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Improving Cognitive Development in Secondary Chemistry through Gagne's Events Of Instruction

Sarfraz Ahmed (Corresponding author)

Foundation University Islamabad, Pakistan

E-mail: sarfrazfui@gmail.com

Shafqat Hussain

Foundation University Islamabad, Pakistan

Shafqat Hussain_1973@Yahoo.com

Abstract

The work being presented here intended to investigate the role of Gagne's events of instruction in the teaching learning process. The focus of this study was to bring about improvement in the conceptual framework and strengthening of their neural networks and the pruning misconceptions of students in the subject of chemistry at secondary level and to evaluate whether the events of instruction are helpful to assimilate the stimulus material with the neural networks of the learners. It was also observed that the events of instruction significantly reduced the learning time and simultaneously the assimilation rate was also increased. Information bridging time was reduced to a significant level. Comparison was made between the students taught by Gagne's events and the students taught by traditional method of instruction. The change or significant difference was observed in favor of those students who were treated by Gagne's events of instruction.

The study put emphasis on the incorporation of Gagne's events of instruction while planning, designing and teaching phase of lesson plan. The events of instruction need to be employed in the planning and designing phase of teaching learning process. The teachers can improve their pedagogical content knowledge and can design the learning situations and learning environments that are conducive to learning. So the teaching learning process, teacher's teaching skills can be made efficient and effective by incorporating Gagne's events of instruction.

Keywords: Gagne's events of instruction, learning, events to support neural linkages.

1. Introduction:

The study aimed to investigate the effectiveness of Gagne's events of instruction and their role in the strengthening of the neural networks and as a whole to improve the learning of students in the subject of chemistry. The central to this study was to activate and support the linking of neural networks and initiate the linking between the existing knowledge and the knowledge to be entered in to the working memory of the learners. The learning with understanding is the ultimate goal of any teaching learning process. The prime objective of learning with understanding can be achieved by proper utilization of previous knowledge of the learners and the bridging up the conditions that are entirely external to the learner and some that are entirely internal to the learner. It is up to the teacher how efficiently and effectively he exploits and manipulates these conditions.Gagne pointed out that the events are exclusively environmental in nature and need to manipulated with utmost care. He further pointed out that the events are necessary to stimulate and activate the formation of neural paths and the further strengthening of the relevant neural

networks. He further viewed that external conditions are also necessary for the pruning of those neural paths which are irrelevant and based on misconceptions. The events of instruction can facilitate the improvement of intellectual skills, ways to form further cognitive networks and the ways to improve the existing ones and the further development of metacognitive abilities. These are helpful in gaining of the control of the learning. The important aspect of these is multifaceted nature and can be used for multi levels and layers of learning. The order of the events is highly flexible and can be utilized in various situations. The teacher can make use of these events as the learning and teaching situations desire. The order of the events due to its flexibility can be employed according to the situation. The events can also be used in other disciplines beside chemistry.

Teaching and learning has always been under scrutiny. The humans have always trying to improve and refine the upbringing of the young generation so that their experiences be transferred effectively and efficiently. The lasting learning is highly dependent upon the cognitive framework of the learners and how effectively information is presented to the learners.Aquisition of knowledge is central to education but this objective seems rooted in older theories of knowledge. This objective is too much limited in range.Aquisition of knowledge is one of the learning outcomes. Acquisition of knowledge falls in the category limited objectives and wide range of objectives can not be achieved just acquisition of knowledge.Taba (1962) revealed that wide range of objectives demand proper planning and organization of learning experiences. The means of attaining wide range of objectives is not content they learn but the way the learners learn.Taba thinks that that the two areas i.e. planning of content and planning of situations that are conducive to learning with understanding needs to be understood and integrated.Taba further indicated that each objective demands specific way to learn. It can be inferred from this that it is not suitable to use a single method of teaching in every situation. The diverse pedagogy needs to be planned for diverse content.Taba (1962) envisioned that the attainment of effective and multiple objectives highly depends upon the provision of active forms of learning.Taba further recommended to devise and design such situations that in which a diverse active learning processes are involved. It means that the learners be provided such situation in which the learners do something on the environment and not the environment do something on them. The learning situations needs to be underpinned by the principle leaning by doing.Gagne (1979) conceptualized that instruction is planning and organizing of situations that are exclusively in the environment and their prime function is to develop pertinent linkages in the existing ideas and weakening of those linkages which may hinder the ongoing process of learning with understanding.Johnstone (2010) emphasized to relate the learning with the way learners learn and stressed to revisit what is going on in chemistry classrooms.Ausubel (1968) put much emphasis on the use of concepts and ideas that are already the significant part of learner's memory.Gagne (1979) also stressed to exploit the ideas of learners that are relevant to the content and skills that are to be learned by the learners by gaining their attention and informing them of the objective under consideration.Johnstone (2010) visualized that the basic intent of information processes is to efficiently and effectively develop proper linkages between the working space and permanent memory that leads to learning with understanding and prevent any kind of irrelevant linkages. The irrelevant linkages may lead to alternative neural networks. It is the job of the teacher to develop, devise and designs such learning experiences that prone to relevant learning with understanding and inhibit any kind wrongly perceived neural networks.Curzon (2004) put great emphasis on the initial status of the learners and asserted that the initial status of the learners is central to instruction and is also the essence of instruction. He further suggested taking in to account the learning levels of the learners and design the learning experiences accordingly. He further stressed to link the learning experiences and teaching with the cognitive demands or levels of cognition.Chiapetta (1989) envisaged that meaningful learning results when the new information is relevantly linked with the information held in the minds of learners.Ausubel (1963) conceptualized two essentials of learning with understanding i.e. the learner must be well cognizant about the learning with understanding and the information presented to the learner must be relevant to the information already possessed by the learner.Johnstone (2010) put great emphasis on the way the information is presented to the learner and suggested that the presentation of chemical concepts must be properly sequenced and should take start from those ideas that are already the part of learner's long-term memory.Valanides (2000) revealed the

difficulties of the students when the learning situations are not properly organized. He pointed out that students specifically feel difficult to move from intangible to tangible concepts. If the learning situations are organized ignoring the notion of familiarity the learning will be hampered.Johnstone (1991) identified three aspects or levels that are central to the teaching and learning of chemistry. He further conceptualized that if chemical concepts are organized around these three levels, learning will maximally occur. To make further sense of chemistry Mahaffy (2004) visualized that learning situations in chemistry be organized around four aspects and called it tetrahedral chemistry. He reframed Johnstone's chemistry triangle and suggested to add a new element such as human context to further make sense of chemistry. He put great emphasis on the human element and visualized it significant in the understanding of chemical concepts. Mahaffy (2004) put great emphasis on the contexts and stressed to integrate context and subject matter knowledge.Nelson,P.G (2003) suggested to commence from those concepts that are quite tangible and quite sensible. And further stressed that learning must revolve around the concepts and ideas that are macroscopic in nature. Gagne (1979) revealed an important condition for learning i.e. learning needs to be initiated inside. He further pointed out that internal initiation of learning can be influenced by some factors that surround the learner and are absolutely external to learner. The awareness of the learner to learn may be affected by the arrangements of the external stimuli. The selective perception or the efficiency of the perceptive filter can be enhanced by such sequencing of stimuli or concepts. The meaningful ordering of concepts stimulates meaningful learning.Gagne envisioned that meaningful ordering of concepts is supportive to the formation of meaningful inter conceptual linkages. This sequencing technique can be used to further strengthening of inter conceptual linkages and weakening of the linkages that may lead to alternative conceptions or misconceptions.Various studies agree that instances and non-instances are crucial to concept learning (Gagne 1979., Johnstone 2000 ; Bruner 1960 ; and Nelson,P.G 2000) conceptualized that proper sequencing of chemical concepts can enhance the intelligibility of the concepts to be learned.Gagne (1979) found that external events strengthen overall learning. Aspects or events of learning are also central to learning concepts.Gagne (1979) indicated that when learners distinguish between the stimuli or concepts learning occurs. The learning enhances when the things are classified on the basis of similarities and differences.Gagne (1979) identified four levels of concept attainment i.e. concrete level, identify level, classificatory level and formal level.Johnstone (2000) placed much importance on the concrete level and recommended to start the learning and teaching of chemical concepts from concrete level.Bruner,Goodnow and Austin (1956) conceptualized categorizing an important precondition for concept learning and is an important factor that eases the complexity of our environment and the phenomena under observation can be easily conceived.E.Chiapetta (1989) while discussing the nature of concept learning indicated that concept learning is an active process and is crucial to the understanding of scientific concepts.Chiapetta pointed out that a concept is comprised of five elements.Heron,Canter,Ward,and Srinivasan (1977) suggested to characterize the abstract nature of concepts through perceptibility i.e. according to their concreteness and abstractness.

1. Concepts with observable illustrations and observable qualities.
2. Concepts with observable illustrations but with no observable features.
3. Concepts with no observable examples and no observable characteristics.

The concepts that are observable and carry observable examples and observable characteristics are easily grasped by the students e.g. beaker, test tube etc. Many scientific concepts due to the lack of perceptible examples can not be perceived directly and need to illustrate through models and diagrams and their features are made evident through visual means.E.Chiapetta (1989) suggested that while learning scientific concepts the factor of relevancy must be taken in to account.He suggested that while learning a concept the working memory of the learners might not be overloaded. He suggested to use the features with great care.Johnstone (2000) also found that too much information causes overload and hampers the learning. Examples and non-examples should be used while teaching a concept (Johnstone, 2000., Bruner, 1960., Ausubel, 1968).Examples and non-examples are crucial to concept learning (Chiapetta, 1989).Gagne (1970) suggested to use a number of examples related to a concept under study. Examples and non-examples efficiently clarify the concepts and remove confusions.Huttenlocker (1962) concluded that examples and non-examples have positive effect on learning a concept.Chiapetta (1989) pointed out that

difficulty arises when concepts get related in the form of a rule. The relationships demand advanced thinking skills.Gagne (1979) conceptualized that rule learning is an important prerequisite for the learning of complex concepts. Rules and principles are composed of several concepts.Gagne (1970) pointed out that basic concepts are critical to rule learning because rule has relational nature and it shows a relation between two or more concepts. The basic concepts that lead to the framing of a rule are prerequisite to rule learning.Gagne (1977) revealed that that the learning of each concept demands specific external processes that support the internal processing of concepts. The more valid and reliable external processes or aspects, the more explicit learning will occur.Gagne proposed to make use of concrete situation. Concrete situations and examples are critical to the learning of scientific concepts and especially for practical work.Gagne urged to make use of verbal words and verbal associates because these generate the conditions that are within the learner and conducive to concept learning.Gagne (1979) emphasized the following sequence of the learning situations.

1. Gaining attention
2. Informing the learner of the objective or concept to be learned.
3. Stimulating the recall of prerequisite learning
4. Presenting the stimulus material or concept to be learned
5. Providing the learning guidance
6. Eliciting the performance
7. Providing feedback about the performance
8. Assessing the performance
9. Enhancing the retention and transfer

The study intended to investigate the effectiveness of the learning processes in the learning of chemical concepts at secondary level that are entirely external to the learner and carry environmental nature i.e. learning situations or experiences. A characteristic value of these processes is that these are not rigid but quite flexible and can be modified according to the learner's cognitive level and way learner learns.

2. Hypothesis H_O 2:

There is no significant difference between the mean scores of Gagnian and the non-Gagnian (traditional group) on posttest.

3. Methodology:

The study primarily focused to compare the role of Gagne,s events of instruction and the traditional lecture method in the sufficient understanding of chemical concepts at secondary level. The contents were sequenced as per the events envisioned by Gagne.The students got frequent formative assessment and feedback about their performance and concept formation. To examine the role of these external processes and events the appropriate design selected was "posttest only equivalent group design" was selected.

3.1. Population for the study:

The population for the study comprised of all 9^{th} grade male science students in F.G.Boys Model schools of urban area of Islamabad.

3.2. Sample for the study:

There were 140 male science students in the eights class. All the students got promoted to the 9^{th} class and opted for science. Out of 140 students 56 students were randomly selected and given the descending order and matched. The criterion for equalizing the groups was 8^{th} class science achievement scores. So the two groups were created and randomly assigned Gagnian and non-Gagnian groups. The randomly selected students were assigned as Gagnian and non-Gagnian (traditional group).Each group involved 28 students. The demographic details of the subjects were:

3.4. Data collection Tools:

The data was collected with the help of posttest. Both the groups were equated by using 8th class science achievement scores. The posttest was administered at the end of the experiment to reveal the difference between the achievement level or the terminal behavior of both the groups.

4. Conclusion

It is very obvious from the data that the calculated value of *t* (*t*=2.87) is greater than the tabulated value of *t* (*t*=2.009 at 0.05 level of significance), Hence, the null hypothesis, "There is no significant difference between the performance scores of students taught by Gagnian instruction called Gagnian group and the students taught by traditional instruction called traditional group or non-Gagnian group on post-test" was rejected.

5. Results and Discussions

The vital intent of the work offered here was to bring improvement in the cognitive structure of the learners by making use of Gagne's events of instruction that are really external processes. The fundamental function of these processes is to help the learners to bring about conceptual change and learn the scientific concepts with understanding. The effectiveness of events purely rested on the learner achievements. The first event is very critical and crucial i.e. attentiveness of the learner. It is basic to learning. Learning is meaningless unless the learner is attentive and ready to grasp the task. It is also significant that learner be informed about the objective or what he is going to do. He must be informed about the learning outcomes and competencies to be achieved. Another important event is that learner be properly be guided while the concept formation process is in progress. Lack of guidance may lead to failure. Another hard core of the model presented by Gagne is sporadic and frequent use of assessment which is purely formative in nature and has carry over effects. The learners are provided regular feedback regarding their learning progression as the work has proved the effectiveness of this intermittent inbuilt assessment in the Gagne's model. But continuing efforts be made to prevent the model from mechanization. The mechanization may lead it towards the behavioristic mode which is not the intent and essence of the study. The last step is most significant that ensures whether the knowledge /information presented to the learner can be transferred to other situations and applied for the daily problem solving. From the work presented here it can be concluded that improvement in the presentation and sequencing of information and content leads improvement in the cognitive structure and learning with understanding. It can be said that external processes are directly related to the learner's internal conceptual ecology and both the internal and external processes are symbiotic in nature. Both the processes nurture each other. Another important characteristic of Gagne's events is that these are not rigid but quite flexible and their use with flexibility is highly dependent upon the teacher. At lower level learning the maintenance of rigidity is mandatory.

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Table 1

Demographic details of the participants

Gender	Teaching Type	Teaching Type
Male	28	28
Age Level	13.5	13.5

Two Sample t-test and Confidence Interval

Table 2

Two sample t for Gagnian vs. Non-Gagnian /Traditional group

	N	Mean	St. Deviation	*SE* Mean
Modular	28	39.79	7.10	1.3
Traditional	28	34.21	7.43	1.4

95% CI for mu modular - mu traditional: (1.7, 9.5)

t-test mu modular = mu traditional (vs. not =): *t*= 2.87 *p*=0.0059 *df* = 53

The t-test was applied to find whether there was any significant difference between the achievement scores of the students in the subject of chemistry taught through Gagne's events of instruction and the traditional instruction. The result indicates that the mean value for the Gagne's events of instruction (M=39.79) is significantly greater than the mean calculated for traditional instruction (M=34.21).

Figure 1. Post-test scores of Gagnian group or modular

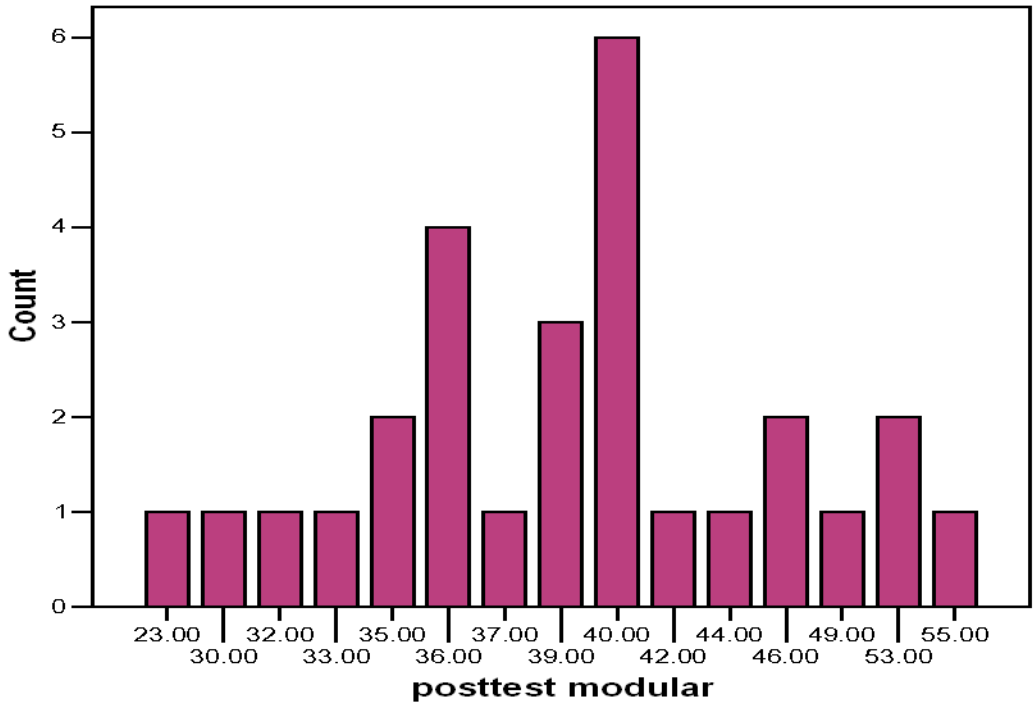

Figure 2. Post-test scores of Non-Gagnian /traditional group.