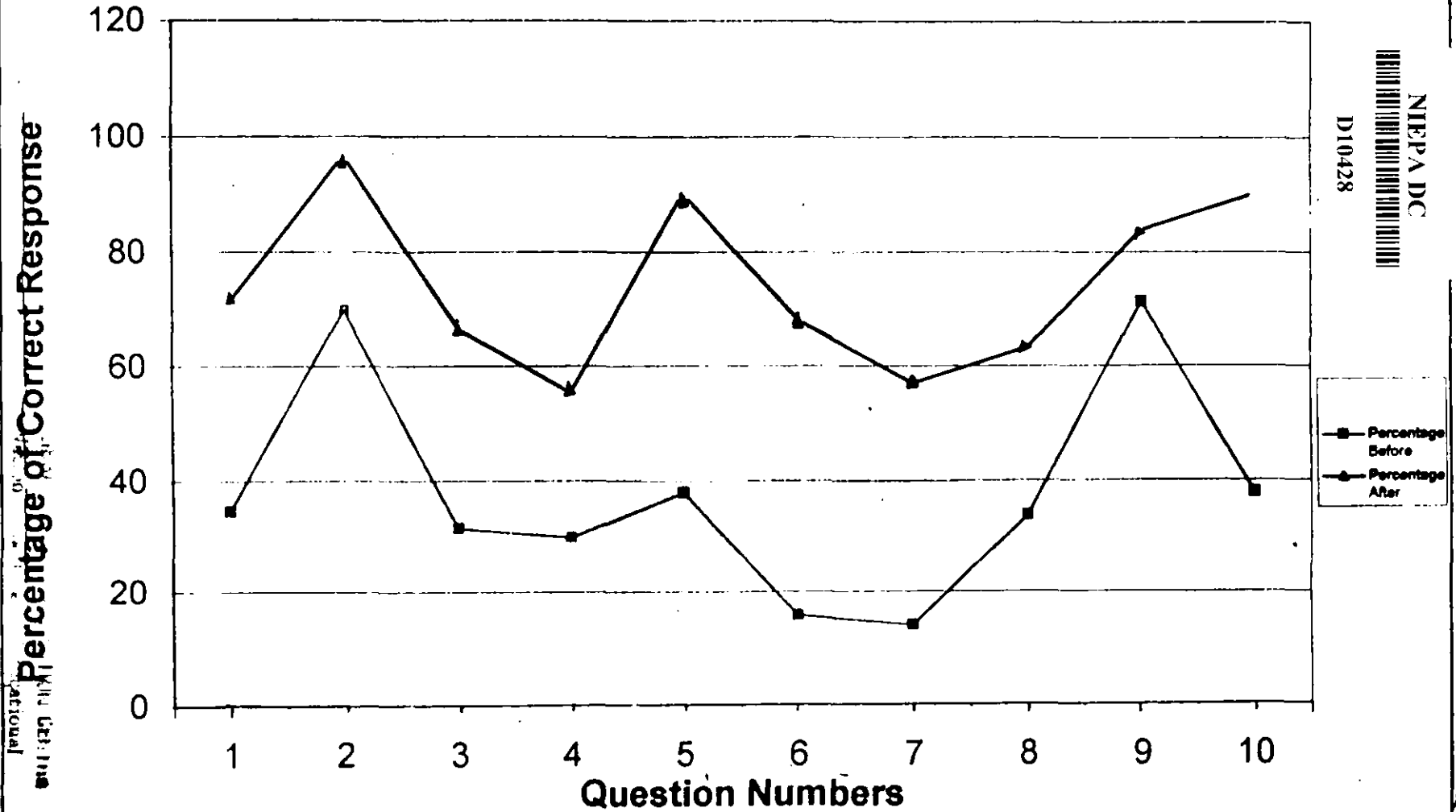| Question Number	Percentage Before	Percentage After
1.	34.9	71.4
2.	69.8	96.8
3.	31.7	66.6
4.	30.1	55.5
5.	38.0	90.4
6.	15.8	68.2
7.	14.0	57.1
8.	34.0	63.4
9.	71.4	84.1
10.	38.0	90.4
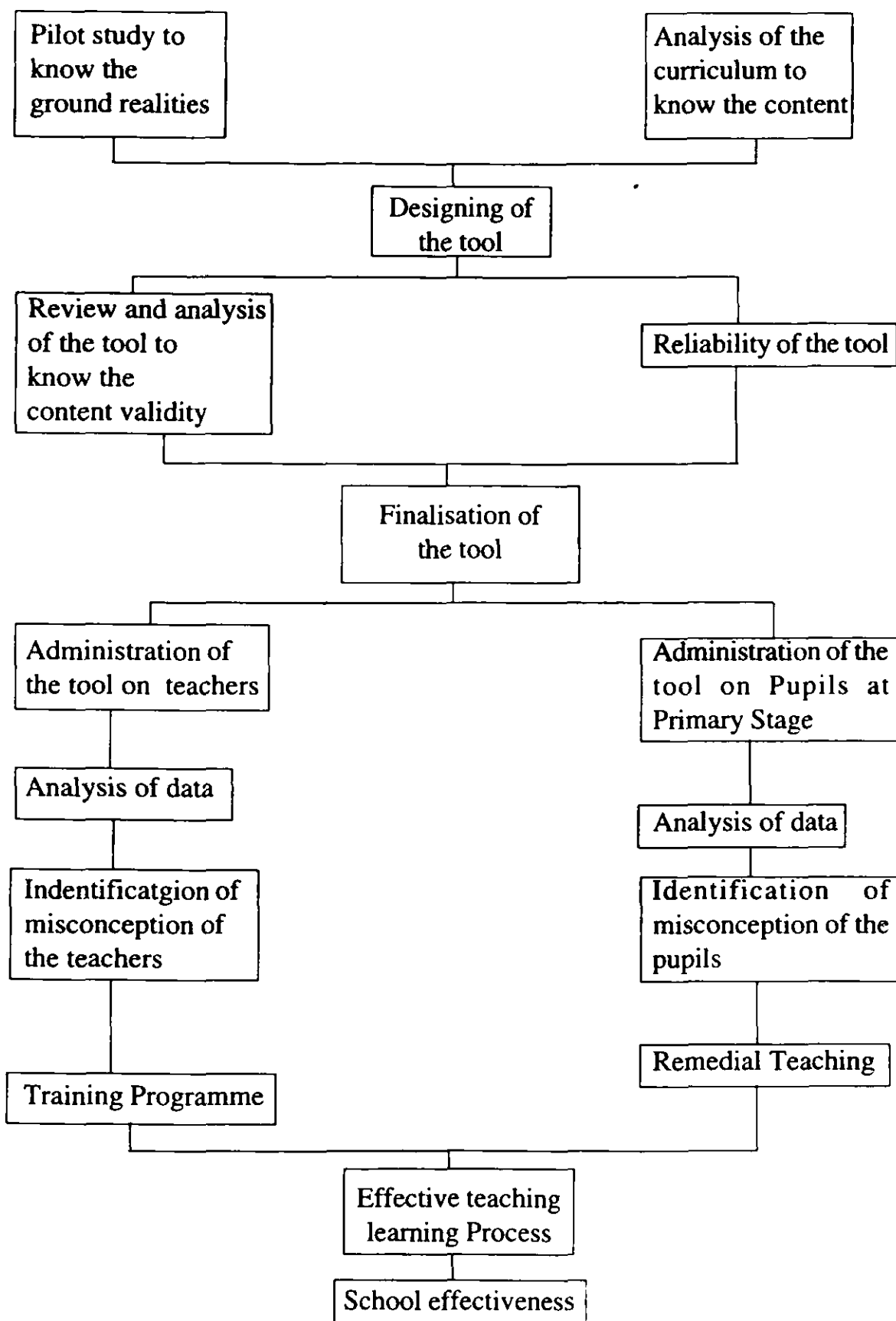
Fig. 1. Conceptual model of the work.

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Fig. 2: Percentage of Correct Response Questionwise For Different Classes

Fig. 3 : Percentage of Correct Response Questionwise For Class - V