

# **Predicting learning outputs and retention through neural network artificial intelligence in photosynthesis, transpiration and translocation**

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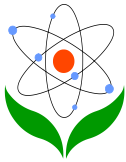
## **Contents**

- [Abstract](#)
  - [Introduction](#)
  - [Methodology](#)
  - [Analysis and Results](#)
  - [Findings and Discussion](#)
  - [Conclusion](#)
  - [References](#)
  - [Appendix](#)
- 

## **Abstract**

Artificial Intelligence is a branch of computer science connects, classifies, differentiates, and elaborates the domains of learning in neural network, a paradigm shift is using in the construction of knowledge. In this pretest-posttest single group experimental design, neural network artificial intelligence used to investigate the existing misconception status of the participants, and predicted the learning

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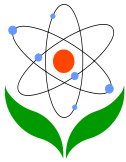
outcomes, and retention of learning. The study aimed to assess the effects of neural network artificial intelligence approach on the achievement and retention in science learning. Forty students of a class were participated in this study, and out of them five students found having 60% to 80% of misconceptions assessed in the misconception test before exposed to the neural network artificial intelligence approach. It resulted that the mean of posttest score was statistically significant in different from the mean of the pre test score. It was resulted that input layer and first hidden layer were related with the output of the artificial intelligence.

**Keywords:** Artificial intelligence, neural network, photosynthesis, translocation, transpiration

## Introduction

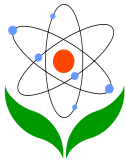
Artificial Intelligence (AI) is a branch of computer science relates, connects, classifies, differentiates, and elaborates different cognitive domains in the neurological network. John Mc. Carthy coined the term in 1955 and viewed, “it is the science and engineering of making intelligent machines.” AI is highly technical, specialized, and based on deduction, reasoning, and problem solving techniques linked with mathematics, reasoning, logic, and engineering to identifying the concept in various situations. The central theme of AI research includes reasoning, planning, learning, communicating, perceiving, constructing knowledge (Jena, 2012), and manipulating the objects or concepts. This field includes human creativity, and intelligence to stimulate the cognition (Goyache, 2001). Recently, statistical methods and computational intelligence is included in AI for mathematical optimization and ontological classification while neural network stimulates human brain and intelligence, and in fact, the nature of mind stimulates to perform better or to give an appropriate response.

Now a day, online learning approaches are using to enhance science learning performance (Jena, 2014, 2015), but AI a new paradigm shift increases the levels of learners’ intelligence (Guastello & Rieke, 1994). Human intelligence is based on intuition, common sense, judgments, creativity, beliefs and ability to demonstrate the intelligence by communicating effectively through reasoning and critical thinking those stimulate human behaviour and cognitive process (Jolly et al. 2007). It needs



human expertise for quick data entry, manipulation, accumulation, and assimilation of information to find a better result and long retention. AI is not a mixed knowledge but a developed knowledge while human intelligence is a mixed knowledge, is not able to write a huge amount of data in memory. In the 19th century, French scientist, and philosopher Claude Bernard argued, “we achieve more than we know, we know more than we understand and we understand more than we can explain”. AI sometimes contrasts with conventional computing process. It uses to search the matching code in the environment to decode the human intelligence but it's just like the software process needs inputs, short term memory, and intervention for long term memory results to long term retention and high output while conventional computing system needs software, followed by logical series of input to reach a conclusion. The conventional computing system is a software process needs algorithms, but AI is an image interpretation labeling or a segmented image interprets the human intelligence for conceptualization of the knowledge and it also detects the unexpected conceptions, doubts and misconceptions (Khosrowshahi, 2011). Here, questions raised on how neural network does work effectively on learners' achievement and retention. Does it help in detecting the misconception, if so, then how? Does the neural network encourage long-term retention, and how does it work to predict the output of the problems?

Science teachers are trying to teach the proposition or the conceptual network directly to stimulate the central nervous system of children, and many researchers have been conducting research on the effect of artificial intelligence on learner's change of behaviour, and science ability of students (Jena, Gogoi, Deka, 2016). Shaw and Fox (1993) found that neural network could solve the learning difficulties or problem in different situation. However, game artificial intelligence provided reinforcement to the learners and speedup the learning process (Ajung & Gaol, 2012). Artificial intelligence as a technique helped learners to learn symbolic reasoning and increased the flexibility and capabilities of learning (Cavus, 2010; Mellit & Kalogirou, 2008). However, Conrad (1987) found the dynamic mechanism of artificial intelligence and it is a computer network topology (Pierre, 1993). Not only was that, Conrad (1987) found that artificial intelligence is a dynamic mechanism of computer network topology (Pierre, 1993). Artificial intelligence demonstrates the feasibility of the approach and found 50% more improvement among the student (Bennett & Hauser, 2013). In addition to that, it was found, artificial neural network is a learning environment use to embedded algorithm to enhance the quality of



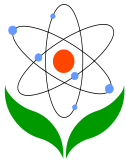
solution, and points out differences in performance between light and standard bovine carcasses (Bahamond et al, 2003; Noroozi et al, 2013). Estimating environmental pollution through Artificial Intelligence is successful (Compare, 1998) as comparable to other techniques. Machine learning in Artificial Intelligence uses to teach different concepts through inductive and logical programming (Bratko, 1993).

Not only was that but also the prediction of cotton yarn properties was assessed through artificial intelligence was successful (Stjepanovic & Jezernik, 1991). However, neural network and machine learning are the kind of artificial intelligence (Prieto et al, 2013). Artificial Intelligence is a machine learning technique manages complexity, changes and uncertainties and can predicts productivity (Barto & Sutton, 1997, Hendry, 1987, Monostory, 2013) and inspired social intelligence (Dautenhahn, 1995). Artificial neural network intelligence is an approach of induction vs. self-organizing neural networks (Mullohand, 1995) could restructure the knowledge and it is an efficient technique for predicting the learning out comes (Kolodziejczyk, 2010) especially, used as the semantic analyzer (Feldman & Yakimovsky, 1974). Literatures, found that artificial intelligence effects on mind, and achievement and it is an effective approach for teaching and learning process could predict learning outputs. That's why the study aimed 1) to study the existing misconception of students in science learning; 2) to study the effectiveness of neural network artificial intelligence approach on the prediction of learners' learning outputs; and 3) to study the effectiveness of neural network artificial intelligence approach on the achievement and retention of science learning. Based on the objectives the study assumed that 1) there are misconceptions of students in science, 2) there are significant effects of neural network artificial intelligence approach on the prediction of learners' learning outputs, and 3) there are significant effects of neural network artificial intelligence approach on achievement and retention of science learning.

## Methodology

Pretest-posttest single group experimental design used to investigate the existing misconception status of the participants. However, the improvement of learning performance and retention was assessed after exposed to neural network artificial intelligence for its broader generalization. Out of forty students of a 8th standard,

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five students' age ranged 13.5-14.6 years and the mean age was 14.5 with S.D= 9.8 found 60% to 80% of misconception in photosynthesis, transpiration and translocation test. Hierarchical multiple regression model assessed the relationship between more than two independent variables and a dependent variable in the present study. The output contributes important information. a) R is the correlation between the predicted values and the observed values of Y, and b) R-square indicates how well a regression model predicts responses for new observations (R<sup>2</sup> represents the proportion of variance in the dependent variable explain by the independent variable, in the regression model, which is beyond, and below the mean mode). c) An adjusted R<sup>2</sup> is the value corrects positive biased of the population, d) F value, and the degree of freedom shows the statistical significance of the regression model; and e) the coefficient ( $\beta$ ) is a constant, and independent variable predicts the dependent variable. The detail of the design of the study is given in table 1.

**Table 1-Design of the Study\***

| Group        | Pre-test | Treatment | Post-test | Delayed-test |
|--------------|----------|-----------|-----------|--------------|
| Experimental | x        | NNAI      | x         | x            |

## **Instrumentation**

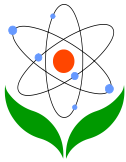
### ***Misconception test cum Achievement test***

Jena (2015) developed a misconception test cum achievement test in photosynthesis, transpiration and translocation based on the syllabus for standard 8th students affiliated to NCERT, New Delhi. It has thirty multiple-choice items having four point options where the normative group for the Misconception test cum Achievement test randomized among the cross-cultural group of Indian who accurately reflected the diversity of that group of respondents of the test. In psychology, the normative group for the misconception test used among the students of 13.5-14.6 year from various demographic groups in India. The Content Validity Ratio (CVR=8.0) and Cronbach alpha was .86 (see Appendix I).

### ***Neural Network Blank sheet***

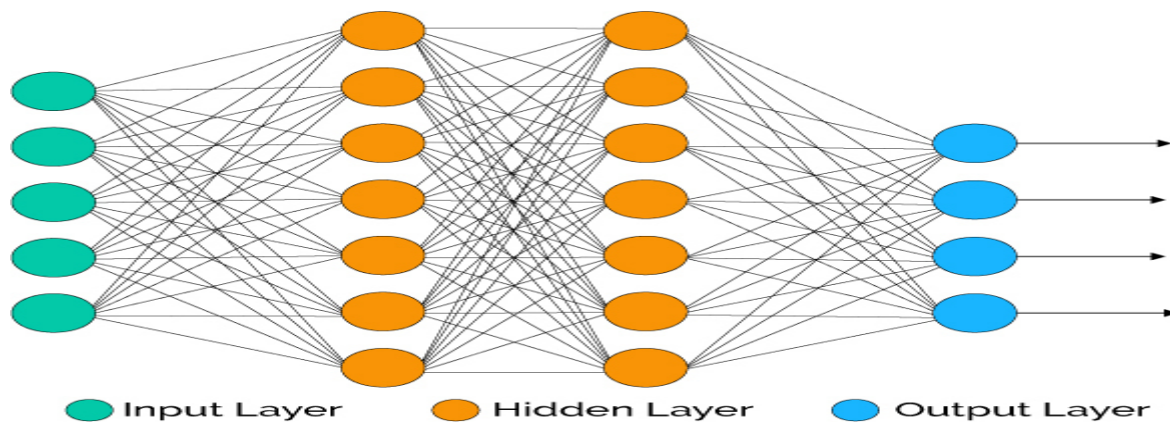
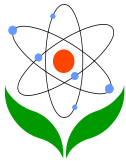
Through the misconception test it was identified that five students who had 60%-80% of misconceptions in the photosynthesis, transpiration, and translocation

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concepts. Before experiment, the researcher provided two tutorial classes to acquaint with the neural network teaching. Neural network is an online software developed by University of Missouri, Columbia is available in <http://www.semanticresearch.com>. By the help of this software, students could construct their mental and cognitive information on the concept of photosynthesis, transpiration, and translocation. Students can be directly followed the steps like: selection of neurons(inputs), link all neurons with the hidden neurons, link neurons with hidden neurons, making links with hidden neuron and outputs, and sharing of individual neural network with peers. In this study, neural networks used when the exact nature of the relationship between inputs and outputs were unknown. A key feature of neural networks training was to train the students on how to link inputs and outputs. There were three types of training in neural networks was used as networks supervised, unsupervised training and reinforcement learning with supervised. Some neural network training techniques were back propagation, quick propagation, conjugate gradient descent, projection operation and some unsupervised neural networks are multi layer. Artificial Neural Networks (ANN) has input, scaled input, hidden neurons, scaled output, and output ([https:// www.xenonstack.com/blog/overview-of-artificial-neural-networks-and-its-applications](https://www.xenonstack.com/blog/overview-of-artificial-neural-networks-and-its-applications)). Input and scaled inputs belong to input layer and hidden neurons are hidden layers. The schematic representation of an artificial neural network is given in Fig 1. Input layer contains the units of artificial neurons which receive input from the outside world on which network will learn, recognize about photosynthesis, transpiration and translocation or other process. It means all the concepts, sub concepts, micro concepts, and examples students will learn from the environment. Output layer contains units that respond to the information about how it helps to learn any task. Hidden layer are the units are in between input and output layers. The job of hidden layer is to transform the input into something that output unit can use in some way.



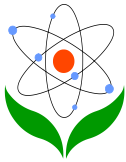


**Figure 1.** Artificial Neural Network Blank Sheet

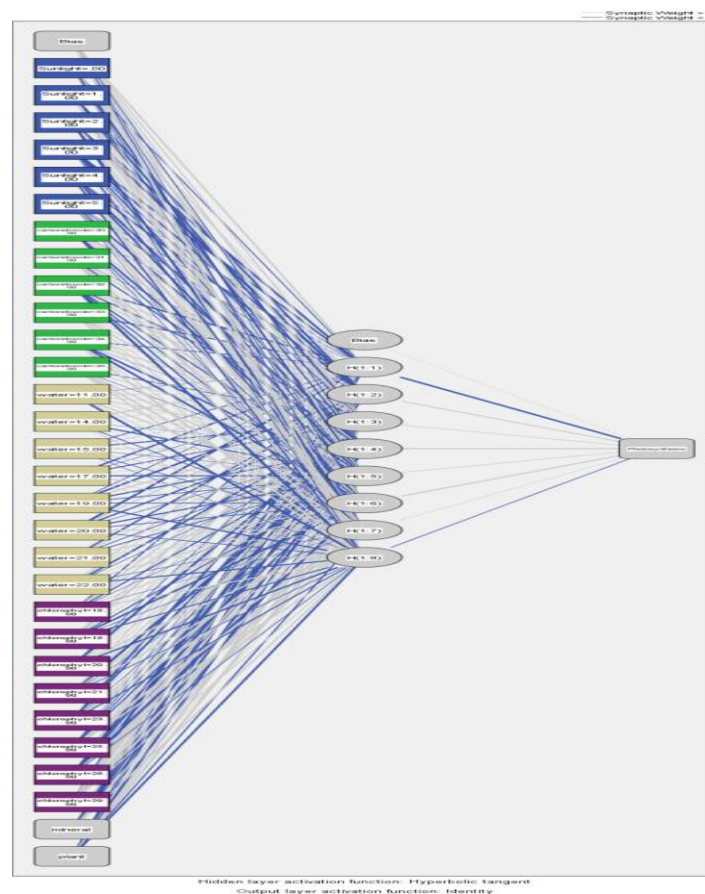
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### **Learning Techniques in Neural Networks**

Before instruction, a misconception test on photosynthesis, transpiration, and translocation administered to the participants, and after scoring the answer sheets, it showed that 60 -80% of concepts were misconceived. The participants were advised to use online and offline neural network blank sheets on photosynthesis, transpiration and translocation concepts (Appendix-I). Neural network template used to frame the concepts of photosynthesis, transpiration, and translocation in input & hidden positions. In fact, a twenty-contact hour of intervention was provided to learn and practice the propositional neural network on photosynthesis, transpiration, and translocation concepts. Every day, thirty minutes, students used internet to develop neural network and followed by that thirty minutes they practiced through offline neural network blank sheet. However, the learners felt comfortable with the offline mode neural network blank sheet to conceptualize photosynthesis, transpiration, translocation rather than online. This instruction cum self-learning practice continued

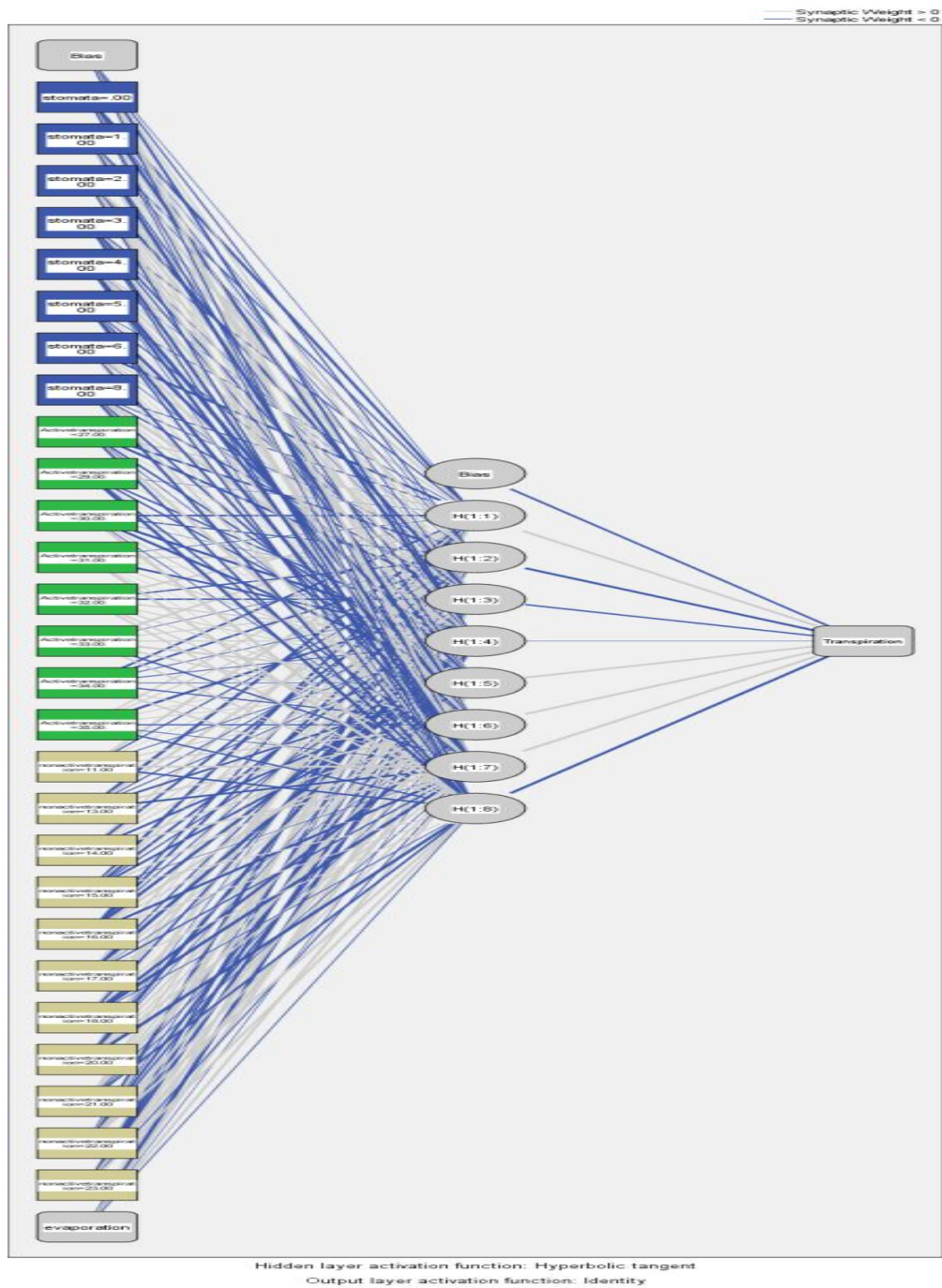
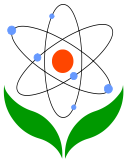


up to twenty contact hours. After instruction, the achievement test (the earlier misconception test) was administered to the students as the posttest and the same test was administered after one month was the delayed test used to assess the retention. To predict the actual output, students were tested through Neural Network Blank sheet. Both pretest and posttest score analyzed to predict the students' output or performance, through input layer and hidden layers. The Neural Network Blank sheets were scored in such a manner that for each correct output 10 points, and for each partial output 5 points and these points or marks were provided to the students according to their number input layer, in different hidden layers and output layer. Finally, linear regression analysis used to predict the output performance from the input and hidden layer entries. SPSS version 21 used to identify the predictors of Photosynthesis, transpiration, and translocation. The details of the activity of NNAI on Photosynthesis, Transpiration, and Translocation are showing in Figures 2, 3, & 4.

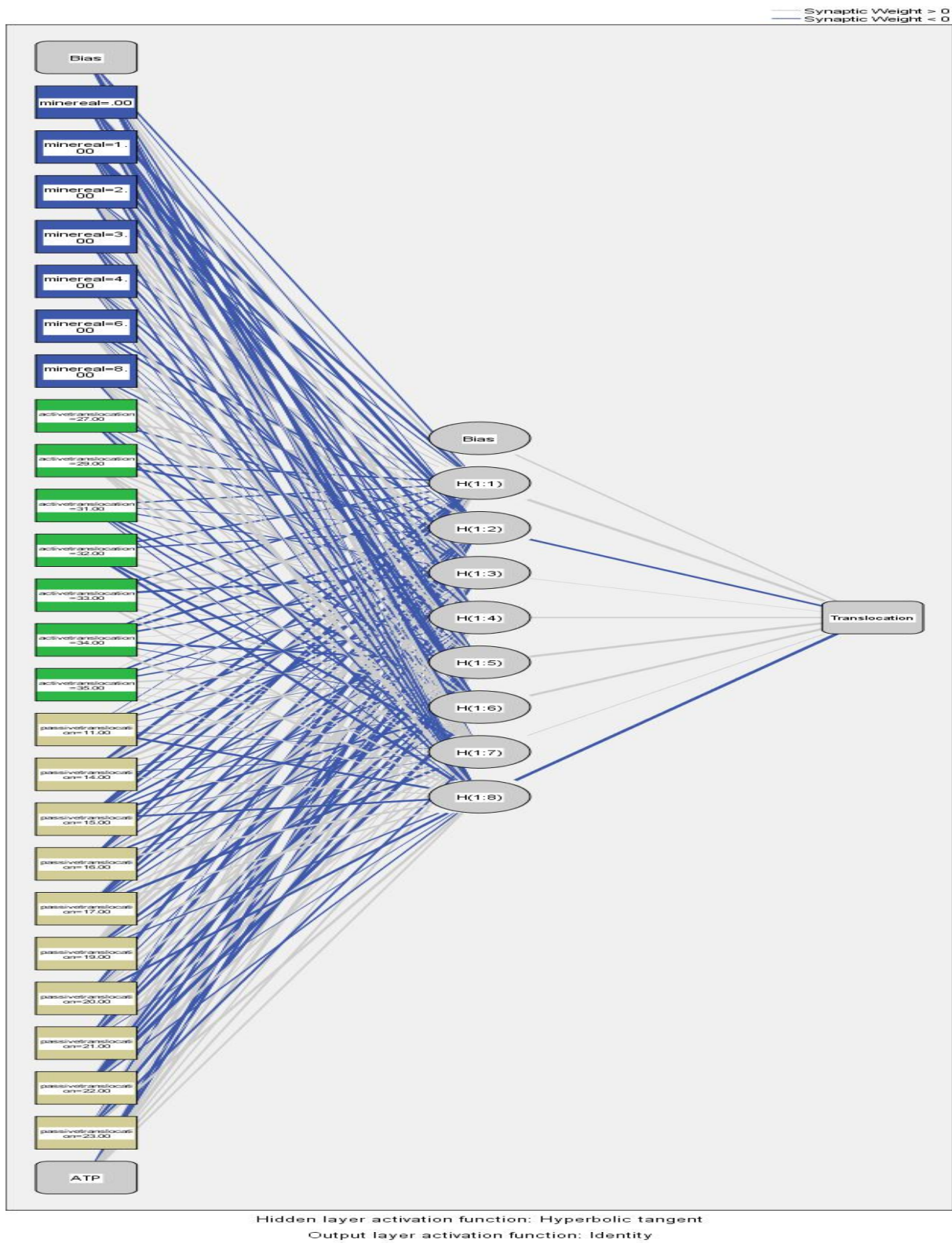
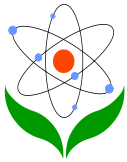


**Figure 2.** Neural network artificial intelligence on Photosynthesis

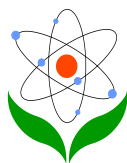




**Figure 3.** Neural network artificial intelligence on Transpiration



**Figure 4.** Neural network artificial intelligence on Translocation

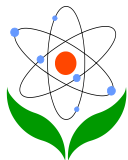


## Analysis and Results

### Hypothesis 1: There are misconceptions of students in science

**Table 1.0** Analysis of Misconception Test

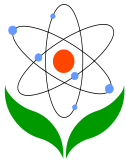
| I No | Items   | Options and % of Responds                               |  |   |   |
|------|---|---|--|---|---|
| 1    | Photosynthesis takes place in                               | (a)Thaylakoid **<br>2 (40%)                             | (b)Grana *<br>(0%)                             | (c) Photosystem I & II **<br>2(40%)                   | (d)photons**<br>1(20%)                        |
| 2    | Dark reaction in photosynthesis is limited by               | (a)Co <sub>2</sub> , temperature and light **<br>1(20%) | (a)Co <sub>2</sub> light and water *<br>2(40%) | © Water, temperature and Co <sub>2</sub> **<br>1(20%) | (d)Oxygen, water and temperature **<br>1(20%) |
| 3    | Colours of light most useful in photosynthesis are          | (a)Green, yellow and orange **<br>3(60%)                | (b)Red, violet and blue **<br>1(20%)           | © Infra-red, red and yellow *<br>1(20%)               | (d)Red, white and blue **<br>0(0%)            |
| 4    | During what stage of photosynthesis is oxygen produced      | (a)Cyclic photophosphorylation **<br>1(20%)             | (b)Carbon fixation **<br>3(60%)                | (c)Kreb's cycle **<br>1(20%)                          | (d)Photosystem (i) and (ii) *<br>0(0%)        |
| 5    | Photosynthesis pigment found in                             | (a)Cytoplasm **<br>2(40%)                               | (b)Thylakoid *<br>0(0%)                        | © Stroma **<br>2(40%)                                 | (d)All the above **<br>1(20%)                 |
| 6    | Which of the reactions produce oxygen gas                   | (a)Respiration **<br>2(40%)                             | (b)Fermentation **<br>1(20%)                   | (c) Photosynthesis *<br>1(20%)                        | (d) All the above **<br>1(20%)                |
| 7    | Glucose is stored in the plant as                           | (a)Chlorophyll **<br>1(20%)                             | (b) Leaves **<br>0(0%)                         | (c) Sugar **<br>2(40%)                                | (d) Starch *<br>2(40%)                        |
| 8    | _____absorbs light energy for photosynthesis                | (a)Vacuoles **<br>0(0%)                                 | (b) Nucleus **<br>0(0%)                        | (c)Cytoplasm **<br>3(60%)                             | (d) Chlorophyll *<br>2(40%)                   |
| 9    | Solar energy converts into chemical energy by _____         | (a)Respiration **<br>2(40%)                             | (b)Growth **<br>0(0%)                          | (c) Photosynthesis *<br>2(40%)                        | (d)All the above **<br>1(20%)                 |
| 10   | In order of a plant to complete photosynthesis, all must be | (a)Oxygen *<br>1(20%)                                   | (b)Sunlight **<br>2(40%)                       | Water **<br>1(20%)                                    | (d) Co <sub>2</sub> **<br>1(20%)              |



|    |                                   |                                     |  |   |  |
|----|-----------------------------------|-------------------------------------|--|---|--|
|    | present except gas                |                                     |  |   |  |
| 11 | What is produce by photosynthesis | (a)Glucose **<br>0(0%)              | (b)Glucose and oxygen *<br>2(40%)      | (c)Glucose & CO <sub>2</sub> **<br>2(40%) | (d)Glucose and water **<br>1(20%)              |
| 12 | Photosynthesis removes            | (a)Sunlight from earth **<br>0(0%)  | (b)Oxygen from atmosphere **<br>1(20%) | (c)Pollution from atmosphere **<br>1(20%) | (d)CO <sub>2</sub> from atmosphere *<br>3(60%) |
| 13 | Photosynthetic cells are          | (a)Parenchyma *<br>0(0%)            | (b)Phloem **<br>1(20%)                 | (c)Collenchyma **<br>2(40%)               | (d)All the above **<br>2(40%)                  |
| 14 | Photosynthesis is more in         | (a)C <sub>2</sub> plant**<br>1(20%) | (b)C <sub>3</sub> plants *<br>0(0%)    | (c)C <sub>4</sub> plants**<br>1(20%)      | (d)None of the above**<br>3(60%)               |
| 15 | Photosynthesis is a               | (a)Biological process**<br>1(20%)   | (b)Organic process**<br>1(20%)         | (c)Chemical process*<br>2(40%)            | (d)All the above**<br>1(20%)                   |

\*Correct Answer \*\* Wrong respond / Misconceptions

Table 1.0 reveals that 40% of students responded the item wrong. This was item no.1 (i.e. photosynthesis takes place in a-----) with correct response was grana, but that was wrongly responded by the students. Similarly, item no. 2 (i.e. Dark reaction in photosynthesis is limited by-----) correctly responded by 40% and 60% of students wrongly responded. Item no. 3 is related with the colours of light which is most useful in photosynthesis, responded wrongly by 80% student, only 20% of student responded correctly (i.e. Infra-red and yellow). 100% of students wrongly responded Item no. 4, (i.e. during what stage of photosynthesis is oxygen produced). It was resulted that the misconception level was growing and growing because of misconception started in preliminary level (That is item no. 1). 'Photosynthesis pigment found in thylakoid' that was wrongly responded by 100% of students (i.e. Item no. 5). Similarly, in item no. 6 (i.e. which reaction produces oxygen gas). The right response was photosynthesis, which was correctly responded by 20% of students. With response to item no. 7, 40% students responded (sugar) and 40% students' responded (starch) but the answer was actually carbohydrate that was stored in the form of starch. In item no. 8 (----- absorbs light energy for photosynthesis), 60% students wrongly attempted the item and only 40% students' responded it 'chlorophyll' which was the correct response. Solar energy converts into chemical energy by ----- process was the stem of item no. 9 was responded by 60% of students found wrong. Similarly, to respond the item no. 10, 80% students responded the item wrongly. Item no. 11 wrongly responded by 60% students but



rightly responded by 40% of students. In addition to that, item no. 12 & 13 correctly responded by 0% and wrongly responded by 100% of students. In case of item no. 14 & 15, only 0% and 40% correctly responded the item. It was resulted that 60% - 100% students has misconception and wrongly responded the item ranged item no. 1-15. This was due to pre-conceived notion, non-scientific belief, and conceptual misunderstanding. Hence, there were misconceptions of students in science.

**Testing of Hypothesis 2: There are significant effects of Neural Network Artificial Intelligence Approach on the prediction of learners’ learning outputs.**

**Table-2.1** N, Mean & SD of output layer, input layer, and Hidden layers

|                  | N | Mean | Std. Deviation |
|------------------|---|------|----------------|
| Output layer     | 5 | 9.00 | 2.236          |
| Input layer      | 5 | 3.60 | .548           |
| 1st Hidden layer | 5 | 4.40 | .894           |
| 2nd Hidden layer | 5 | 2.80 | .447           |
| 3rd Hidden layer | 5 | 1.80 | .447           |

**Table-2.2** Linear Regression of output layer, input layer, and Hidden layers

| Model | R                  | R Square | Adjusted R Square | Std. Error of the Estimate |
|-------|--------------------|----------|-------------------|----------------------------|
| 1     | .612 <sup>a</sup>  | .375     | .167              | 2.041                      |
| 2     | 1.000 <sup>b</sup> | 1.000    | 1.000             | .000                       |

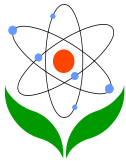
a. Predictors: (Constant), Input layer b. Predictors: (Constant), Input layer, 1st Hidden layer c. Dependent Variable: Output layer

**Table-2.3** ANOVA<sup>c</sup> of output layer, input layer, and Hidden layers

| Model |            | Sum of Squares | df | Mean Square | F     | Sig.              |
|-------|------------|----------------|----|-------------|-------|-------------------|
| 1     | Regression | 7.500          | 1  | 7.500       | 1.800 | .272 <sup>a</sup> |
|       | Residual   | 12.500         | 3  | 4.167       |       |                   |
|       | Total      | 20.000         | 4  |             |       |                   |

a. Predictors: (Constant), Input layer b. Predictors: (Constant), Input layer, 1st Hidden layer c. Dependent Variable: Output layer





**Table-2.4** Coefficients<sup>a</sup> of output layer, input layer, and Hidden layers

| Model |                  | Unstandardized Coefficients |            | Standardized Coefficients | t        | p     |
|-------|------------------|-----------------------------|------------|---------------------------|----------|-------|
|       |                  | B                           | Std. Error | Beta                      |          |       |
| 1     | (Constant)       | -2.135E-15                  | 6.770      |                           | .000     | 1.000 |
|       | Input layer      | 2.500                       | 1.863      | .612                      | 1.342    | .272  |
| 2     | (Constant)       | 5.000                       | .000       |                           | 2.081E7  | .000  |
|       | Input layer      | -5.000                      | .000       | -1.225                    | -3.249E7 | .000  |
|       | 1st Hidden layer | 5.000                       | .000       | 2.000                     | 5.305E7  | .000  |

a. Dependent Variable: Output layer

Table 2.1 reveals that the output ( $9.00 \pm 2.23$  mean) was higher than ( $3.60 \pm 0.54$  mean), ( $4.40 \pm 0.89$  mean), ( $2.80 \pm 0.44$  mean) and ( $1.80 \pm 0.44$  mean) of input layer, first hidden layer, second hidden layer and third hidden layer respectively. Similarly, the regression of output layer on the basic model ( $R = 0.612$ ,  $R^2 = 0.375$  and adjusted  $R^2 = 0.167$   $P > 0.05$ ) revealed statistically not significant relationship with input layer ( $\beta = 0.612$   $P > 0.05$ ). The output regression model ( $R = 1.00$ ,  $R^2 = 1.00$ , adjusted  $R^2 = 1.00$ ,  $P < 0.05$ ) was resulted significant and positive relationship with input layer and first hidden layer ( $\beta = -1.22$   $P < 0.05$ ) and ( $\beta = 2.00$   $P < 0.05$ ) respectively. The F value of output and input layer ( $1/4$   $1.80$   $P > 0.05$ ) was not significant whereas the relationship among output layer, input layer and first hidden layer  $F = (2/4$   $10.00$   $P < 0.05$ ) was significant (see table 2.2, 2.3 & 2.4). Hence, the hypothesis was accepted and there was a significant effect of Neural Network Artificial Intelligence Approach on the prediction of learners' learning outputs.

### Testing of Hypothesis 3: There are significant effects of Neural Network Artificial Intelligence Approach on achievement and retention of science learning.

**Table-3.1** Descriptive statistics of students pre test, post test and delayed test scores

|              | N  | Mean  | Std. Deviation | Std. Error |
|--------------|----|-------|----------------|------------|
| Pretest      | 5  | 6.20  | .837           | .374       |
| Posttest     | 5  | 11.40 | .548           | .245       |
| Delayed test | 5  | 10.80 | .447           | .200       |
| Total        | 15 | 9.47  | 2.475          | .639       |



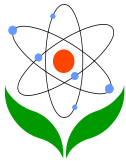


Table 3.1 depict the mean and SD of students' pre test, post test and delayed test scores before and after exposed to Neural Network Artificial Intelligence Approach in science learning. Mean of pretest score ( $6.20 \pm .837$ ) was smaller than the mean of posttest ( $11.40 \pm .548$ ) and delayed test ( $10.80 \pm .447$ ).

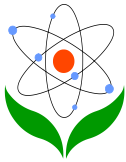
**Table-3.2** Test of Homogeneity of Variances

| Levene's Statistic | df1 | df2 | Sig. |
|--------------------|-----|-----|------|
| 1.412              | 2   | 12  | .281 |

**Table-3.3** ANOVA of students pre test, post test and delayed test scores

|                | Sum of Squares | df | Mean Square | F       | Sig. |
|----------------|----------------|----|-------------|---------|------|
| Between Groups | 80.933         | 2  | 40.467      | 101.167 | .000 |
| Within Groups  | 4.800          | 12 | .400        |         |      |
| Total          | 85.733         | 14 |             |         |      |

Output 2 shows the results of Levene's test in table 3.2 for pre test, posttest, and delayed test score assessed before and after exposed to neural network artificial intelligence approach of science learning. Levene's test is significant, indicating that the group variances were not equal (hence the assumption of homogeneity of variance is likely been violated). There was a significant effect of posttest, and delayed test score assessed before and after exposed to neural network artificial intelligence approach of science learning. The  $F(2,12)=101.167$ ,  $p=.000$  was significant. Hence, the hypothesis was accepted and there was significant effects of neural network artificial intelligence approach on achievement and retention of science learning (*see* table 3.3).

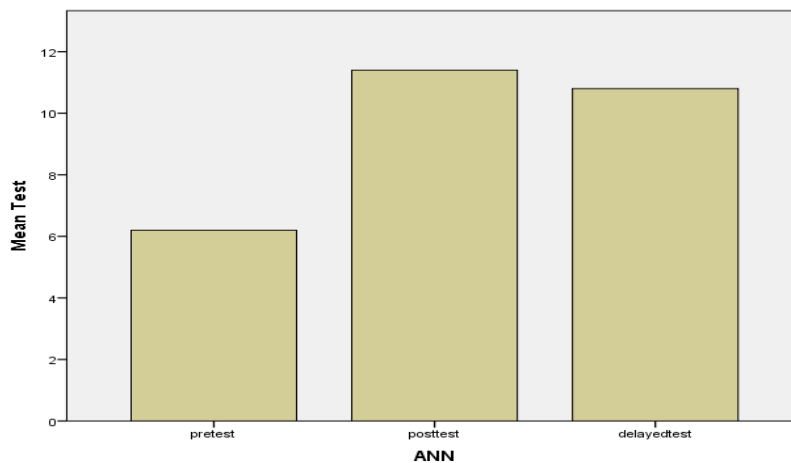


**Table-3.4** Scheffe Multiple Comparisons of students pre test, post test and delayed test scores

| (I) ANN      | (J) ANN      | Mean Difference (I-J) | Std. Error | Sig. | 95% Confidence Interval |             |
|--------------|--------------|-----------------------|------------|------|-------------------------|-------------|
|              |              |                       |            |      | Lower Bound             | Upper Bound |
| Pretest      | Posttest     | -5.200*               | .400       | .000 | -6.32                   | -4.08       |
|              | Delayed test | -4.600*               | .400       | .000 | -5.72                   | -3.48       |
| Posttest     | Pretest      | 5.200*                | .400       | .000 | 4.08                    | 6.32        |
|              | Delayed test | .600                  | .400       | .357 | -.52                    | 1.72        |
| Delayed test | Pretest      | 4.600*                | .400       | .000 | 3.48                    | 5.72        |
|              | Posttest     | -.600                 | .400       | .357 | -1.72                   | .52         |

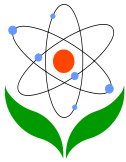
\*. The mean difference is significant at the 0.05 level.

Table 3.4 reveals the Scheffe Multiple Comparisons of students pre test, post test and delayed test scores. The mean difference between pretest and posttest ( $m = -5.200, SD_{Error} = .400, p < .05$ ), and pretest and delayed test ( $m = -4.600, SD_{Error} = .400, p < .05$ ) was also significant. This was because of the effects of neural network artificial intelligence approach on achievement and retention of science learning.



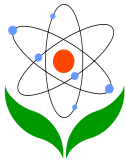
**Figure 5.** Histogram of pre-test, post-test and Delayed test mean score

Figure 5 interpreted the pre-test, post-test and delayed –test score. X-axis represents types of test and in the Y-axis mean of the test score. The pre-test mean 6.20 showed smaller than the posttest mean 11.40 and the delayed-test mean 10.80.



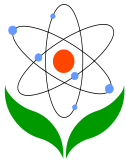
## Findings and Discussion

The study claimed that 60% of students had misconceptions in photosynthesis concepts because of their doubt in the previous classes. It was found that input layer and first hidden layer were strongly related with the outcomes and predicted outcome. Because the outcome depends on the input layer and first hidden layer. It was found that the posttest score was significantly different from pre test score and delay test score. This was due to the treatment effect. Most of the researcher in the world of education found that artificial intelligence is a modern approach and this could be used in teaching learning process, mostly in engineering, statistics, and arithmetic and computer science. Out of different artificial intelligence, neural network artificial intelligence is used to know its effectiveness to predict the learners' outcome as well as achievement and retention in science learning. Objective 1 of the study is based on the misconception test. It was found that 60% of students had misconception in science concept and the result was corroborated with (Cavus, 2010; Kalogirou and Mellit, 2008). However, Conrad (1987) argued that it was difficult to assess students' misconception. Objective 2 of the study deals with the neural network artificial intelligence and prediction of learners' learning outcomes. In this study, it was found that input layer and first hidden layer were related with the output of the artificial intelligence. Therefore, input layer and first hidden layers were the predictors of output layer. This result was supported by (Bratko, 1993; Hendry, 1987; Monostory, 2013 and Prieto et al, 2013). In addition, objective 3 of the study reveals the impact of Neural Network Artificial Intelligence on learners' achievement and retention. It was found that before treatment (pre test), after treatment (posttest) and the delay test were significantly different. The mean of posttest score was significantly higher than the mean of pretest and delay test score. This was due to the treatment effect. This result was supported by (Barto and Sutton, 1997; Dautenhahn, 1995; Feldman and Yakimovsky, 1974 and Kolodziejczyk et al, 2010). From the above discussion, it was found that neural network artificial intelligence intervention has a significant effect on the concepts of input layer with the concept of hidden layer to get the output layer. This is a kind of machine learning that provides output after getting the inputs while hidden layers are the processors used in computer science, logarithm, and science learning.



## Conclusion

The recent study investigated the effectiveness of neural network artificial intelligence on achievement and retention of learners. However, NNAI belongs to computer science, but it influences science learning. After the misconception test, the percentage of misconception among the students was identified, and NNAI approach used. Students used their previous knowledge in the neuron or inputs that helped to connect the first hidden, second hidden and third hidden layer to get the output or they found the answer, means input and hidden layer only can predict the output because these were related with output. In the recent teaching learning process, NNAI approach was using along with other approaches for science teaching. For preparing the students for different state board examinations, central board of examination and Indian council of secondary education, teachers should try to apply this model in science teaching to get better performance. It is no doubt; this approach has high value to motivate learners to answer the essay type questions as well as the short type items, and teacher should take precaution to train the learners. NNAI should be used in various levels of education because it's student active process could help to share information to get collectively a product or answer. Particularly, NNAI is useful for science subject but it has high value in other subject. It encourages and motivates learners to think, re-think the neurons or the inputs. Students have the freedom to link; interlink neurons with different hidden layers and put their effort to get the final answer. Here previous knowledge or the related neurons or inputs are primary task than to get the output. Artificial Neural Network is a part of cognitive science and it directly influences learners' cognitive inputs to process information to represent knowledge. Artificial Intelligence a Neural Network Approach helps the learner to strengthen their knowledge structure. The networks of knowledge in Neural Network could help the learners to remember concept at various stages because neuron is the input to link the hidden layers and to get output. Out of different Artificial Intelligence Approach, the researcher has used Neural Network AI but it needs to apply other approaches of Artificial Intelligence in their research. Recently, five students were included in this study but the researcher recommended to taking more than thirty students in their study to know the effectiveness of Neural Network Artificial Intelligence Approach. In this study, there was no effort to realize the impact of NNAI on gender at different levels and different disciplines and that is why, it is suggested to undertake other variables such as gender, and age variables for



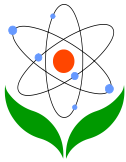
further study. Neural Network Artificial Intelligence especially used in computer science, but it could be used in humanities and social studies. That is why the researcher recommended to the world of teacher educators, teachers, research scholars to use this model in their teaching learning process as well as in research.

### **Limitations**

Neural Network Artificial Intelligence is a branch of computer science is a part of cognitive science; still it is a complex method needs expert to apply in teaching learning process. Normally, children like simple and activity based approach and want to take freedom in every dimension of learning, but this approach has many lacunas in its application, motivation generation, assessment and interpretation of result.

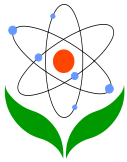
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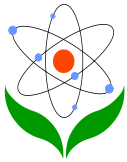


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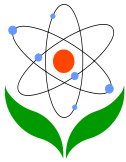




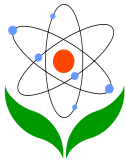
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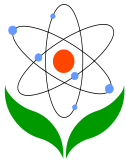
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## Appendix

### Photosynthesis Test

1. Photo synthesis takes place in
    - (a) Thylakoid
    - (b) Grana
    - (c) Photo system
    - (d) Photons
  
  2. Dark reaction in photo synthesis is limited by
    - (a) Carbon dioxide, temperature and light
    - (b) Carbon dioxide, light and water
    - (c) Water, temperature, carbon dioxide
    - (d) Oxygen, water and temperature
  
  3. Colours of light most useful in photo synthesis are
    - (a) Green, yellow and orange
    - (b) Red, violet and blue
    - (c) Infra-red, red and yellow
    - (d) Red, white and blue
  
  4. During what stage of photo synthesis is oxygen produced
    - (a) Cyclic, photophosphorylation
    - (b) Carbon fixation
    - (c) Kreb's cycle
    - (d) Photo system (i) & (ii)
  
  5. Photo synthesis pigment found in
    - (a) Cytoplasm
    - (b) Thylakoid
    - (c) Stoma
    - (d) All the above
  
  6. Which of the following reactions produce oxygen gas?
    - a) Respiration
    - b) Fermentation
-



- c) Photo synthesis
- d) All the above

7. Glucose is stored in the plant as

- (a) Chlorophyll
- (b) Leaves
- (c) Sugar
- (d) starch

8. \_\_\_\_\_ absorbs light energy for photo synthesis

- (a) Vacuoles
- (b) Nucleus
- (c) Cytoplasm
- (d) Chlorophyll

9. Solar energy converts into chemical energy by \_\_\_\_\_

- (a) Respiration
- (b) Growth
- (c) Photo synthesis
- (d) All the above

10. In order of a plant to complete photosynthesis all of the following need to be present except.....

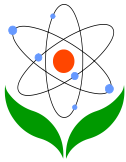
- (a) Oxygen
- (b) Sunlight
- (c) Water
- (d) Carbon dioxide

11. What is produced by photo synthesis?

- (a) Glucose
- (b) Glucose and oxygen
- (c) Glucose and carbon dioxide
- (d) Glucose and water

12. Photosynthesis removes

- (a) Sunlight from earth
- (b) Oxygen from atmosphere



- (c) Pollution from atmosphere
- (d) Carbon dioxide from atmosphere

13. Photosynthetic cells are

- (a) Parenchyma
- (b) Phloem
- (c) Collenchymas
- (d) All the above

14. Photo synthesis is more in \_\_\_\_\_

- (a) C<sub>2</sub> plants
- (b) C<sub>3</sub> plants
- (c) C<sub>4</sub> plants
- (d) None of the above

15. Photo synthesis is a \_\_\_\_\_

- (a) Biological process
- (b) Organic process
- (c) Chemical process
- (d) All the above