ET 611 (Learning Sciences) Mid-Semester Examination

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ADHERENCE TO HONOR CODE:

As a student in IIT Bombay, I acknowledge that it is my responsibility to learn and abide by principles of intellectual honesty and academic integrity. I will not ask for or give help in this exam. I have not directly copied words from any other material and all my answers are in my own words.

Ques1: **State whether the following statements are true or false. Provide short explanation/justification for your answer.**

1. "Legitimate Peripheral Participation" did not evolve from the theories of apprenticeship and situated learning.

   False. Legitimate Peripheral Participation was initially mistaken for Situated learning and for cognitive apprenticeship. However, evolution of these theories over time have bifurcated apprenticeship from situated learning, and both of these constitute and result in legitimate peripheral participation. *(reference: Legitimate Peripheral Participation by Jean Lave and Etienne Wenger, pg 29-30)*

2. Learning according to "Social theory" is based on the component of community, practice, meaning and identity.

   True. A social theory of learning must integrate the components necessary to characterize social participation as a process of learning and of knowing. . *(reference: Communities of Practise by Etienne Wenger, pg 4-5)*

3. One of the premises of constructivist approach is – Learning is a process of adapting the prior knowledge.

   True. Learning is the compilation and modification of complex knowledge structures. The learner must consciously think about trying to derive meaning, and through that effort, meaning is constructed through the pre-existing knowledge structures. The knowledge structures that are present are derived from past experiences, and the learner benefits by adapting to whatever his/her prior knowledge. *(reference: Mark Guzdial's notes on Constructivism vs Constructionism)*

4. According to constructivist learning theory, learning cannot happen in a lecture based classroom.

   False. "*Piaget liked to emphasize learning through play, but the basic cognitive theory of constructivism certainly supports learning through lecture - as long as that basic construction of meaning takes place*." Lecture can complement a constructivist learning approach, as long as the learner makes conscious efforts to derive meaning off these lectures. When he/she does so, construction of meaning takes place uniquely, and this construction will be strong. *(reference: Mark Guzdial's notes on Constructivism vs Constructionism)*

5. Prior knowledge, skills, beliefs, and concepts significantly influence what a learner notices about the environment and how they organize and interpret it.

   True. Prior knowledge plays a vital role in learning a new concept. Learning can be considered as modifications or adjustments of prior knowledge or using prior knowledge as a foundation to build a concrete knowledge tower. . *(reference: How People Learn, pg 10)*

Ques2: **How does teaching and learning happen in the environment informed by situated learning? What are the challenges and issues? How according to you, can these challenges be addressed?**

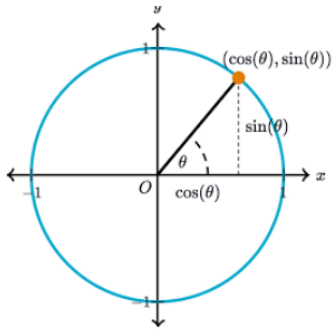
The theory of Situated Learning differs from other theories of learning which usually define learning as the acquisition of propositional knowledge. Rather, they focus on learning as a process of participation in a community, and lays its onus on the relationship between the process of learning and the social environment in which it is taking place. In other words, it "situates" the learner in a social environment. In a situated learning environment, learning takes place in the same context it is applied in. It is often termed as "*learning by doing*" because you learn to do what you are trained to do primarily by doing. In a way it involves the whole person rather than simply ingesting a piece of information and taking it to be granted. In a situated learning environment, teaching mostly entails guiding, owing to the definition of situated learning itself; learning through instruction is minimal, and is supplemented by apprenticeship. An ideal teacher in this environment only reveals a part of the requisite knowledge to the trainee, and expects the trainee to figure out the rest by him/herself, not as an assessment but because it is believed to be the best resort. Theories of situated learning aim to educate the trainee by addressing the interactive relations between the trainees and the social environment by local reconstruction of interpersonal and individual events. Theories of social structure which in extreme cases, oppose theories of situated learning must be considered by a social theory of learning. Hence, quite a few challenges arise while considering an ideal situated learning environment.

The most extreme theories of social structure deny knowledge to its individual actors. Further, there is not much specificity in the knowledge that is obtained and hence, each task in a situated learning environment carries its particularities and limitations. Generality or abstractness can be in large amounts, and this "*general knowledge*" may not accomplish the goals that more instruction based, specific learning theories tend to. There might not be sufficient participation by the trainee, in which case a social theory can not be applied satisfactorily. These drawbacks are the cons to what else would be a very powerful theory of learning. These issues can be ameliorated by a broader social theory of learning which incorporates ideas from theories of ***identity***, ***practise***, ***situated learning***, ***social structure***, ***collectivity***, ***subjectivity***, ***power*** and ***meaning*** and unifies them with minimal conflict. An agreement or a pact should be made between the individuals who officiate the social structure and the individuals who are more involved in the situated learning environment, which grants sufficient transparency of knowledge. Complementary instruction should cover more specific information rather than general knowledge which can be acquired by apprenticeship. This tends to constitute a rich situated experience and makes up for the generality. An example would be to have regular seminars for junior surgeons about high risk surgeries even though the probability of a junior surgeon encountering one is small (usually the seniors take care of them). This prepares the surgeon for a more specific but rather important task which is not covered by his general knowledge. Participation must be incentivised and the community must be made more accessible to the newcomers. This may involve a community meeting for a reason other than the one on their agenda; for example, a group of (junior and senior) doctors going out for lunch and discussing the exciting cricket match that happened the previous night. In broad terms, the community must be glued together better in order to optimize the drawbacks that a situated learning can have.

Ques3: **Based on your current understanding from the readings, videos, and discussions of how people learn, what changes would you suggest in the traditional modes of teaching used in schools? To answer this question, you can choose the "depth approach" where you take a specific example/context and explain in detail the existing practices in that context and what changes you suggest. Other is the "breadth approach" where instead of going into depth of one example, you shed light on different contexts and scenarios.**

I shall use the "depth approach" and explain a particular example in detail. The example I choose is a topic called **Trigonometry**, which is first introduced to high school children in India in their 9th or 10th standards. I did not have much trouble with this topic, but I could see my peers struggling to understand what I thought were easy concepts. Note that previous knowledge structures play a vital role in the understanding of a new topic; for example, in this case, one must have a thorough knowledge of basic geometry, ratios and indeterminate algebra. Those that do not have a foundation must be gauged first and few extra classes of 15 minutes each must be taken to strengthen these topics alone. In general, schools must do a better job organising content, maybe even ignoring the order given in the curriculum. They also must find out the hardest topics in the curriculum and precisely identify 2-3 topics that are necessary for understanding that hard topic. I have outlined the three topics required for trigonometry above. This involves gauging the prior understanding of the students.

In addition to extra classes, instructors must make use of a constructivist approach to this topic. I was not at all satisfied with the way I was taught, and I loved reading myself from a Pre-calculus book. In schools, students are blindly introduced to the concept of "trigonometrical functions" even though most students would not have grasped the notion of a "function". A "function" is again a mathematical structure that is hard to understand at the lower high school level. Hence, teachers should make tough concepts dependent on ***less complicated*** cognitive structures in mathematics, for example, graphs, ratios and proportions. Instead of having the students learn by heart the "formulae" for sine, cosine and tangent, through acronyms like "SOH CAH TOA" *(this one is so infamous that you probably remember it!),* Instructors should follow this approach:



The x- axis and y-axis are defined, and students know about them well because they have had experience with graphing lines on graph sheets.

Here, if the radius of the circle is 1 unit (cm), then by drawing any angle as follows, one can obtain $\sin(\theta) = x$ and $\cos(\theta) = y$ where x and y are simply the x and y co-ordinates of the point where the dark line intersects the circle!

Further, the sine and cosine for an angle of a triangle can be defined by simply "magnifying" the above picture! (and making the triangle in the circle fit our given triangle)

In fact, students are often baffled when you tell them that you can find the sine and cosine of an angle up to an accuracy of 0.005 by just using a scale, a protractor (to measure angles) and a compass! they think that scientific calculators are required to calculate any angle that is not equal to one of the special angles $(30, 60, 90$ degrees) and hence, alienate themselves from trigonometry thinking that it is too complicated. This can be done by just drawing a circle of 10 cm by repeating the same exercise described in the box above. The only difference would be that the whole diagram is magnified by a factor of $M = 10$ from the previous image, and we make the use of ratios to do the rest- The x axis co-ordinate we measure is $10 * x$. Naturally, to get x, we must divide this by 10, and voila, you now have the cosine of an arbitrary angle!

Doing this could significantly reduce the trepidation shown by students towards this very important topic in mathematics. In fact, trigonometry is used in almost all of the curricula of 11th and 12th grades. This is just an example, where I have gauged and made use of the **prior understanding** of the students better (by helping them access ***less clouded, clearer and easier cognitive structures***) and also, to a degree led the students into an outbound trajectory into the subject, and made it more accessible to them. In a way, this is a **constructivist approach** because we are constructing an artifact (a diagram) which will help us understand better about trigonometric ratios.

Ques4: **Design a short lesson plan using Constructionism theory to teach any topic from the domain of your choice (STEM/Non-STEM). Specify different aspects of the lesson plan – for example what will the teacher do, what will the student do, sequence of events, etc. Justify how Constructionism is suitable for the chosen problem and how it helps in overcoming the challenges that students might face in learning the topic. Also, explicitly mention the features of the Constructionism theory that you used in the lesson plan and justify their relevance in your context.**

Constructionist theories stress the importance of tools, media, and context in human development and learning. I will take the topic of interest to be Music theory. Music theory is a fast evolving branch of arts that is centred upon analysing principal structures of music namely rhythm and melody. It is also a very abstract and subjective study. The tastes of people that are highly variable must be kept in mind while composing a melody.

Let us say that I devise a hypothetical course called CMP101 abbreviated as Composing 101. Then, in order to make the course successful, I must pique the interest of all the attendants and have a lasting impact on their musicality and music appreciation. Composing music for cinema, dramas, and musicals is composing at its heart and is much more involved when compared to composing pop songs or writing rap.

It involves critical elements like stable chords, unstable chords, rhythms, tempo, harmonies, consonance, dissonance, intervals and many more. All these elements can be intricated to convey strong emotions and blend the listener with their feelings. These are mostly very abstract concepts, but are more easily understood when practising with an instrument and having someone else hear it and critique it. Since this course will be for graduate students, I will assume that they can read simple beginner level sheet music.

I will divide the course into two parts;

1) **Music appreciation**: " *The learning activities should be related to a larger task. The larger task is important because it allows students to see that the activities can be applied to many aspects of life and, as a result, students are more likely to find the activities they are doing useful."*
   - https://en.wikipedia.org/wiki/Constructionism_(learning_theory)

   This component involves listening to notable musical works form the classical, romantic and contemporary periods and simply enjoying it. The incentive is that the course-takers will hopefully have the ability to compose music of such distinction.
   I will also delve into geographical and chronological aspects of the scores and try to get the audience to appreciate the beauty in its differences and similarities.
   (In fact, even STEM students who are inspired by this component will be encouraged to take this course)

2) **Introduction to composing** (***theory*** and ***practical***)
   Since music scores can be used as public artifacts, constructionist learning can take place very efficiently. In the theory section, more rigorous music theoretical concepts shall be covered. The

learning that will take place here is mostly constructive. But more onus will be laid on the practical section, where I plan to bring the concepts taught in theory alive by dividing the students in groups and asking them to come up with a short score based on a theme using the content that has been covered so far. For example, if I covered polyrhythms (A concept in music where different instruments of the orchestra or the two hands in a piano play at different time signatures, i.e. Say one hand at 3 beats per bar and the other at 4 beats per bar), I will ask the groups to make use of polyrhythms to bring a certain theme alive. I will assign a theme to each group and have them listen and explore various classical and contemporary works which highlight that theme. The theme can be
(The theme is accompanied by a musical score that captures it quintessentially)

- Joy *(https://www.youtube.com/watch?v=6hc5FKmr3FA)*
- Reminiscence or Bittersweetness *(https://www.youtube.com/watch?v=eyHOUMWw5_M)*
- Mystery*(https://www.youtube.com/watch?v=tk_eqKUjDXE)*
- Flamboyance (https://www.youtube.com/watch?v=XU1kOOunlRk)
- Majesty *(https://www.youtube.com/watch?v=zHalXjs0cDA)*
- Melancholy (https://www.youtube.com/watch?v=sbTVZMJ9Z2I)
  to be a few examples. Listen to the first 30 seconds of the scores to get an idea of how feelings are conveyed through music!

This may seem like a hard task, and it is rightly so! Bringing a theme alive is one thing, but to instate technical elements into the score at the same time takes tremendous skill! (Note how easily you were able to draw a connection the musical piece and the feeling that is mentioned next to it. This is because public artifacts are great sources to learn!)
Each group will get 2-3 weeks to come up with a score that is of 30-40 bars with two main sections and a transition. This will have to be done twice in the course. They will be allowed to use ideas and elements from famous composers. Since music scores are public artifacts which they will be building using the knowledge and the artistry of the group as a whole, they will be open to analysis and criticism by the world.

- This whole setup is a based on a problem because I have given a clear cut goal/context: Suppose they have to compose for a movie scene which emphasises a certain emotion, what will they compose? This task is clearly within the reach of all of the students in the group and hence they can all contribute to it. The process of group-making itself is a constructionist approach because it encourages sharing of ideas between students and thus, students of a group will make connections with what they already know.
- Since the students are bound to have different personalities and different musical backgrounds, they learn from each other different composing styles and attitudes. One student may compose melancholic themes well while the other may do the same with bittersweet themes, and exchanging ideas between themselves will be very beneficial to the group as a whole, in terms of increasing technical as well as compositional skills. Each student may create his own score and put it up for criticism by the other members of the group, and the best idea can be furthered to the instructor. ***Appropriation*** is how learners make knowledge their own and begin to identify with it. Appropriation by the group will evoke of responsibility about the artifact that they are expected to produce.
- After finalising the theme, one part of the group can focus on the melody and the other can focus on the rhythm(time signature). The sub-group that focuses on melody can delve into advanced music theoretical concepts of harmonies, consonance and dissonance, and so on. The other subgroup can focus on the rhythm and work to incorporate polyrhythms into the score; this decentralisation is all in direction to construct a common artifact.

In such a group activity, I will have the following advantages over a regular, boring music theory class:

- Assessment will be based on reception by various audiences. I will carefully analyse how each group has worked together to tailor the one score which they think would best suit the

circumstances, and I will also take public and expert opinions on those scores. I will also incentivize them that the best score would be submitted to a music director/arranger so that the task is taken more seriously and with more enthusiasm.

- I am allowing the students in a group to construct their own knowledge initially. Later, they will be constructing a public artifact in the form of a score which will be open to criticism by the rest of the groups and to outside audiences. Thus, learning takes place more felicitously through the composition of the score itself, more than what takes place during the instruction, or by reading up.
- Materials are not textbooks and students are free to refer to any source they wish. This encourages the students to listen to more scores from other composers and critique them, and incorporate their elements into their artifact.
- It allows the learners to test their ideas in different contexts (for example, maybe combine two themes or technicalities) and reflect back on the process they have undergone to learn a certain concept. This is instrumental to a constructionist learning theory.

Such a lesson plan can never happen if the instruction is just mere concept explanation and demonstration, which is the case with most music courses. Furthermore, since each individual brings his/her own personality and skill to the table, it might not be a very good idea to leave them alone to understand complex concepts like these. For all we know, they just might have taken the course because they were curious, and a rote learning approach awards the curiosity of these students only harshly. Hence, a constructivist learning approach may get a vastly improved reception by interested students mostly because of the sense of responsibility and ownership it bolsters in the students.