1. **Title :** Interdisciplinary Pedagogy: Teaching technology to design students.
2. **Theme:** Fashion Beyond Borders
3. **Sub Theme:** Educational Responses

**4.0. Keywords:** teaching, design, technology, pedagogy, interdisciplinary.

**5.0. Introduction:**

In today’s learning, there is an increased demand and requirement of higher education. The demand gets further reinforced and emphasized for the socio cultural and economic need to build a prosperous future. The current generation is therefore in search of higher skills, knowledge and training to face the upcoming challenge. And higher education provides that required skill based training at the post secondary level by universities and other educational establishments.

 Though the main purpose of higher education is to educate students to become well informed and deeply motivated citizens, who could think and act critically, solve our complex problems of daily life and therefore build a happier society of trust and responsibility, some students see this differently. Their main purpose of completing a graduation, or a post graduation, or seeking a doctorate degree is not for its intellectual appeal but for the social position, or status, or to get a job. They are less bothered with the passion for knowledge. Rather they just want to achieve the degree and use it as a stepping stone for achieving something else. Therefore higher education is catered to the requirement of a diversified category of people. This affects the classroom delivery, its contents, methods, practices and means of knowledge transfer to the students. To achieve these goals, it may be necessary to change the curriculum and use newer and other more appropriate methods of delivery, so as to go beyond the cognitive mastery of discipline. Newer didactic and pedagogical approaches should also be used to increase the overall understanding and therefore the acquisition of knowledge, independent understanding of the subject, and the level of application in real life situation.

Along with this present challenge, tutors are nowadays plagued with yet another problem of interdisciplinary teaching. The current curriculums in most universities consist of core subjects called majors, supported by peripheral electives, called minors. A minor is a module which is not directly linked with the core area of the curriculum. Rather its importance lies in gaining a holistic understanding of the core module. In a way it is a supporting module of the curriculum major. Teaching such a subject in a classroom of a wide range of students with different aspiration and ambition turns out to be a major challenge to a tutor. Ordinary teaching therefore fails to promote equal interest and motivation throughout the whole class. Proper research based scientific approach to teaching, also called Pedagogy, is therefore required which can only dramatically shift the performance of ‘weak’ students who have been failing or struggling to pass the assessments.

**6.0. Literature Review:**

Pedagogy (Jacobs, 1994) is the study of being a teacher or the process of teaching. This term mostly refers to the style or strategy of instruction. The word pedagogy comes from the Greek source literally meaning ‘to lead the child’. In ancient Greece, a slave used to supervise the instruction of his masters son. He used to take the child to school, or gymnasium, looking after him and carrying his books and equipments.

However in English, the term pedagogy is used to refer to a method or practice of teaching, especially as an academic subject or theoretical concept (Oxford Dictionary, 2011). It refers to different strategies and designs of teaching a particular subject based on some established successful practices.

In the conventional teaching/learning environment, very little attention is paid in pedagogic enhancement which must go hand in hand to make classroom teaching exciting, understandable and enjoyable to every student in the class. Pedagogic strategy gives the tutor a rich repertoire of moves and techniques. This helps him in matching the right strategy to the situation. Though sometime this trial and error method might end up in a failure, still a constant search for the right teaching technique based on pedagogic learning is far better than the limited strategies of classroom teaching that one might explore out of intuition. And for challenges like interdisciplinary teaching, it requires a different treatment with some surprise factor to keep up with the expectation of the students. Much of the success of any tutor in such a situation depends upon his correct understanding of the class, and ability to re innovate and reinvent in order to find out the right teaching strategy to develop active ‘creators of knowledge’ instead of ‘passive receivers of information.’ Only then interdisciplinary teaching becomes successful.

 Interdisciplinary teaching, which is present in every program nowadays, is included as a foundational objective of a number of curriculum areas. It connects curriculum in an effective manner in order to help the teachers deal with knowledge that grows in exponential proportions. It helps in making links between disciplines and therefore plays an important role in sketching a holistic picture across disciplines in the mind of the students. It gives a more relevant, less fragmented, and stimulating experience (Jacobs 1989,p.10).Thus it dissolves the boundaries of areas of study, and encourages learning across curriculum. Finally it leads to a well rounded education where critical thinking and transfer of knowledge takes place amongst the students. Where researchers like Repko(2009) asserts that interdisciplinary instruction fosters growth in cognitive ability, other contemporary educationists like Kavaloski (1979), points out that a number of distinct educational benefits result from interdisciplinary learning. The benefits are as follows:

1. The first benefit of interdisciplinary teaching is that it uncovers preconception or recognizes bias. This help the students in clearing their powerful misconceptions in unexplored topics, by introducing them to the new subject matter in a variety of ways that nullify and further correct their existing notions. Bransford, Brown & Cocking(2000)argues that interdisciplinary teaching accomplishes its goal in two ways. Firstly, it guides the students in identifying insights for a range of disciplines that contribute to develop a newer perspective about the matter under consideration. And secondly, it directs the students to develop the ability to substantiate concepts and ideas from relevant disciplines into broader conceptual framework of analysis. As a result, the students can overcome their preconceived notions quite easily and therefore are open to newer methodologies promoting better understanding.

2. The second benefit of interdisciplinary teaching is that it helps the students in developing their cognitive and critical thinking. Allen Repko (2008) asserts that interdisciplinary learning helps students acquire the capacity to understand multiple viewpoints on a given topic. The students therefore acquire perspective-taking techniques ( Haynes, 2002), gain wider understanding of the subject and therefore acquire structural knowledge (or factual information), and procedural knowledge (or process based information). Thus the students increase their knowledge formation capacity, and can engage in conversation of more complex issues. So, instead of taking a narrow one sided view in solving a problem, the students can explore it from a wider perspective, and therefore integrate conflicting ideas from multiple disciplines.

3. The third benefit of interdisciplinary teaching lies in the students’ holistic understanding of any situation or problem, therefore teaching them to embrace ambiguity and appreciate the complexity of the problem. With interdisciplinary learning, the students understand why conflicts arise, what are the reasons behind this disharmony and therefore find out an ideal solution equally appreciated by everyone. When learning is confined to a single discipline, ambiguity arising out of complex situation is considered short comings of the analytical framework. With a holistic interdisciplinary training, the students tend to explore alternative perspectives rather than criticize the shortcomings of a particular discipline. This leads to the much required healthier working environment where people complement each others limitations instead of criticizing each others shortfalls. They understand that ambiguity results from complex situations arising out of alternative perspective from different disciplines instead of a single department. Therefore the problem can be sorted out in the right way.

4. Interdisciplinary education also promotes ethical face of every problem. It helps us to distinguish between the ‘right’ from the ‘wrong’ and the ‘good’ from the ‘bad’ which again gives a holistic perspective as against mere objective factors which increases our narrow mindedness. Interdisciplinary knowledge leads to integration of ideas from different departments and helps us in finding out the best solution by properly studying the ethical side of the decision.

Fink(2003) in his path breaking essay ‘Self-directed guide to designing courses for significant learning’ further points out 6 elements of educational process which permits ‘significant learning’. And all these elements are available with interdisciplinary education. The elements and their relation with interdisciplinary learning are as follows:

## Figure 1. The taxonomy of significant learning



1. Foundational knowledge-what key information is acquired from the new module. Interdisciplinary learning focused on some established areas of information gives the relevant foundation knowledge to the students.
2. Application goals- this element based on ‘critical thinking’,’ creative thinking’ and ‘practical thinking’ again comes out from interdisciplinary education which stresses largely on application based learning.
3. Integration goals- this element, focused on the connections and similarities that the students need to make for ‘significant learning’, again is largely prevalent in interdisciplinary learning where the main aim of the tutor is to give a broad based holistic understanding of the subject area.
4. Human dimensions goals- this element which helps the students learning relevant personal or social issues from the subject taught is yet another feature of interdisciplinary teaching. A lot of self reflection and understanding with respect to other branches under consideration comes from interdisciplinary classes.
5. Caring goals- this element promoting ethical side of the business and acknowledging the role of feelings, interests and values are again present in interdisciplinary teaching that focuses on holistic learning of an area under consideration.
6. ‘Learning how to learn’ goals- this element promoting insights into the process of learning and guiding the students to become ‘good self directed learner’ is also another significant feature of interdisciplinary teaching. Interdisciplinary instruction at its basic level fosters the acquisition of fundamental knowledge, advocates integration of ideas from various disciplines and provides insight on how to apply this knowledge. Thus, ‘learning how to learn’ element is also present in interdisciplinary learning. Also, an interaction of each of these 6 elements with each other definitely promote the well intended significant learning of the students.

Real life problems are complicated. So, no single discipline can solve it. Therefore we need a multifaceted outlook where ‘educational experiences are more authentic and of greater value to students’ as compared to a ‘compartmentalized neat subject matter packages’ in specialized disciplines as discussed in National Council for Teachers of English(N C T E, 1995). Additionally, interdisciplinary teaching is cheap since most institutes nowadays have multiple disciplines. Therefore, they can easily interchange tutors from disciplines to import interdisciplinary skill amongst the curriculum. No wonder that for all these reasons, interdisciplinary forms of teaching are prevalent and also increasing in plenty throughout higher education (Edwards 1996). With scientific pedagogic learning one needs to challenge these interdisciplinary teaching.

Pedagogic theories or established steps and procedures to promote effective learning can be generally classified into 3 basic models based on the role of tutor and student in understanding the concepts. The theories are:-

1. Top down Model, where the teacher directly passes on the instruction to the students.
2. Social Model, where students and tutor equally participate in establishing the concept.
3. Bottom up model, also called student directed model where the students actively take part in developing the concept. The tutor in this case merely acts as a facilitator.

Numerous teaching models have thus been derived from the above 3 basic models. This current research is also an effort to plan a model to take an interdisciplinary class on technology-‘Time and Motion study’ for fashion design students. More than one model are mixed and matched to meet the objectives.

**7.0. Objective:**

Though different teaching theories are already in use in higher education, a single theory sometime remains insufficient for effective delivery. As pointed out by Ramsden (1992, p.87), though there cannot be ‘one’ best way of teaching, it is a mistake to suggest that there are no better or worse ways of teaching in higher education. Therefore salient features of more than one model can be mixed and matched to meet the objectives. And in interdisciplinary teaching we need such ‘tailor made’ models to increase the effectiveness of teaching.

Here, a batch of undergraduate fashion design students was taught the key area of manufacturing technology-Time and Motion study of stitching operators. This study helps in finding the job content, increase in productivity of the floor, and further calculating the labor time and cost for manufacturing. In traditional teaching model, this class is usually boring and one sided where the tutor teaches, and the students note down the method. Finally when the concept is taught, tutors usually demonstrate a practical example to explain its application. But in spite of all these efforts, the session always remained dull and monotonous with very little participation from the students.

This time it was decided to explore a new method based on some existing teaching/learning models. This research was therefore divided into 2 parts:

1. To plan an intuitive teaching model to take an effective class on Time and Motion study.
2. To execute the plan in an actual class and analyze the response from the students.

**8.0. Methodology:**

29 undergraduate fashion design students from a Delhi based fashion design school were taken as a sample for teaching ‘Time and Motion study’-a technology based concept required for interdisciplinary learning. The teaching methodology involved an intuitive ‘out of the box’ strategy including various teaching /learning theories for higher education. The session started with a set of questions followed by a short video clip. Then through group discussion the concept of motion study was introduced. Lastly, through class room lecture, the actual principle was explained.

The same procedure followed for Time study also. This time the video was again played and the students (this time in groups of 2-3) were asked to time the operation (Time study). Then the best time was recorded and the theoretical concept was again explained through class room lecture.

The main purpose of the session was to facilitate the students in establishing the complicated concept of ‘Time and Motion study’ in a simple yet accurate method. Since the session planned was student led, understanding and appreciation of the principles were supposed to be better.

At the very end, an anonymous student feedback on the teaching methods was taken.

**9.0. Results and Discussion:**

**9.1. Results to Research Objective 1:**

**The Plan**

Different teaching theories and learning strategies are used by tutors for higher education. Where some topics may be effectively taught using any strategy, some may not have an ideal successful strategy. We therefore need to mix and match the existing strategies to tailor make an ideal teaching strategy. After studying several teaching models for higher learning, the following popular models were taken up for planning the session. The models and their brief explanations are given below:

1. Problem Based Learning (PBL) - This is a teaching strategy promoting critical thinking amongst students leading to develop the required knowledge to solve the problem. PBL starts with a real problem and requires the students to research, explore, analyze, and apply information’s and theories to solve it. Here students work in groups to manage situations without any established prior knowledge or hint of the solution. They themselves decide what skills they need to understand in order to manage the situation more effectively. As per Biggs(2003,p231), PBL is not a method so much so as a total approach to teaching, which includes several ‘teaching learning activities’ as well as assessment methods. It is something like a real life situation where one starts solving the problem with whatever resource one has and slowly tries to build up on ones existing knowledge. However, the aim is not only to solve the problem but to acquire knowledge, relevant skills, attitudes and every aspect of professional wisdom to solve similar problems in future. This technique of teaching is mainly used in application based subjects like technology, medicine, law etc. The plan used in this current research was primarily based on PBL. Different characteristics of PBL and how this strategy was planned in the current session are given below:
* PBL requires a practical stimulation to present it.

 Three short video films for stimulation were planned in the session.

* In PBL, problems should be presented as a simulated professional practice of an actual situation.

Three typical sewing floor activities were used as simulations of actual professional practice in the class.

* In PBL, the tutor should encourage relevant critical thinking in the class.

In this case, three basic questions before the video show were intended to promote critical thinking amongst the students.

* The students need to work in smaller groups to discuss, explore, differentiate and arrive at the correct answer.

Here, it was planned to divide the class in smaller groups of only 2-3 members to promote effective small group teaching in the session.

* The students should select the correct resources to address their own learning needs.

Here, healthy inter group discussions were planned after the video show such that the students could identify their learning needs, and therefore choose the correct resources.

* The students should reapply their knowledge to the initial problem and reevaluate its process.

Here, it was planned to play the video once again after the theoretical explanation (based on Direct Instruction Strategy) so that the students could carry out the required activity correctly (by following the standard method this time). Of late, many tutors have blended PBL with theoretical lecturing based on ‘Direct Instruction Strategy’ to make the class a ‘plenary’ session (Exley & Dennick, 2004, p.1).

B. Direct Instruction Method-This is a highly structured teacher centered information delivery method characterized by class presentation, class exercises and direct instruction following Hunter(1994). It includes giving the objective and aim prior to the session, followed by explaining the theories of the subject, and finally having an evaluation of the students on the said topic through some questions and answers. Since this technique covers up all important points of the lecture in a short time, it was also planned in the current session.

C. E- Learning- Commonly called Computer Based Training (CBT), this is yet another teaching strategy lately used by tutors of higher education. Developments in internet and multimedia, the primary enablers of e learning can be effectively used in technology, content, consulting, services and support industry in general. According to Allen (2008), there has been an increase of around 12-14% per year on average in enrollments for online learning in the US Higher Education Society. Not only in online courses, e learning comprised of all forms of learning and teaching which is supported electronically. It was therefore planned to use ‘small video clips’ as an e learning tool to support teaching in the class.

D. Social Learning- This is a tutor –guided co operative learning facilitating student interaction on the said topic (Pearson,1988). Very often it involves ’reciprocal teaching’ methods where students and teachers have an open debate on an article, or a theory or a case study that is presented in the class-room. The teacher assumes the responsibility for guiding the dialogue, followed by helping the students to create a model, thus explaining the students to use the strategy.

The current plan of students in small groups of 2-3 analyzing the given questions with respect to the video clip, and arriving at a common ground through discussion, can be taken up as a typical model for ‘Social Learning Strategy’ in teaching.

**9.2. Results to Research Objective 2:**

**The execution of the plan**

The class started with three basic questions followed by three short video clips, each of 1-2 minutes duration. A short duration video clip was intentionally chosen since a longer video make the students relatively passive and they tend to see it as watching television (Race, 2003, p.90). The content of the video clips were as follows:

1. A short stitching cycle in a garment manufacturing assembly line.
2. An in-line pressing operation in the same garment manufacturing assembly line.
3. A long stitching cycle in the same line.

For each of these clips, the students were supposed to find answers to the following questions:

1. What is happening here?
2. How can we improve it?
3. How to record the improvement?

The first question was supposed to make the students analyze a sewing operation, and systematically investigate all the factors that affect efficiency and economy of the work. In short they were supposed do Work Study without any prior knowledge or awareness of the concept. This Work Study should help them in effectively carrying out Time and Motion study - the two branches of Work Study.

The second question was directed to make the students critically examine the existing method of doing the work and therefore suggest an improvement on it. The students were unknowingly carrying out a Motion Study of the operation.

The third question was intended to make the students think of a systematic way to record the time of an operation. In short they were doing Time study.

In all the three cases, the situations were typical of a sewing floor where the students were required to identify the nature of the problem, collect information to deal with it and finally synthesize a solution. As per Ramsden (1992, p.148), such an approach of PBL improves the retention of knowledge and therefore enhance student freedom and motivation.

The students were clearly very excited about the whole activity and participated in the class with full vigor and enthusiasm. The answers given by some of them were very impressive and the students surprisingly defined the three key concepts of Production Engineering-Work Study, Motion Study and Time study without actually learning them. They were more involved in higher order cognitive activities (Biggs, 2003, p.4) like theorizing, applying and relating as compared to the conventional lower level engagements like memorizing, note taking and describing. Then the theoretical part of the session was taken.

Through PowerPoint presentation, the ILO (International Labor Office) definitions of Work study, Motion Study and Time Study were explained. Since the students found their answers in the definition, they could understand and appreciate it better than the traditional method where the theory comes before the real life example. With more emphasis on application than its technical theory, the session content also became more lively and relevant.

After a short break, the second part of the session started. This time the students were required to do a time study of the operation. The first video clip (by then the students were thorough about its content) was again played and the students were asked to record the actual time by utilizing their wrist watch or mobile phone as a stop watch. The common steps and practices used in the industry to record the standard time were again not told to the students. The students had to develop their own systems and methods to arrive at the answer. Here, the class was divided into small groups of 2-3 members and each group was asked to find out the answer collectively. The students were then given an opportunity to learn from each other (peer teaching) which is a characteristic feature of Social learning. Again the students showed lot of interest and keenness in arriving at the answer. Then the methods were compared with each other in order to get the best method. Finally the standard time study method (again ILO certified) was explained with proper justification. The students understood the method much better now and therefore appreciated all the steps.

Last of all, the video was again played and the students were asked to time the operation following the ILO standard method. Needless to say, most of the groups got it right this time.

**10.0. Conclusion:**

***Critically reflective teachers learn from the past but live in the present with an eye to the future.***  ***(Stephen D. Brookfield)***

In the conventional Direct Instruction Method, a lot of things remain unclear to the students in the class. It only becomes clear once this time study is carried out in professional life. A lot of steps and sequences which otherwise seem unnecessary and redundant for Motion Study also becomes understandable when it is practically carried out on the production floor. Therefore the classes stand monotonous and boring and required a lot of memorizing and writing. On the contrary, when the new method was experimented with the chosen batch, the students enjoyed participation in the exercises and therefore unknowingly learnt the concept in detail. The tutor’s role in the whole process remained more of a supervisor, a consultant or a group leader. The self initiated knowledge that students imbibed through this process is sure to remain life long. Along with a high quality effective learning of the students, it also produced a sense of enjoyment and commitment towards the subject.

The student’s feedback at the end of the session was also overwhelming. Almost every parameter for judging the session were either marked ‘good’ or ‘very good’ (the best 2 responses)by the students. Additional comments by some of the students (one of the student even commented that it was a ‘fun exercise with a surprise factor!’) confirmed that the application based outlook of teaching was well taken by the students.

With the paradigm shift in higher education interdisciplinary teaching and emergence of newer teaching pedagogy to facilitate self-initiated student learning, the tutor needs to reorient himself through constant reflection. Here, the actual responsibility of a teacher goes far beyond the transmission of knowledge to teaching how knowledge can be sought, substantiated, assimilated and used as a basis for further learning (Goble 1977, p.56). It requires the tutor to be a lifelong reflective teacher in order to become such ‘facilitators of learning’ (Doll 1989, p.40).

Since every class has its own uniqueness and individuality, one cannot say that a single set method will be equally successful in every case. One needs to constantly carry out his reflection and challenge to research, explore and apply newer techniques to ‘make students understand to the extent that they feel that a particular sector of their world has changed, and is coming under their control’ (Biggs, 2003, p.53).With such an understanding, the students reciprocate with a deeper sense of satisfaction and contentment. And that becomes the biggest improvement motivator for a true teacher.

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