4.1 Lesson Planning Assessment

TEACHING SESSION PLAN	
Module: *Statistics and Experimental Design* *(STAT08011)*	**Level:** ***8*** **Year: 4**
Duration: *2 hours - 6:30pm to 8:30pm*	
Title of session/ topic: *Hypothesis Testing, Part 1*	
Mark the type of session: **Lecture ☐✓** **Tutorial ☐** **Lab ☐** **Studio ☐** **Workshop ☐**	
Module Outcome (What module outcome(s) is the class/session aligned to)**:** ***This lecture is aligned to the following Learning Outcomes from the Module Descriptor:*** 1. *Identify and conduct the relevant statistical tests and analyses relevant to industry.* 2. *Evaluate and interpret experimental data (with the use of a statistical package).* **Class/Session Outcomes:** Upon completion of this session, you should be able to: (Share with students e.g. Write on board /slide/ project image at beginning of lecture for students) 1. *To understand the main concepts and rules of hypothesis testing and where it fits in to the Define, Measure, Analyse, Improve and Control (DMAIC) process improvement roadmap.* 2. *Perform and analyse hypothesis tests, t-tests on the statistical package, Minitab and understand what the Minitab outputs mean from statistical and practical standpoints.* 3. *To apply the theory and be able to evaluate what hypothesis test is required in a particular manufacturing* 4. *To determine where and how to apply Hypothesis Testing to perform Problem Solving activities and optimise products and processes in industry related data problems, with the use of Minitab.*	

Select & Prioritise Your Content:

For the session, decide what material is used in class and what material the students should study independently and/or online. To do this, think about the material and its relative importance and prioritise and list in the appropriate quadrant.

	Independent Learning – Teacher led	**Independent Learning – Student led**
Priority **(Need to know)**	**1** *The lecture will follow the class lecture notes on Hypothesis testing, part 1 on my Statistics for Experimental Design Moodle page.* *Minitab resources relating to Hypothesis testing on my Moodle page.* *My experience in the use of Minitab in industry which I have developed into a trouble-shooting guide – as Minitab has some particular default settings and foibles which require changing depending on the statistical test being performed.*	**2** In advance – flipped classroom *Read the Hypothesis testing, part 1 lecture notes on* *Go through all the Minitab commands required to complete a t-test hypothesis test.* *For any of the Hypothesis testing command windows, review the Minitab "Stat Guide" and "Minitab Assistant" functions.*
Supplementary Learning **(Nice to know)**	**3** *Be familiar with the Minitab "Stat Guide" and "Minitab Assistant" functions.*	**4** *Review the Khan Academy video on hypothesis testing on the Statistics for Experimental Design Moodle page.* *I have advised students to review the use of any Hypothesis testing tools (that will be covered in this lecture) in action/use in the workplace.* *Talk to a colleague who has previous experience of performing a hypothesis test.*

Material in quadrants <u>1 and 3 typically become the focus during classes</u>. Quadrants 2 and 4 represent material students could study themselves and use the VLE/Moodle and online learning objects to support this learning.

Think about how you might incorporate *Technology Enhanced Learning Tools and Blended Online Learning Objects,* that will develop students learning and engagement with the module.

Teacher Activity (what you will do during the class):	**Student Activity** (what students will do during workshop/lecture):
Stage 1: 0 to 15 mins. *Recap on the previous lecture's learning outcomes on Normality Testing and Process stability and capability asking open ended questions to check for understanding.* *Check for prior knowledge/prior learning of hypothesis testing with the students.* ***Stage 2: 15 to 45 mins.*** *Introduction of the theory and the key elements of Hypothesis testing using the class lecture notes on PowerPoint and the Minitab statistical analysis package. Draw illustrations and examples on my printed lecture notes, using the document camera. All illustrations/examples drawn live in class will be scanned in and stored on Moodle for students to use as a learning resource.* ***Stage 3: 45 to 75 mins**.* *Give the students a past exam question on hypothesis testing to do in 30 mins, which is a typical exam question time. Visit each student at their PC to ensure all are attempting the question and to provide guidance.* ***Stage 4: 75 to 100 mins.*** *Through the use of the document camera in the lecture room, record the working out of this mathematical exam question live in an in-class short video explaining the method as I am writing it out, as a model answer for the exam question.* *This video will be uploaded to Microsoft Stream, with a link to Moodle and made available to the students as a reusable learning object on my Experimental Design Moodle page after the class.* ***Stage 5: 100 to 120 mins.*** *Recap on the learning objectives for the lecture and work through any questions or concerns the students may have. Outline the topics for the following week's lecture and outline the expected pre-reading required.*	***Stage 1: 0 to 15 mins.*** *Provides a bridge/link from the last lecture to this new topic of hypothesis testing and allows the students to make the links. Encourage the students to answer the review questions that I am asking and constantly encourage students to ask any questions.* ***Stage 2: 15 to 45 mins.*** *Listen and ask any questions. To make this difficult topic of hypothesis testing as easy as possible to follow, I give the students printed lecture notes, which are exactly the same notes as are on the slides on screen, so they can concentrate on only writing supplementary notes and information and can better concentrate on the new topic as the material is printed in front of them. This lecture takes place in a computer lab. so the students go directly into Minitab and walk through the Minitab commands (that I have screen shots of on my slides) and create a Minitab output file of the class work. The students can also open my PowerPoint slides from Moodle and annotate them with their own notes live in class, which they can then save to their GMIT OneDrive as a personalised learning resource.* ***Stage 3: 45 to 75 mins**.* *Practice activity: The students will work on their own but can discuss with their neighbour, to complete a Hypothesis testing question from last year's exam paper. The students get to put into practice the theory and the Minitab analysis they have just learned.* ***Stage 4: 75 to 100 mins.*** *The students will interact with me during the recording of the video and will ask questions throughout the construction of the model answer, recorded on the document camera.* ***Stage 5: 100 to 120 mins.*** *Students get an opportunity to demonstrate their knowledge and comprehension of the topics covered in the hypothesis testing lecture and to ask for clarification of any of the statistical elements covered. The students will leave the lecture with the confidence that they have achieved the learning outcomes and are clear on the expectations and plan for the following week.* 

Online Student Engagement Tools:

All my lecture notes and Minitab notes are on my Statistics for Experimental Design Moodle page.

I have also placed the past Exam Paper from May 2018 on the Statistics for Experimental Design Moodle page for easy student access and to encourage engagement and practise of the past exam paper as a study and revision tool.

On my Moodle page, there are a number of videos that I have recorded in the Statistics for Experimental Design class that the students can view (and re-view) as a learning resource (a reusable learning object).

All students have been given access to Minitab 18 on their home or work PC so that they can stay engaged with this statistical package and practise it outside of lectures.

On the Statistics for Experimental Design Moodle page, there are links to the Minitab "data library" so that students can download a data set and practise the various statistical analysis tools that they learn in this module.

Teacher Reflection:

What worked?

The lecture worked well for most students and most of them were delighted with the opportunity of doing an exam question in class with the safety-net of the lecturer there to guide them through if they hit something they could not figure out. This is the use of the "Zone of Proximal Development" (ZPD) which I referred to in my earlier lesson plan on Control Charts. The ZPD refers to the difference between what a learner can do without help and what he or she can achieve with guidance and encouragement from a skilled facilitator/teacher. For years, I have been calling this my "teach a person to fish method" rather than handing them the fish! Thanks to my research into the education theorists I have Vygotsky to thank for this correct, more formal term for my teaching method. I reminded the students that they should now have confidence in the new statistical method they have just learned and applied and advise to use it in the workplace if they get the opportunity during the week, in order to crystalize the learning.

Most students were actively engaged throughout the 2-hour lecture and were able to work out the exam question in the allocated time.

After the students had completed the attempt at the exam question, I recorded a live in-class video of the construction of a model answer to the exam questions in my handwriting, showing all calculations and workings. That evening, after the lecture, I shared the video on my Moodle page. The feedback from my students regarding this and other videos I have created in class for this module been very positive and some students even watch the video the same evening after the lecture, to further embed the learning from the evening's lecture while it is still fresh in their minds, which they say is very effective.

What did not work?

This module, Statistics for Experimental Design is part of an add-on degree, a BSc (Hons) in Quality for Industry. There are 35 students on this programme, all of whom have an existing level 7 degree qualification. However, not all students have a level 7 degree in a Science, Technology, Engineering or Maths (STEM) discipline and have thus not covered maths or statistics to level 7. Often the students who do not have maths/stats in their degree have many maths related questions on some of the more basic elements of the lecture, this can frustrate those who do have level 7 maths. Finding a balance in lectures has been a bit of a challenge which was the case in this Hypothesis Testing lecture also. I did get around to check in with all 35 students during the exam question practice activity but there was not a lot of time available to spend with any individual student, some of whom need to attend one-to-one maths tuition in the maths resource centre in the library, which I have recommended to them.

To what extent did you address different domains of learning?

The three domains of learning are:

1. *Cognitive: mental skills (knowledge)*
2. *Affective: growth in feelings or emotional areas (attitude or self)*
3. *Psychomotor: manual or physical skills (skills)*

Cognitive: mental skills (knowledge):
The Cognitive Domain of learning was addressed with the delivery and absorption of the lecture content – the students received new knowledge about hypothesis testing which the cast majority of them did not have before this lecture. Comprehension and application of the new knowledge was demonstrated by use of this knowledge in the completion of the Hypothesis testing exam question. In a part of the exam question, the students had to demonstrate their knowledge of the outputs from Minitab which displayed their ability to draw conclusions from the facts and data they had been presented with.

Teacher Reflection (continued):

To what extent did you address different domains of learning? (continued)

Affective: growth in feelings or emotional areas (attitude or self):
The Affective Learning Domain involves our feelings, emotions and attitudes. In the exam question practice activity, they had to develop a plan to solve the problem (complete the exam question) in the time allocated. This involved (in most cases) active participation of the learner, two of the students did not engage fully in the completion of the practice exam question as they said they felt under pressure and would rather try out a new exam question initially on their own at home, which I think was coming from a fear of failure as these students did not have maths to level 7. I pointed out that trying something new and making mistakes is a valid and valuable way of learning and that there was nothing at stake in this exercise.

Psychomotor: manual or physical skills (skills):
The psychomotor domain is concerned with utilising motor skills and coordinating them. The use of the computer and the Minitab statistical analysis software would develop some motor skills in the key strokes required for some of the statistical analysis and possible some muscle memory – when we look at a number pad on a phone or computer, our fingers can often type in the numbers rather than our mind specifically remembering the required number.

What would I do differently next time?

This is only the second year that this module has been in existence, so I will continue to tweak it and improve it for each subsequent year. The topic in the Quality Management 1 module that I described in lesson plan 1, I have been teaching for over 10 years and though I still improve it every year, it is more finely tuned than this Statistics and Experimental Design module and thus more practised and polished. Overall, the lecture worked well and anyone who had previous level 7 maths/stats qualifications followed the lesson plan easily and met the learning outcomes and successfully completed the exam question task in the allocated time.

One thing I would do differently for next year is to make the lecture pre-reading a formal prerequisite and only allow opening of the lecture notes on Moodle to students who had completed the pre-read and the Minitab practise. This is the first module these students have engaged with at level 8 and I think some of them are finding the increased responsibility of student-led or self-lead learning to be a challenge and a large step up from their level 7 studies - I will discuss with my colleagues on this programme, ways of addressing this.

Last year, 2017/2018, was the inaugural year for this programme. All students last year had a level 7 degree in a STEM related discipline. I would recommend that we review the entry requirements for this level 8 add-on degree at the next Programme Board meeting of the BSc (Hons) in Quality for Industry.

One of the core themes throughout this level 8 programme in Quality for Industry is "Continuous Improvement" which I endeavour to employ in the ongoing development of all the modules I teach.

Regards,
Rachel