

# A Constructivist Strategy for Medium/Large Student Groups- The Contextual Learning Model

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**Abstract:** Constructivist theories of learning describe learning as an active process in which learners construct new ideas or concepts based upon their past knowledge or experiences. This makes problem-based learning very attractive compared with traditional medium / large group lectures, which are thought to encourage passive assimilation of knowledge. Problem based learning can however be labor intensive for faculty particularly with medium / large student bodies. This article explores the practicality of a pedagogic application of the constructivist theory of learning, which can be applied to a medium / large body of students in a traditional lecture called the contextual learning model. Students found the sessions enjoyable and interactive and thought the sessions stimulated their thinking, introduced new material and facilitated the far transfer of knowledge.

## INTRODUCTION

Constructivist theories of learning describe learning as an active process in which learners construct new ideas or concepts based upon their past knowledge or experiences [1]. Pedagogic applications of this theory encourage learning by doing. Some of the perceived advantages of constructivist pedagogies include the development of meta-cognitive skills, problem solving, increased retention of knowledge gained and increased motivation.

In practice, teaching/learning sessions are organized so that students build on their existing prior knowledge to make meaning of new information gained. One pedagogic approach consistent with constructivism is problem based learning, in which small student groups of about seven students are introduced to a new learning situation by first presenting a problem. The students then go away to read up on the problem and return at a later date to discuss the findings from their reading. This constructivist framework makes problem-based learning more attractive than traditional medium / large group lectures, which are thought to encourage passive assimilation of knowledge. Problem based learning can however be labor intensive for faculty particularly with medium / large student bodies [2]. This article explores the practicality of another pedagogic application of the constructivist theory of learning which can be applied to a medium / large body of students in a traditional lecture called the contextual learning model. Data on student's perception of learning using this model are presented and discussed.

The contextual learning model as originally advanced [3] has three main components. In the first step, an appropriate context is set to activate prior knowledge and provide a framework on which any new information acquired can be built. This context could take the form of a paper-based

problem, as is the case sometimes with problem-based learning; however, this may not always be appropriate. The context could also be set with a video recording of a scenario or situation, which highlights some of the learning outcomes. In some cases, real patients or contexts are used, for example medical students sitting in on a clinic consultation could base the context for any subsequent learning on the patient that has just been seen. In the second step, information or knowledge relevant to the pre-established context is transmitted. The mode of knowledge transmission could however vary. For example, it could take the form of a lecture, or in other cases, it could take the form of some self-directed learning where appropriate (similar to problem based learning). In the early stages of a complex curriculum, this information is best packaged. However later on in courses or where the students already possess some knowledge, they could be expected to gather the information for themselves. The third step involves the elaboration of acquired knowledge, where the students apply the information gained from the learning sessions to new situations or problems. This could take the form of private study, essay writing, problem solving in groups, preparing and presenting a paper or case, computer assisted learning or examination revision. Theoretically, parallels have been drawn between the contextual learning model and Kolb's experiential learning [4] and Schons reflective practice [5].

There are two other potential advantages of the contextual-learning model. One advantage is the ability of introducing contexts beyond "a problem to be solved" for example a session exploring the links between inequality in health and socio-economic status does not necessarily lend it-self to be presented as a problem to be "solved" [3]. The second advantage is the opportunity to ensure that structured elaboration occurs, which doesn't always necessarily happen, in pure problem-based learning. For example, in the "come back and talk" stage of problem-based learning, unless careful thought is given, the self directed information acquired by the students may not be directly relevant to the problem in question [3].

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**Table 1. Detailed Description of the Implementation of the Contextual Learning Model and Free Text Feedback Comment During the Sessions on the Aetiology and Investigations of Infertility, Unexplained Infertility and Recurrent Implantation Failure**

<b>Table 1</b>	<i>Aetiology (causes) and Investigations of Infertility. 30/1/03</i>	<i>Unexplained Infertility 27/02/03</i>	<i>Recurrent Implantation Failure 06/03/03</i>
<u>Aims:</u>	The aims of this session were to enable the students identify and understand the causes of infertility and identify some of the circumstances in which assisted conception may be required to treat these causes of infertility.	The aims of this session were to enable the students understand the diagnosis of unexplained infertility and the role of assisted conception in the management of these women.	The aims of this session were to understand the clinical and embryological strategies for overcoming recurrent implantation failure during assisted conception.
<u>Structure</u>	This session took place in the form of a one-hour session structured along the theme of the contextual learning model. The session was delivered with the aid of 30 power-point slides.	This session took place in the form of a one-hour session structured along the theme of the contextual learning model. The session was delivered with the aid of 25 PowerPoint slides.	This session took place in the form of a one-hour session structured along the theme of the contextual learning model. The session was delivered with the aid of 19 PowerPoint slides.
<u>Context</u>	The context was set by asking the group to break-up into four groups of four to five students. Each group was asked to spend five minutes reflecting on any past encounters with couples undergoing assisted conception (patients, relatives, friends e.t.c) and to make a list of the various reasons it was required and any tests which were carried out to investigate the cause of infertility. The students gave various examples. The students with a medical background gave examples from their previous professional practice while one science students gave an example from a friend who had suffered from infertility.	A made up "paper" case was used to set the context in this session. Students were asked to individually reflect on a couple with unexplained infertility and feedback on any similar cases that had been encountered (professional or personal) in the past and discuss the management issues. Again the students with a medical background gave examples from their professional experiences and none of the science students gave any examples but sought clarification about some of the terms used by the medical students.	The context was set by getting the students to work in 5 groups (each made up of a mixture of clinicians and scientists). Each group was asked to discuss any cases of recurrent implantation (or pregnancy) failure they had come across in their previous experience (professional or otherwise). They were asked to list the causes on a flip chart and paste it on the wall. A brief discussion then ensued following feedback from each group.
<u>Information.</u>	Information was then presented in the form of an interactive lecture on the causes and investigations of couples with infertility. The value of this information for future practice was emphasized in the slides outlining the clinical situations where assisted conception such as in-vitro fertilization or artificial insemination was required in treating couples.	Information was then presented in the form of an interactive lecture on unexplained infertility. The value of this information for future practice was emphasized by outlining the role of assisted conception in the treatment of these women.	This was again presented as an interactive lecture highlighting the causes and treatment of recurrent implantation failure. Reference was made to a paper on the subject that had just been published before the lecture.
<u>Elaboration.</u>	There was not enough time to incorporate elaboration of knowledge separately within the one-hour slot allocated to this session. However on several occasions during the lecture, students were asked questions and to elaborate knowledge that had just been acquired.	This was provided by asking the students to reflect on the answers to a short essay, "outline the role of assisted conception in the management of a couple with unexplained infertility".	Elaboration in this case occurred by basing the mid course formative essay on this lecture "Discuss the clinical and embryological strategies for overcoming recurrent assisted reproduction technology treatment failure". Students were encouraged to briefly discuss their approaches to the essay before embarking on the real task.
<u>Student free text</u>	"Group work good at start, really good. Provides a good introduction to the lecture. Much encouragement as questions and discussion is good". "Thank you for this type of teaching". "Interactive, discussion, very organized slides". "Group work seems to be unique and creative. Helps us much more than traditional types of lecture Thank you". "Very effective way of teaching". Interesting lecture".	"Found the lecture interesting and learned much new information. But as a scientist, I could do with more detail about investigating and treating individual cases". "Sometimes all these sound Chinese to me. I never came across cases and I have no idea of how to find an answer to a case because most of the times, I don't even know what the diseases e.t.c mean and how they can be treated. I am not a clinician. For example what does a hysterosalpingogram mean in details?" (The last 2 comments were from students with a science background).	"Very responsible way of approaching matters. Interactive teaching" "Interesting lecture like previous lectures". "Thanks a lot" ! "Perhaps the context section could be kept shorter to allow more time for discussion during lecture". "Still have problems to follow (scientist)".

Timelines: The plan was to set the context in the first 5-15 minutes of the one hour sessions, provide information in an interactive lecture format over approximately 40 minutes and allow 5-10 minutes at the end of the sessions for elaboration of learning.

On a practical note, as previously outlined, one main attraction of the contextual learning model is that it offers the option of re-structuring a “traditional” lecture into this format. Thus “contextual” knowledge transmitted could be carefully packaged in line with the learning objectives of a lecture topic. This in theory would avoid some of the challenges of pure problem-based learning based curricula where self directed learning could stray from the learning objectives of the curriculum thus either compromising the required knowledge base for the course or increasing the time taken to cover the required curriculum. A wider audience could also be reached in one setting, avoiding the human resource issues associated again with pure problem-based learning, where small groups of seven students at most were deemed optimal. With the contextual learning model, small group work at the out-set of a lecture during the context setting stage or at the stage of elaboration could still happen, but they could be managed by one or two tutors.

Prior to this project, published studies on the contextual learning model were scanty. In one study [6], interactive contextual learning environments were discussed which placed the learner into a virtual learning environment that was active rather than passive. This was said to lead to a 90% retention rate among learners although no control group was assessed. In another study [7], 33 teachers in a center for community college development, in Oregon were surveyed for attitudes on the contextual learning model and student’s attitudes and performance at tests pre and post the introduction of the contextual learning model were evaluated. The study found that that teachers were generally positive toward the contextual curriculum, while students expressed mixed feelings, generally enjoying the classes but not overwhelmingly supportive of the methodology in terms of learning. Comparisons of contextual and non-contextual student outcomes after the second year were inconclusive, but they did find that contextual learning did not reduce students’ academic learning.

Given the dearth of evaluative studies of the contextual learning model in the literature, the aim of this article was to describe and evaluate the implementation of the contextual learning model in medium / large student groups and determine whether the contextual learning model resulted in high student perception of learning.

## METHODS

Six lectures / sessions were structured along the lines of the contextual learning model and evaluated (see Tables 1 and 2 for full description of the sessions). Five of these lectures were delivered to Masters Student’s on an assisted reproduction technologies course at the University of Nottingham and one lecture was delivered to fourth year undergraduate medical students in obstetrics and gynaecology at the same University. There were 16 students on the Masters course in assisted reproduction technologies, of which there were 12 female students and four male students. Six of the sixteen students (38%) were doctors and the other ten had a science background. Two of the students were UK graduates and all the others had graduated overseas including Greece, Egypt and the Middle East. There were 53 students on the undergraduate BMedSci course in Medicine doing their Ob-

stetrics and Gynaecology attachment, of whom, 35 were female.

The title of the lectures delivered to the Masters Students were as follows, Aetiology (causes) and investigations of infertility, Unexplained Infertility, Recurrent Implantation Failure, Treatment Options and Complications of Infertility Treatment. The lecture delivered to the undergraduate medical students was on problems in early pregnancy. One hour each was allocated to the five Masters lectures and the lecture to the medical students was a joint one with another colleague and the total allocated time for the delivery of both sessions to the medical students was two hours.

## Setting the Contexts

In the aetiology (causes) and investigations of infertility session, the context was set by asking the group to break-up into four groups of four to five students. Each group was asked to spend five minutes reflecting on any past encounters with couples undergoing assisted conception (patients, relatives, friends e.t.c) and to make a list of the various reasons it was required and any tests which were carried out to investigate the cause of infertility. In the unexplained infertility session, a made up “paper” case was used to set the context. Students were asked to individually reflect on a couple with unexplained infertility and feedback on any similar cases that had been encountered (professional or personal) in the past and discuss the management issues. In the recurrent implantation failure session, the context was set by getting the students to work in 5 groups (each made up of a mixture of clinicians and scientists). Each group was asked to discuss any cases of recurrent implantation (or pregnancy) failure they had come across in their previous experience (professional or otherwise). They were asked to list the causes on a flip chart and paste it on the wall. A brief discussion then ensued following feedback from each group. In the treatment options session, the intention was to allow two groups of students in the group concisely present their arguments in a debate on treatment options for infertility over 10-15 minutes and continue with a lecture using 14 power-point slides. In the complications of treatment session, the intention was to allow twenty minutes for a role-play of doctors and an infertile couple discussing the issues of the complications of fertility treatment in a clinic setting to set the context and then proceed to a lecture presentation of 15 power-point slides. In the problems in early pregnancy session, the context was set by asking students to work in groups of 6-7 and complete a blank algorithm based on their prior knowledge on the management of a woman who was pregnant and presenting with vaginal bleeding.

## Elaboration

Elaboration occurred using essays, verbal questioning and an objective structured clinical examination-OSCE.

## Assessment of Outcomes

Student perception of learning was measured with a 4-point Likert Scale [8], based questionnaire (Fig. 1) and free text comments. The questions asked on the questionnaire were designed to measure the following five aspects (or domains); overall enjoyment of the session, knowledge gained, attention span, interaction and “deep learning”. The questionnaire was piloted and validated (see below) during the

**Table 2. Detailed Description of the Implementation of the Contextual Learning Model and Free Text Feedback Comment During the Sessions on the Treatment Options, Complications of Treatment and Problems in Early Pregnancy**

<b>Table 2</b>	<b>*Treatment Options 10/3/03</b>	<b>Complications of Treatment 13/3/03.</b>	<b>Problems in Early Pregnancy, 5/3/03</b>
<u>Aims:</u>	The aim session was to get the students to understand the treatment options for assisted conception.	The aim of this session was to enable the students understand the complications of treatment by assisted conception and the strategies for preventing complications of treatment by assisted conception.	The aims of this session were to enable students assess and plan the management of women undergoing a miscarriage or an ectopic pregnancy (a pregnancy that implants outside the womb).
<u>Structure</u>	This session took place in the form of a one hour session.	This session took place in the form of a one hour session in which students making up group B (described below) participated in a role play of doctors and an infertile couple discussing the issues of the complications of fertility treatment in a clinic setting	The session was run jointly with a colleague over two and a half hours. The first half consisted of an interactive lecture presentation on miscarriages followed by a short break and a session on ectopic pregnancies delivered by my colleague in the second half.
<u>Context</u>	In this session, context and information were merged. The original intention was to allow both groups of students in the group concisely present their arguments about treatment options for infertility over 10-15 minutes and continue with a lecture based on around 14 power-point slides. However the students had done a lot of preparation and expressed a deep desire to present their arguments over a longer period (not limited to 15 minutes). The passion with which each side argued its case and the very interesting rich information, ideas and arguments exchanged was such that I decided to let the debate run through most of this hour and instead present the contents of my lecture in the form of handouts which they could study in their private time.	Context, information and elaboration occurred simultaneously in this session. The original intention was to allow twenty minutes for the role-play and then proceed to a lecture presentation of 15 power-point slides. However, again the students had prepared extremely hard for this session and wanted more time. Two of the eight students in this group acted as doctors and 2 as the infertile couple. The remaining 4 students took turns at various points during the consultation to present a slide show to the rest of the class, of various issues highlighted in the course of the consultation.  The consultation began with the Doctors seeking general clinical information, following which the first of the four presenting students, presented a talk on the basic investigations required by the couple. The consultation then continued with the couple asking about the available treatment options, following which the second student presented a set of slides covering treatment options. The consultation subsequently continued, with three further slide presentations at various stages on the complications of assisted conception, the estimated risks of these complications and finally the prevention. There was a final debriefing session of the "couple" by the "doctors" following which the rest of the class was provided with an intranet site on which the slide shows could be found. The slides I had prepared were again handed out as handouts and by this stage on the course; I had set up an intranet folder with all my lectures on them so that students could easily gain access.	The context was set by asking students to work in groups of 6-7 and complete a blank algorithm based on their prior knowledge on the management of a woman who was pregnant and presenting with vaginal bleeding. The students were asked to discuss what information would lead to diagnoses of particular types of miscarriages and what treatment would be best for each type.

(Table 2). Contd.....

Table 2	*Treatment Options 10/3/03	Complications of Treatment 13/3/03.	Problems in Early Pregnancy, 5/3/03
<u>Information.</u>	See above	See above	Information was then presented by way of the two interactive lectures on miscarriages and ectopic pregnancies (separated by a fifteen minute break). At the end of the second lecture on ectopic pregnancies, students were asked to reflect upon the earlier blank algorithm discussed at the beginning of the session and the blank spaces were filled. Two groups in the class also debated a case scenario of ectopic pregnancies.
<u>Elaboration.</u>	There was no time available for explicit elaboration at the end of this session; however a lot of implicit elaboration occurred during the preparation and presentation of this debate.	See Context	Elaboration occurred in this session by simulating an objective structured clinical examination-OSCE. The students were split again into groups of six to seven. The mock examination case was based around a 35-year-old woman who had recently been diagnosed with a miscarriage and wanted to ask several questions regarding the causes, treatment and future prevention. One student in each group was asked to volunteer to be the candidate, another the role player and the rest of the group were to act as examiners having been provided with mock examiners score sheets. The students were asked to reflect on what they had just learnt in the session and use that information as the focus for managing the woman.
<u>Student free text</u>	<p>“Very creative, informative procedure. Well done for the interactive lecture”</p> <p>“The presentation made me read things I would not have read on my own”</p> <p>“THANKS”.</p>	<p>“Thank you very much. Hope we see you soon again.”</p> <p>“Thank you. I hope to see you more. I wish to do my PhD with you”.</p>	<p>“A bit too much time for discussion compared to level of knowledge at the moment”.” Couldn’t concentrate at the end. Too big groups to be productive for everyone. Otherwise a real good lecture”.”</p> <p>Disruption when students had to group”.</p> <p>“OSCE practice not very useful. Perhaps more case studies/scenarios to consider would be useful”. “The lecture went overtime by one hour I believe”. “Timing &amp; little use of algorithm at beginning of session, but enjoyable and informative”</p> <p>“Probably a little early to have OSCE teaching as we do not have the knowledge/skills appropriate for it”. “Very good”.</p> <p>“Definitely a useful session”. “Really helpful, good level, kept my concentration. “Lecture was excellent. Good interaction and kept my interest”.</p>

Timelines: in the treatment options session, the intention was to set the context in the first 10-15 minutes of the one hour session, provide information in an interactive lecture format over approximately 40 minutes and allow 5-10 minutes at the end of the sessions for elaboration of learning. In the problems in early pregnancy session, the intention was to set the context in the first 15-30 minutes of the two hour session, provide information in an interactive lecture format over approximately 60 minutes with a break in between and allow 15-30 minutes at the end of the sessions for elaboration of learning. In the complications of treatment session, context, information and elaboration of learning occurred simultaneously.

\* At the end of session three, I observed that the degree of student interaction was beginning to wane. I therefore decided that the information stage of the following two lectures would involve getting the students to undertake some self-directed learning. The class was therefore divided into two groups of eight students each made up of a mixture of students from a science and medical background. One group of eight students ( group A) were given the task of further dividing themselves into two groups of four each and arguing for or against a motion titled “Given the advent of Intra-cytoplasmic sperm injection, there no longer is a place for In-vitro fertilisation”. The second group of eight students (group B) were asked read up about the complications of assisted conception and present their findings in the form of role play, with the context set in an actual clinic consultation. Group A were asked to present their debate at the session titled treatment options and group B at the session titled complications of treatment.

first lecture on the causes and investigations of infertility delivered to the MMed Sci students and the validated questionnaire was used to objectively capture student perception of learning in the remaining sessions. At the end of each of the six sessions, students were asked to fill in the feedback questionnaire and encouraged to write down any other comments in free text with a space provided below the list of questions. No incentives were provided and for anonymity, students were asked not to write down their names but to include their gender and for the master's student's background (doctor or scientist).

### ***Development and Validation of the Questionnaire***

The questionnaire was created by the author in collaboration with David Guile from the institute of education, University of London. The development and validation was as follows. There were 16 questions in an initial questionnaire piloted during the session on aetiology and causes of infertility, and each question was scored from 1 to 4 depending on the response. The maximum score per student was therefore 64 and the minimum 16. All the replies from the initial questionnaires 1-4 (reverse scoring negative questions where applicable i.e. low scores (one) reflecting a negative outcome and high scores (four) reflecting a positive one) were scored and entered into a Microsoft excel spreadsheet. For each of the sixteen items on the scale, the mean of the bottom 25% scores was deducted from the mean of the top 25% scores to obtain an index of discriminative power [9, 10]. Items with an index of discriminative power of more than 0.5 were selected for inclusion in the final scale. Although this cut off point was set arbitrarily, higher scores of discriminative power are more sensitive measures of the variable of interest [9, 10]. In theory, the index of discriminative power could have ranged from 0 (if for example an item was scored "4" by all the judges) to 3 (if the top 25% all rated the question "4" and the bottom 25% "1"). The index of discriminative power was used purely to select questions to be included in the final 10 item questionnaire which were then re-evaluated in the subsequent 5 sessions and scored "1-4" in line with the views of the respondents. In theory therefore, the mean scores of the respondents to the 10 item questionnaire (Table 3) could have ranged from 1-4.

For each of the five domains of interest, the item with the highest discriminative power was selected to make up five

questions for the final scale. An additional question from the domain measuring student perception of knowledge gained was included in the final scale as in the contextual learning model, information transmission is encouraged. The scale was finally made up to 10 questions by the inclusion of the four new questions. These questions were; (i) I was able to engage with and, understand the content of the lecture (ii) The session introduced new material to me (iii) I started to see the implications of what I learnt for the practical aspect of my future practice (iv) I found the balance between information and discussion helped my attention. These new questions were structured to measure the student's perception of "deep learning", knowledge gained, bridging the gap between theory and practice and attention span. Thus the final student perception of learning scale (Fig. 1) provided a score that ranged from 10-40.

### ***Data Analysis and Statistical Methods***

Responses from each student were scored from 1 to 4 for each item; reverse scoring negative statements where appropriate. Data was then entered on a spreadsheet (Microsoft Excel). The total student perception of learning score was calculated by adding up the scores from all the questions for each student. The total student perception of learning score for each session was then summarized by calculating the mean ( $\pm$  standard deviation) total score for the students. The mean ( $\pm$  standard deviation) score was also calculated for each question asked and the highest and lowest scoring questions for each session noted. Analysis of variance was used to test for significant differences, in the response to the questions across the 5 sessions where the definitive questionnaire was used.

## **RESULTS**

The response rate to the questionnaires from the Masters students was 100% and the medical students, 69.8% (37 students). The overall student perception of learning scores were high in all sessions with mean scores ranging from 35 to 37.50 out of a maximum score of 40 (See Table 3). There was also an overall positive response to all the individual questions with scores ranging from 3.49 to 3.82 (Table 3). The question asking if the sessions stimulated the students thinking was rated highest (mean ( $\pm$ SD) score of 3.82 ( $\pm$ 0.11) out of 4) and analysis of variance showed that this

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| <ol style="list-style-type: none"> <li>1. I found the session enjoyable.</li> <li>2. I found the session informative</li> <li>3. I did not learn something new</li> <li>4. I was able to engage with and understand the content of the lecture</li> <li>5. The session introduced new material to me</li> <li>6. I started to see the implications of what I learnt for the practical aspect of my future practice</li> <li>7. I found the balance between information and discussion helped my attention</li> <li>8. I could follow the lecture</li> <li>9. I found the session interactive</li> <li>10. The session did not stimulate my thinking</li> </ol> |
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*Possible range of responses to each question*  
Strongly disagree / Somewhat disagree / Somewhat agree / Strongly agree

**Fig. (1).**

**Table 3. Summarizing Student Perception of Learning Scores from the 5 Sessions where the Validated Feedback Questionnaire was Used**

Questions	Number	Unexplained Infertility (27/2/03)	Recurrent Implantation Failure 06/03/03	Treatment Options 10/03/03	Complications of Treatment 13/03/03	Problems in Early Pregnancy 05/03/03	Mean Scores on Individual Questions	Standard Deviation
I found the session enjoyable.	1	3.44	3.50	3.94	3.88	3.62	<b>3.67</b>	<b>0.22</b>
I found the session informative	2	3.63	3.63	3.81	3.56	3.84	<b>3.69</b>	<b>0.12</b>
I did not learn something new	3	3.50	3.81	3.81	3.81	3.97	<b>3.78</b>	<b>0.17</b>
I was able to engage with and understand the content of the lecture	4	3.19	3.31	3.63	3.69	3.62	<b>3.49</b>	<b>0.22</b>
The session introduced new material to me	5	3.06	3.63	3.44	3.50	3.86	<b>3.50</b>	<b>0.29</b>
I started to see the implications of what I learnt for the practical aspect of my future practice	6	3.06	3.38	3.56	3.75	3.68	<b>3.49</b>	<b>0.28</b>
I found the balance between information and discussion helped my attention	7	3.44	3.50	3.81	3.75	3.49	<b>3.60</b>	<b>0.17</b>
I could follow the lecture	8	3.50	3.50	3.69	3.80	3.68	<b>3.63</b>	<b>0.13</b>
I found the session interactive	9	3.56	3.63	3.94	3.88	3.76	<b>3.75</b>	<b>0.16</b>
The session did not stimulate my thinking	10	3.87	3.88	3.88	3.88	3.62	<b>3.82</b>	<b>0.11</b>
Mean student perception of learning score (0-40) per session		<b>35.00</b>	<b>35.75</b>	<b>37.50</b>	<b>37.25</b>	<b>36.94</b>		
Standard deviation		<b>3.63</b>	<b>2.67</b>	<b>2.92</b>	<b>4.51</b>	<b>3.05</b>		

finding was significant between groups with a mean score of 3.62 in the undergraduate student group and scores of 3.87-3.88 amongst the science students ( $F=20$ ,  $p<0.01$ ). Students also rated highly the questions to find out if they learnt something new and determine whether the sessions were interactive (questions 3 and question 9, Table 3) with mean ( $\pm$ SD) scores of 3.78 ( $\pm 0.17$ ) and 3.75 ( $\pm 0.16$ ) respectively. The questions on the ability to of the students to engage and understand the content to the lecture see the implications of what was learnt for the practical aspect of their future practice was rated lowest with mean scores of 3.49 each.

When considered against the backdrop of student learning, the stated aims of the sessions delivered to the Masters students were met as all the students passed the standard assessment used on the course.

Tables 1 and 2 provide a detailed description of the sessions and free text comments from the students. From the organizational perspective while it was always possible to incorporate the first two steps of the contextual learning model (context setting and information transmission), there were occasionally challenges with incorporating formal elaboration of learning into the one-hour sessions. The overall student free-text feedback was positive, with specific positive feedback on the group work, interactivity and encouragement of self directed learning. However, there were concerns from some students about the introduction of clinical

contexts at the start of the sessions before they had acquired the knowledge to be able to understand the contexts.

## DISCUSSION

The aim of this article was to describe and evaluate the implementation of the contextual learning model in medium / large student groups and determine whether the contextual learning model resulted in high student perception of learning. The rationale for the study was that the contextual learning model was consistent with constructivist pedagogies which had potential advantages including the ability to foster the development of meta-cognitive skills, problem solving, increased retention of knowledge gained and increased motivation and which could be used in medium / large student groups which suffered the criticism of fostering a passive transmission of knowledge. This study described the implementation of this model in lectures to Masters Students in an assisted reproduction course and undergraduate medical students. The study set out to apply the three components of the model (step1; setting an appropriate context activate prior knowledge, step 2; providing information or knowledge relevant to the pre-established and step 3; elaboration of acquired knowledge, where the students applied the information gained from the learning sessions to new situations or problems) in medium / large student groups. The context was set at the beginning of each session with a variety of exercises including small group work, paper cases, a debate, role-

play and a problem solving exercise to activate prior knowledge. Information was transmitted using interactive lectures, self-directed learning sessions, a debate and role-play sessions. Finally elaboration occurred using essays, verbal questioning, objective structured clinical examinations and in the process of debates and role-play.

On a practical note, while it was always possible to incorporate the first two steps of the contextual learning model (context setting and information transmission), there were occasionally challenges with incorporating formal elaboration of learning into the one-hour sessions. The results of the evaluation of the student's perception of learning revealed that it was possibly to satisfactorily engage with "medium / larger" groups of students using the contextual learning model. Student perception of learning scores were consistently high, students felt the sessions stimulated their thinking and liked the interactivity. Although also scoring highly, the questions on the ability of the students to engage with the contents of the lecture and see the implications for future professional practice did not score as highly as the question assessing stimulation of thinking. Some students also stated a preference for the acquisition of some basic knowledge before the requirement to apply their prior knowledge at the start of a new session. It is however difficult to explain the reasons why in some classes greater variation was evident in the overall student perception of learning scores for example in the session on "Complications of Treatment". There is also no obvious explanation for the smaller variation in the "Recurrent Implantation Failure" session. One possibility is that the context was not set so well in these sessions, but there is no evidence that this was the case.

These results imply that some of the challenges of teaching medium / large student groups such as the passive transmission of knowledge can be overcome by using the contextual learning model. However careful thought has to be given to establishing the context at a level that students feel comfortable with based on their prior knowledge. This is particularly important as activating prior knowledge of different levels and students of demographic variation may induce different information processes [11]. For example, the activation of new knowledge in a novice may lead to difficulty interpreting new information, whereas in an expert, it will lead to integration of this new knowledge into the schema of their prior knowledge. This was evident in our study, where the free text comments from science students in sessions that used clinical problems as the context identified difficulties with interpreting the new information presented. On the other hand, the high scores on the ability of the model to stimulate the thinking of the students was a positive finding and consistent with hypothesis that the contextual learning model stimulates meta-cognitive skills as expected of constructivist pedagogies [1, 12,13].

A strength of this study was that it combined quantitative and qualitative tools. These include the Likert scale, student perception of learning questionnaire and the free text comments by the students. It would however be simplistic to assume that the domains ("knowledge", "deep learning", "ability to bridge theory with practice" e.t.c) or the constructivist attributes that the questions in the Likert scale tried to measure were an accurate reflection of the "true results", as these issues are often quite difficult to encapsulate and

measure. However, Likert scales have been shown to be a valid way of measuring attitudes when individuals respond to questionnaire items using a disagree – agree response scale [14, 15], (used in this study) and are relatively simple to design. Student perception (or attitudes) was a key object of interest in this exploratory project.

## CONCLUSION

In conclusion, this article showed that it was possible to restructure lectures to medium / large student groups using a constructive pedagogy, the contextual learning model. The students found the sessions enjoyable and interactive. They also found that the sessions stimulated their thinking, introduced new material and facilitated the far transfer of knowledge through elaboration. There were occasional practical challenges with fitting the elaboration phase of the model into the one-hour sessions in some sessions but elaboration does not necessarily have to take place within the context of the lectures, but could occur later. There were also some challenges with the activation of prior knowledge during the initial phase of setting the context as students with little prior knowledge had difficulty interpreting the new information. Setting the context in the model therefore needs to carefully take account of the level of prior knowledge. On a practical note, these are important findings in curricula with high student to teacher ratios with faculty under time constraints from other demands including research output and practice as the contextual learning model can be used to complement problem based learning. Further exploratory or empirical studies of the contextual learning model in medium / large student groups are however required.

## ACKNOWLEDGEMENTS

I would like to thank David Guile from the institute of education, University of London, who supervised this project, which formed the basis of my dissertation for the Masters degree in higher and professional education. I would also like to thank all the students who gave their very useful feedback.

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Received: February 05, 2009

Revised: May 11, 2009

Accepted: May 13, 2009

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