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Address:-Ashok Yakkaldevi 258/34, Raviwar Peth, Solapur - 413 005 Maharashtra, India
Cell : 9595 359 435, Ph No: 02172372010 Email: ayisrj@yahoo.in Website: www.isrj.org

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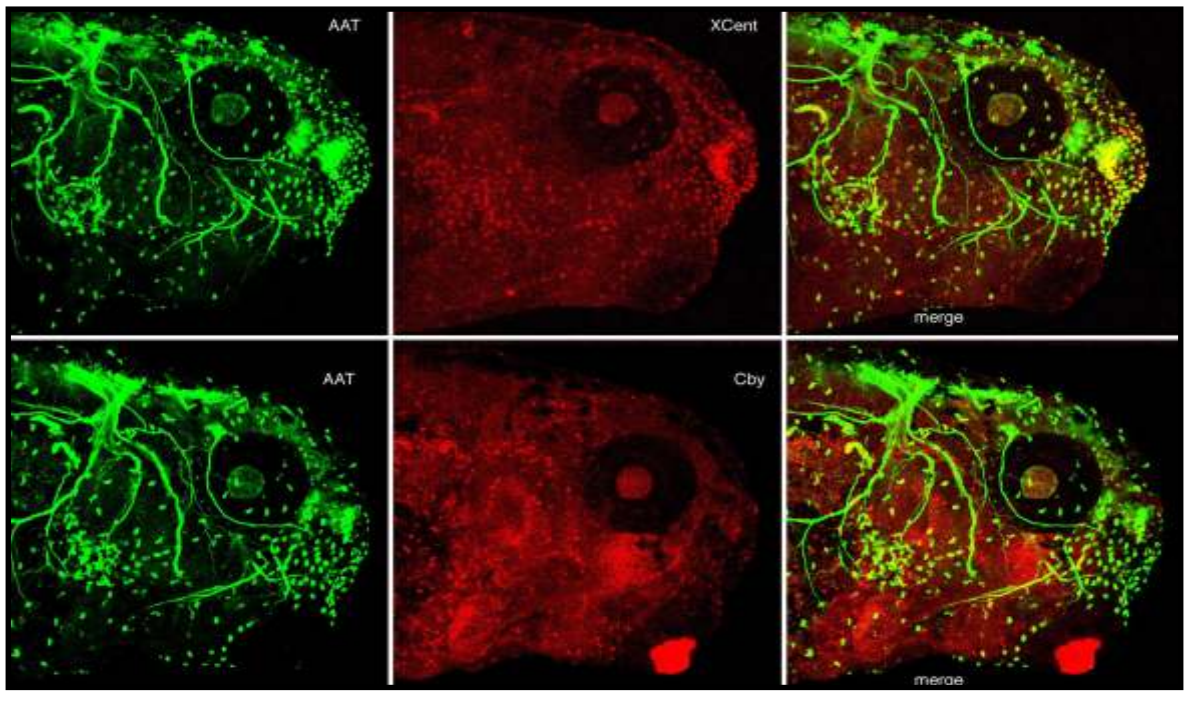
ASSESSMENT OF THE CONCEPT OF BIOLOGY USING BIOLOGY CONCEPT INVENTORY



[1]K.N.CHATTOPADHYAY ,[2] PAPIYA UPADHYAY AND [3]ARNAB JASH
[1]Asstt. Professor, Department of Education, Burdwan University, Burdwan, W.B
[2]Asstt. Professor, School of Education, Netaji Subhas Open University,
CF-162, Sector-I, Salt Lake, Kolkata.
[3]Asstt.Teacher, Mahurapur Nityananda High School, Mahurapur, Birbhum, W.B.

ABSTRACT:

Like other concept inventories in different subjects, Biology Concept Inventory has the same purpose. It is used to assess the understanding of biology concepts. Biology is a diverse field and it is very difficult to locate the core area of the subject.Klymkowsky and Garvin-Doxas (www.bioliteracy.net) (2008) have developed Biology Concept Inventory to test the common concept of undergraduate biology. We have used this Biology Concept Inventory to assess the concept of biology of post graduate Zoology and Botany students and tried to find out whether their conception differs significantly or not. In this paper we have also discussed if there is any significant difference in the conception of biology between male and female post graduate Zoology and Botany students.

KEYWORDS : Concepts of Biology, Biology Concept Inventory, Post graduate biology students.

INTRODUCTION:

Many researchers have highlighted the need for, and value of, concept inventories in many areas of different subjects including undergraduate biology education. A concept inventory in any subject is a multiple choice test designed to evaluate whether a person has an accurate and working knowledge of that subject. The first concept inventory was developed in 1985 (Hallouin and Hestenes, 1985). It covers the understanding of basic concepts in classical mechanics. Hestenes, Halloun, Wells, and Swackhamer developed the first of the concept inventories to be widely disseminated, the Force Concept Inventory (Hallouin and Hestenes, 1985; Hestenes and Swackhamer, 1992; Hestenes, 1998). Interest in assessments of biology education is primarily due to the emergence of a community of biology education researchers. These researchers want to measure the potential successes of their teaching reforms. Well-designed, valid and reliable concept inventories that allow teachers to identify student learning of the main concepts of biology are becoming an essential way to inform biology teachers about what students learn in biology courses. Biology is a diverse field and it is difficult to identify the core area of it. The researchers in biology education recognized that learning biology is quite different from learning physics (Klymkowsky et al., 2003). However, we can find many concept inventories and diagnostic tests in biology like basic biology (Wilson et al., 2006; D'Avanzo, 2008) natural selection (Anderson et al., 2002; Nehm and Schonfeld, 2008; Nehm and Schonfeld, 2010) and genetics (Smith et al., 2008). After many researches in biology education Klymkowsky and Garvin-Doxas (2008) have developed Biology Concept Inventory for the assessment of concept of biology of the college students. This inventory consists of twenty nine questions from different common fields of biology. In Burdwan University campus we have post graduate (PG) students of Zoology and Botany, and we have used this Biology Concept Inventory of Klymkowsky and Garvin- Doxas (2008) to assess the concept of biology of the PG students in Zoology and Botany.

Objectives Of The Study:

The following were the objectives of our study:

I) This study aims to find out the level of conception of biology of the PG Zoology and Botany students.
ii) To find out if there is any difference between male PG students (Zoology and Botany) and female PG students (Zoology and Botany) regarding the conception of biology.
iii) To study whether Zoology and Botany PG students differ in their conception of biology.
iv) To know if there is any difference between male PG students (Zoology) and female PG students (Zoology) in their biology conception.
v) To study whether male PG students (Botany) and female PG students (Botany) differ in their conception of biology.
vi) To find out if there is any difference between male PG students (Zoology) and male PG students (Botany) regarding the conception of biology.
vii) To know if there is any difference between female PG students (Zoology) and female PG students (Botany).

Hypotheses:

The following hypotheses were framed for the study –

H1: The concept of biology of PG. Zoology and PG Botany students differs significantly.
H2: The concept of biology of Male PG Students (Zoology and Botany) and Female PG Students

(Zoology and Botany) differs significantly.
H3: The concept of biology of Male PG Students (Zoology) and Female PG Students (Zoology) differs significantly.
H4: The concept of biology of Male PG Students (Botany) and Female PG Students (Botany) differs significantly.
H5: The concept of biology of Male PG Students (Zoology) and Male PG Students (Botany) differs significantly.
H6: The concept of biology of Female PG Students (Zoology) and Female PG Students (Botany) differs significantly.

Delimitation Of The Study:

Taking into consideration the time in hand, scope and finance available the present study was delimited in terms of scope, area, sample etc.
(I) The study is limited to 114 students selected by random sampling methods due to short stipulated time.
(ii) The study is confined to the students of M.Sc.(Zoology) & M.Sc (Botany).
(iii) The study is performed to the students of Burdwan University only.
(iv) The biology teachers are excluded from this study.

Material And Method:

Tool : Biology Concept Inventory (BCI) of Klymkowsky and Garvin-Doxas (www.bioliteracy.net) (2008) was used for the collection of data regarding concept of biology. BCI is a well proved test to evaluate whether a student has an accurate concept in biology. There are 29 multiple choice type questions and the BCI questions are in 6 broad groups: diffusion and drift (5 questions), energetic and interactions (4 questions), molecular properties and functions (6 questions), genetic behaviours (7 questions), evolutionary processes (5 questions), and experimental design (2 questions).

Sample: In the present study on understanding of concepts of biology, the sample consisted of 114 students of M.Sc. Zoology and M.Sc.Botany of Burdwan University. The details of the samples are given in the following Table.

Sl. No.	Sample	Size of the sample	Level of the sample
1	M.Sc. Zoology students	56	Post Graduate
2	M.Sc. Botany students	58	Post Graduate

Procedure :

After selection of the sample the important aspect of the study is the administration of BCI and collection of data. The BCI test was administered to 114 post graduate students of zoology and botany departments of The University of Burdwan by random sampling method. The investigators went to the above said departments, took permission from the Head of the Department for administering the BCI. After introducing himself the investigator explained the instructions of this test before the evaluation taken and then supplied the question paper containing 29 multiple choice type questions i.e. BCI to the students. They were allowed maximum 45 minutes to answer the questions. The students wrote their answers (by giving a tick to each question) on same question paper and returned it to the investigator. Then the answers of these 114 students have been analysed and interpreted. There are 29 multiple choice type questions and each question has four options. Among the four options one is correct

answer and other three are designed on the basis of misconceptions. The students were asked to tick one option on the basis of their own thinking. Wrong response or more than response or no response was treated as incorrect answer. There was no negative marking. A correct response was scored as +1 and an incorrect response was scored as 0. So a student's maximum score could be +29 and minimum be 0.

Analysis of the data

It is difficult to explain the raw data (the data which are collected by the investigator) without analysis. Categorizing, ordering, manipulating and summarizing of data to find the answers to the research questions are called analysis of data. The investigator in order to study the hypotheses mentioned for the present study, classified the 114 students under study into different groups and has taken a test on BCI towards the concept of biology. The scores obtained by different groups of students are analyzed.

The sample size of this study is 114. The samples are the post graduate students of The University of Burdwan. To find the acceptance or rejection of the hypotheses they are classified into different groups as shown in the following Table.

Table: Size of different groups of the samples

Sl. No.	Variables	Sample No.
1	Zoology Students	56
	Botany Students	58
2	Male Students (Zoology and Botany)	60
	Female Students (Zoology and Botany)	54
3	Male Students (Zoology)	28
	Female Students (Zoology)	28
4	Male students (Botany)	32
	Female Students (Botany)	26
5	Male Students (Zoology)	28
	Male Students (Botany)	32
6	Female Students (Zoology)	28
	Female students (Botany)	26

Each sample got a score and the scores obtained by each group are analysed as follows.

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Table 1: Analysis of data relating to Hypothesis no. 1

H1: The concept of biology of PG zoology and PG botany students differs significantly.

The mean score obtained by the zoology students is 12.41with standard deviation 3.56 whereas the mean score of botany students is 11.97 with standard deviation 3.74. The computed 't' value is 0.64 and from t-table it is verified that this value is insignificant. From this statistical analysis we can say that the concept of biology of PG zoology students and PG botany students does not differ significantly.

Table 2: Analysis of data relating to Hypothesis no. 2

H2: The concept of biology of PG male students (zoology and botany) and PG female students (zoology and botany) differs significantly.

The mean score of male PG students (zoology and botany) is 12.47 with standard deviation 3.81 and the mean score of female PG students (zoology and botany) is 11.87 with standard deviation 3.45. To find out the significance of difference between two means, 't' value is calculated and it turns out 0.88. From the t-table it is seen that this value is insignificant. So we may conclude that the concept of

biology of PG male students (zoology and botany) and PG female students (zoology and botany) does not differ significantly.

Table 3: Analysis of data relating to Hypothesis no. 3
H3: The concept of biology of male PG students (zoology) and female PG students (zoology) differs significantly.

The mean score obtained by the male PG students (zoology) is 12.86 with standard deviation 3.68 whereas the mean score of female PG students (zoology) is 11.96 with standard deviation 3.44. The computed 't' value is 0.95 and from t-table it is verified that this value is insignificant. From this statistical analysis we can say that the concept of biology of male PG students (zoology) and female PG students (zoology) does not differ significantly.

Table 4: Analysis of data relating to Hypothesis no. 4
H4: The concept of biology of male PG students (botany) and female PG students (botany) differs significantly.

The mean score obtained by the male PG students (botany) is 12.13 with standard deviation 3.95 whereas the mean score of female PG students (botany) is 11.77 with standard deviation 3.54. The computed 't' value is 0.37 and from t-table it is verified that this value is insignificant. From this statistical analysis we can say that the concept of biology of male PG students (botany) and female PG students (botany) does not differ significantly.

Table 5: Analysis of data relating to Hypothesis no. 5
H5: The concept of biology of male PG students (zoology) and male PG students (botany) differs significantly.

The mean score of male PG students (zoology) is 12.86 with standard deviation 3.68 and the mean score of male PG students (botany) is 12.13 with standard deviation 3.95. The 't' value is calculated to find out the significance of difference between two means. The value of 't' is found to be 0.73 and this value of 't' is insignificant. So we may conclude that the concept of biology of male PG students (zoology) and male PG students (botany) does not differ significantly.

Table 6: Analysis of data relating to Hypothesis no. 6
H6: The concept of biology of female PG students (zoology) and female PG students (botany) differs significantly.

The mean score of female PG students (zoology) is 11.96 with standard deviation 3.44 and the mean score of female PG students (botany) is 11.77 with standard deviation 3.54. The 't' value is calculated to find out the significance of difference between two means. The value of 't' is found to be 0.20 and this value of 't' is insignificant. So we may conclude that the concept of biology of PG female students (zoology) and female PG students (botany) does not differ significantly.

Table 7: Analysis of data pertaining to Conceptions and Misconceptions of Biology

In the biology concept inventory there are 29 questions and each question has four options. Among the four options one option is correct and others are designed on the basis of misconceptions. From the Table-7 it may be noted that:

I) The overall percentage of correct and incorrect response is 42.1% and 57.9% respectively.

ii) In some cases there are very few correct responses e.g. question number 5, 8, 9, 13, 19, 25 and 28.

iii) Question number 2 is answered correctly by 76.31% students whereas question number 8 is answered correctly by 7.89% students.

Table 1: Comparison between PG Zoology and PG Botany Students towards Concept of Biology

Group	Sample No. (N)	Mean Score (M)	SD (σ)	t-value	Level of Significance
Zoology	56	12.41	3.56	0.64	Not Significant
Botany	58	11.97	3.74		

Table 2: Comparison between Male PG Students (Zoology and Botany) and Female PG Students (Zoology and Botany) towards Concept of Biology

Group	Sample No. (N)	Mean Score (M)	SD (σ)	t-value	Level of Significance
Male	60	12.47	3.81	0.88	Not Significant
Female	54	11.87	3.45		

Table 3: Comparison between Male PG Students (Zoology) and Female PG Students (Zoology) towards Concept of Biology

Group	Sample No. (N)	Mean Score (M)	SD (σ)	t-value	Level of Significance
Male	28	12.86	3.68	0.95	Not Significant
Female	28	11.96	3.44		

Table 4: Comparison between Male PG Students (Botany) and Female PG Students (Botany) towards Concept of Biology

Group	Sample No. (N)	Mean Score (M)	SD (σ)	t-value	Level of Significance
Male	32	12.13	3.95	0.37	Not Significant
Female	26	11.77	3.54		

Table 5: Comparison between Male PG Students (Zoology) and Male PG Students (Botany) towards Concept of Biology

Group	Sample No. (N)	Mean Score (M)	SD (σ)	t-value	Level of Significance
Male(Zoology)	28	12.86	3.68	0.73	Not Significant
Male(Botany)	32	12.13	3.95		

Table 6: Comparison between Female PG Students (Zoology) and Female PG Students (Botany) towards Concept of Biology

Group	Sample No. (N)	Mean Score (M)	SD (σ)	t-value	Level of Significance
Female(Zoology)	28	11.96	3.44	0.20	Not Significant
Female(Botany)	26	11.77	3.54		

Table 7: Response frequencies of the PG students of Zoology and Botany

Item No.	Correct Option	No. Of students opt. for			
		Option A	Option B	Option C	Option D
1	D	18	27	15	54
2	B	07	87	11	09
3	D	29	13	26	46
4	C	23	12	62	17
5	D	47	29	20	18
6	A	42	18	28	26
7	B	34	46	09	25
8	A	09	26	63	16
9	D	52	14	29	19
10	C	21	10	58	25
11	B	16	49	27	22
12	D	24	13	08	69
13	B	32	18	47	17
14	C	19	34	45	16
15	A	72	09	18	15
16	C	13	18	49	34
17	C	21	29	48	16
18	B	14	63	08	29
19	B	15	14	23	62
20	D	23	06	14	71
21	D	19	28	16	51
22	A	56	19	32	07
23	D	17	14	27	56
24	D	18	31	12	53
25	B	22	17	57	18
26	B	26	65	10	13
27	C	14	19	54	27
28	B	63	16	12	23
29	C	05	12	67	30

Interpretation:

The interpretation of this study are as follows:

i) There is no significant difference of the concept of biology of PG Zoology and PG Botany Students.

ii) There is no significant difference of the concept of biology of Male PG Students (Zoology and Botany) and Female PG Students (Zoology and Botany).

iii) There is no significant difference of the concept of biology of Male PG Students (Zoology) and Female PG Students (Zoology).

iv) There is no significant difference of the concept of biology of Male PG Students (Botany) and Female PG Students (Botany).

v) There is no significant difference of the concept of biology of Male PG Students (Zoology) and Male PG Students (Botany).

vi) There is no significant difference of the concept of biology of Female PG Students (Zoology) and Female PG Students (Botany).

vii) The overall conception of biology of the PG Zoology and Botany students is poor.

Suggestions For Further Study:

i) This study will be more valuable if it is extended to the other students of different colleges and Universities of West Bengal.
ii) The concept of biology of the biology teachers of schools, colleges and Universities can be studied.
iii) The study will be more fruitful if the misconceptions of the students are analyzed in details.
iv) Other concepts of biology may also be studied.

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K.N.CHATTOPADHYAY
Asstt. Professor, Department of Education, Burdwan University, Burdwan, W.B