

What should be included in the training syllabus for new online/blended learning instructors in aircraft maintenance?

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Introduction

The aircraft maintenance industry is set to double in size over the next twenty years creating an on-going requirement for trained technicians; this along with the constant pressure for training organisations to reduce costs is driving a need for greater efficiency by training organisations to utilise new technologies and teaching methods. Boeing (2016), published a report quantifying their outlook for the industries future need for aircraft technicians, predicting a demand for 118,000 technicians to be trained and qualified, over the next 20 years in Europe and stated that “*New technologies, devices and training methods will be needed to meet a wide range of learning styles. The growing diversity of aviation personnel will also require instructors to have cross-cultural and cross-generational skills to engage tomorrow’s workforce.*”

In the current regulated aviation training environment, changes are being introduced to facilitate this. The aviation aircraft maintenance training industry is highly regulated (Commission Regulation (EU) No 1321/2014 applies), particularly regarding course content and duration, but very little guidance is given about methods. To date, theoretical training methods have remained relatively traditional, students learn passively as the instructor is the sage and the source of the knowledge (Markel, 1999).

A recent proposed legislative amendment to the regulation, NPA 2014-22 (Notice of Proposed Amendment), is making provision for new training methods and technologies to be used. This will allow training to move from a purely instructor led environment with minimum hours of attendance, to a student centred or blended training approach incorporating e-learning methods. Part of this change specifies that e-learning instructors shall be trained in “*coaching, guiding and mentoring of e-learning students*”. This is a rather vague requirement and in it is left to the regulator to accept proposed training for these instructors on a case by case basis from each training organisation with little guidance. This research topic is to identify a more detailed or useful syllabus that can be used by industry and by involving them in the process, get a shared agreement and understanding of what should be included.

The paper starts with a literature review, which was done to research what is currently recommended practice regarding the subject and to inform the research. It then details the methods used, as following an action research methodology to involve and get agreement by industry in the development of the proposed syllabus followed by the design method of the questionnaire. The development of the training program design was by using the ADDIE (Analysis, Design, Development, Implementation and Evaluation) process, after which the feedback by industry was detailed and used to refine the training program to produce the resulting syllabus. This is followed by a discussion around the limitations, challenges, the views of industry and their progression through the process is detailed. Finally, the paper ends

with the findings of the study suggesting general agreement with the proposed syllabus appropriate for aircraft maintenance instructors new to online and blended learning, and increased clarity in understanding the applicable regulation requirements leading to some recommendations on how to better progress the introduction of e-learning into the industry.

Literature Review

The literature review was conducted using Creswell's five steps model (2002). This approach identified that the research question had not already been sufficiently addressed and informed on any related guidance or requirements specific to the industry and the topic. Step (1) identified key terms from the NPA. Step (2) located appropriate literature. Step (3) critically evaluated and selected appropriate literature for inclusion in the training program. Step (4) organised the literature for use and developed a visual diagram (see Appendix 1) and step (5) required writing a review of the applicable literature for the final report. Feedback from this research provided further additional key terms to locate additional material for inclusion.

The initial review of literature from international aviation sources on appropriate training for online or blended learning instructors in aircraft maintenance, showed extensive requirements and guidance have been published by various international organisations. These included the International Civil Aviation Organisation (ICAO), Doc 9941-AN/1478, (2011), "*Training Development Guide Competency- based Training Methodology*" and Doc 7192-AN/857, (2003), "*Training Manual Part D-1 Aircraft Maintenance*". Similarly, the International Air Transport Association. (2011) "*Guidance material and best practices for the implementation of competency-based training in maintenance*", contained extensive guidance on aircraft maintenance training but gave very little detail regarding online or blending training other than to refer to it being an acceptable emerging option.

The most prominent documents published by national regulators include, the NPA 2014-22 by the European Aviation Safety Agency (EASA) as already mentioned in the introduction. The Federal Aviation Authority (FAA) "*Advisory Circular AC147-3B Certification and Operation of Aviation Maintenance Technician Schools*" (2015), this document makes no reference, to the training of distance or online instructors. It did give an appendix of additional instructions on the control and oversight requirements for the approval of distance training programs but nothing related to the training of instructors.

The European Aviation Maintenance Training Committee published "*Guidelines and recommendations on E-learning – GR 1003*" (2015), which detailed numerous factors and issues related to E-learning in aviation maintenance training on behalf of European training organisations affected by the NPA and recommended online/blended training instructors have training but it did not elaborate on what the content should be. It did include a lot of related and relevant learning theories and instructional design guidance which they thought was applicable to the topic, but not specifically identified as being needed for instructors, this may be related to the fact that this group would become bound by the regulation.

Instruction in appropriate learning theories was advocated by Kearns (2012), as being needed for online/blended learning instructors and identifies the most relevant theories, as including the three learning domains from Bloom (1984), cognitive load theory after Sweller (1984), constructivism and motivation theories, these were also recommended by the European Aviation Maintenance Training Committee (2015). Stuart (2014) highlighted that a behaviorist approach is needed for instruction in cases where practical training is being accomplished due

to the safety aspects of using tools and working in a live environment. By including an overview of behaviorism, it will also give a framework for instructors to understand the current traditional model of instruction which reflects the culture in the aviation industry as being very task- and process-driven, this will help clarify the changed approach to instruction required by a constructivist method specified by the NPA when using E-Learning methods. The seven principles for good practice in undergraduate education cited by Chickering and Gamson (1987) are identified by Crews, Wilkinson and Neill (2015) to transfer to online education as well as face to face education. These principles are, to encourage contact between students and faculty, develop contact and cooperation between students, encourage active learning, give prompt feedback, emphasize time on task, communicate expectations and respect diverse talents and ways of learning. Many of these principles are to be assessed in the NPA evaluation tool and provide a good holistic model to assist in identifying what is best practice and understanding what is being assessed in the evaluation tool.

Each student will have their own learning styles, these need to be accounted for in an e-learning environment by both the instructor and the design of the instruction to achieve the best results. Two of the most prominent theories related to learning styles would be Kolb's (1984) learning cycle and Fleming's (2001) VARK model. As aspects of these theories are also assessed in the NPA assessment tool it is essential that instructors have some understanding of them so that they appreciate the context of why the E-learning environment is designed as it is and their role within it.

Instruction to both instructors and trainees on the benefits of e-learning was found to improve the effectiveness of the training (Kearns, 2012) and that instructors should be "*trained to coach online, understand the learning theories being used and how to use the specific software*". This view is supported by Downing, Pittaway & Osbourne (2012), as it contributes to a positive attitude towards e-learning by students and instructors which they consider as essential to achieving a successful outcome to an online/blended learning training course. Although not identified as a topic by the NPA, inclusion of the benefits of E-learning at an early stage is considered essential to a positive outcome for students and will be added to the proposed syllabus.

Instructional Design is described as a system for analysing the need for instruction, designing effective content, developing training based on good instructional methods, implementing it by giving the instruction and evaluating its application. The ADDIE five step process is a well-known example of this. Salas *et al.* (2002) stated using "*instructional design for the creation of e-learning will increase the overall effectiveness of the instruction*" and Salmon (2013) recommends using learning by doing activity approach to developing an online lesson and a prerequisite for this was for the instructor to have an overview of instructional design theories. A widely used model of instructional methods is Gagne's (2005) nine instructional events, which includes gaining attention, informing learners of the objective, stimulating recall of prior learning, presenting the stimulus, providing learning guidance, eliciting performance, providing feedback, assessing performance and enhancing retention and transfer of the knowledge. Key ingredients for success in online instruction identified by Klemm (2012) as having an introductory section detailing the course material necessary for the student's success including the syllabus, the tasks to be accomplished and due dates, a presentation on how hybrid courses work (including the benefits to the student), grading rubrics and expectations of the students.

Tele-tutoring training is specifically mentioned in the NPA as needed for online instruction and is not currently part of an instructor's competences. This is also identified by Smith (2005), Salmon (2004), Ko & Rossen (2010) as an essential competence for online instructors. Methods and perspectives differed slightly by the various authors, but all agree with having a model or plan on how and what to communicate, aligned with the learning objectives and the students' progress. Goodman *et al* (2001) established that the process facilitator role was the core function for tele-tutoring instruction and expanded on the competencies for this. Salmon (2013) later developed on previous work, to include e-activities and how best to develop them, particularly around collaboration tasks in an online environment. The later stages of these models would appear to go beyond the needs or requirements of industry as they relate to Bloom's higher order objectives and exceed the regulatory requirements and would not be aligned to the target student group or their environment. Although the early stages would be essential for a student to learn in an online environment and an overview of the model for the instructor's training to give them context would be beneficial.

The literature review makes a strong case for inclusion of the findings and conclusions from the above educational research, namely to include an appreciation of the benefits of e-learning, appropriate learning theories, instructional design theories, tele-tutoring instruction and an overview on how the regulation applies to the instruction. This needs to be refined down further to those parts specified as required in the regulation, those most applicable to the industry and their application of the E-Learning methods. This will ensure instructors are informed on how to teach and support students in the new learning environment as opposed to the instructor just adopting the model they are most familiar with in the classroom and attempting to duplicate it in an E-learning environment as this approach has previously met with limited results, (Moller, Foshay & Huett, 2008).

Methodology:

Coming from an engineering background and perspective, where objective and accurate answers are achievable there is a tendency for specialists in the aviation industry to have an objectivist approach. In research topics such as education where there can be more than one valid answer depending on the subjects understanding and experiences and having to accept various limitations that can apply, a more constructivist outlook needs to be taken (Gray, 2013). When people's views, understanding, experiences or circumstances are involved in the research it becomes very difficult to find an objective truth due to the vast number of variables that could be at play.

Methodology: Research Process Design

Following the approach taken by Stuart (2014), the action research methodology (Kemmis & McTaggart, 2000) was applied following the amended version of Stringer (1999). This is an action research interacting spiral of looking, thinking and acting in a repeating process, building on the review and reflection of the findings at each stage as illustrated in Figure 1. The research incorporated two full cycles of observation, reflection, planning and acting in the research and development of the training artefact.

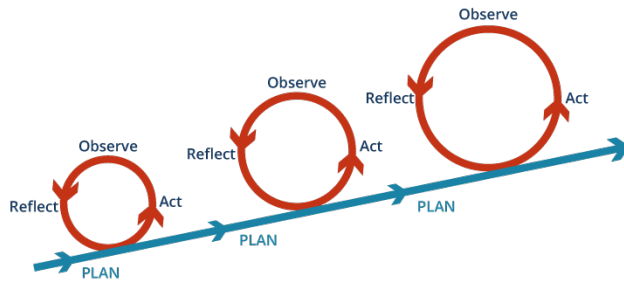


Figure 1 – Action Research interacting spiral (Stringer, 1999)

The action research methodology was selected as the most appropriate research method, as it allowed a process of developing the training artefact and by involving industry, to harness their knowledge and experience in the field to produce a better final training product. This process allowed the author to reflect and improve their practice and contributed to a shared understanding with industry of what is required by the NPA. The characteristics of this approach utilise the six key characteristics of action research identified by Creswell (2002) as an appropriate method. It has 1) a practical focus in that it identified a suitable syllabus, 2) it should involve the authors own practice although this does not apply at this point, but future cycles will include the authors practice, 3) it involved collaboration with the aviation industry, 4) it is a dynamic process in that several cycles of development are involved, 5) it is based on using feedback/collaboration to derive a new plan of action and 6) the research findings were shared with industry. The data was collected by using an online questionnaire at the initial stage and this was followed up using targeted interviews. Finally, the data was analysed and reviewed with a critical colleague to validate the results. Two action research cycles were accomplished, the first in developing the initial training program and the second cycle on the first two developed modules to validate the approach and further refine the training program after feedback from industry. Additional cycles will be needed in future, to complete the second cycle on the remaining modules and again later, to incorporate learning from after when industry goes through the process of developing and running a full or partial blended course and from the author running instructors training courses.

Methodology: Questionnaire & Interview Design

The research was targeted at the aircraft maintenance training industry which can generally be divided in two ways; first by the type of training they provide, either “*Basic*” or “*Type*” training and secondly by the type of training organisation. Basic training is a 2-year full time course in basic aeronautical theory and practical knowledge and skills. Type training consists of approximately 7-weeks of aircraft type specific training. The second main category would be the type of organisation providing the training, they could be either academic organisations such as universities or industry organisations. These are usually set up by the larger maintenance organisations or airlines varying down in size to a small independent training organisations set up to meet the needs of industry. Many instructors are only part-time instructors released from their main job to provide training on an, as needed basis, others are full time lecturers. This results in many and varied complexities to getting a consensus on what would best meet the requirements for instruction for new online instructors. Early questions in the survey were used to identify which categories were applicable to the respondents to enable identifying any variations between the categories. Also included was a consent agreement from the respondents, some profile questions to identify any variations that might exist due to the educational training level, the experience, exposure to computers and web based education of instructors. These questions were asked to give some context for any divergence in responses.

Following the action research methodology detailed in Research Process design section of the paper, the first step was to accomplish the literature review to identify best practice and appropriate topics for inclusion in the syllabus. These are detailed in appendix A and formed the bases of the questionnaire to get industry feedback on the issue. The questionnaires were targeted primarily, at training managers and instructors in both the aviation training industry (maintenance organisations/airlines) and in academic organisations (3rd level institutions accomplishing aviation training). These people were selected as the most likely to be involved in the introduction of online instruction in the applicable organisations. The survey was run anonymously to enable a more honest response by hosting the questionnaire on SurveyMonkey, this minimised potential influence between the author's role as regulator and the respondents. People were contacted by e-mail with a link to the questionnaire and a request to forward it to anybody in their organisation they felt would be informed on the subject. The data was saved on an encrypted network as the combined views of industry with no personal information. This was held for the period of the research after which it was deleted. The Dublin Institute of Technology (DIT) research ethics/assessment of risk form was submitted to the DIT Research Ethics Committee and agreement to proceed was received from the course director, as there were no issues to be addressed.

The main sections of the questionnaires were aimed at identifying topics that should be included in the training, by drawing on the knowledge and experience in the industry and on how well it meets their needs, how it can be improved or indeed how it might be transferred to their current practice. The questionnaires had both open and closed questions, the closed questions were to get an opinion using a Likert scale as to whether a topic was considered beneficial and relevant or not. They were drawn from the recommendations from the literature review and the applicable aviation regulations and guidance e.g. "*Should the training include definition of what is meant by blended learning? (Strongly agree/Partially agree/Don't know/Partially disagree/Strongly disagree)*". Open questions were used to qualify reasons for inclusion/exclusion of a topic and to be informed of any other topics that might be considered. E.g. "*Are there any other learning theories that you think might be appropriate to include?*"

If the respondent was willing to give an interview they could volunteer contact details separately for a follow up interview. As a regulatory inspector to the industry there is an issue around power and influence affecting their responses. From the author's history with the managers in these organisations they are open to listening and do not have a problem voicing a dissenting opinion. This and the fact that no organisation has applied for, or have a plan to adopt e-learning to date, means it should not have a direct impact on them and there is no reason that they should not be able to participate fully.

Purposeful sampling is defined by Creswell (2002) as "*a qualitative sampling approach in which, the researcher intentionally selects individuals or sites to learn from*". In this case, the selection of five participants for follow up interviews were chosen, firstly from those who volunteered for follow up interviews and then based on having a spread of organisations, roles and those who had differing views from the majority of responses. This was to gain a greater understanding of the perceived issues. Notes from the interviews were transcribed and the data was analysed using the Creswell's (2002) model of the coding process in qualitative research.

Finally, the results from the literature review, the questionnaires and the findings from the interviews were cross-checked and then reviewed as a veracity check with an independent colleague to finalise the learning objectives for the training program.

Methodology: Project Design

The ADDIE five step process was used to design the training program to provide guidance to aircraft maintenance instructors new to the online or blended learning environment. Based on the outcome of the questionnaire results, an initial draft of the lessons became possible. This combined with the research led to an initial set of learning objectives being developed as part of the Analysis stage and are listed below

1. List the benefits and limitations of E-learning and how to apply them to current practices
2. Understand the new terminology introduced in NPA 2014-22
 - a. Describe what is meant by Instructor and student-centred learning
 - b. Explain the key features of Constructivism and its historical context
 - c. Explain applicable learning theories to a blended learning environment
 - d. Describe the function and uses of a Learning Management System
3. Summarise the requirements of the NPA 2014-22 and how it applies to their practice
4. Understand applicable learning theories
 - a. Explain Cognitive load theory
 - b. Explain Andrology v Pedagogy
 - c. Explain Kolb's learning cycle
 - d. Explain Fleming's learning styles VARK model
 - e. Explain the key features of Behaviourism
 - f. Explain motivation theory and how it applies in the learning environment
5. Understand the general principles of instructional design
 - a. Explain Gagne's nine events of instruction
 - b. Explain the ADDIE instructional design process
 - c. Explain the use of Formative and Summative assessments
6. Understand the competencies required for tele-tutoring students
 - a. Explain Salmon's 5 stage model of E-Learning
 - b. List the competences required for e-learning instructors and describe how they might be applied
 - c. Describe and evaluate various E-activities for use
7. Understand the theory behind how to use the NPA 2014-22 assessment tool and evaluate an application using the tool.

Several limitations applied to this program, primarily a lack of educational software as the development was restricted to software which was available within the developer's workplace network. The resources to develop the complete program in the time scale available and the preferred method of making it a blended course to demonstrate best practices in this field were not available. Based on this, it was determined that it was technically feasible to produce video-based tutorials developed on PowerPoint using the learning objectives identified from the research arranged into the following course modules

1. Course introduction
2. The benefits and limitations of E-learning
3. Overview of the NPA 2014-22 requirements
4. Learning Theories
5. General principles of Instructional Design
6. Competencies required for tele-tutoring students
7. Evaluation of E-Learning application using the NPA assessment tool

To aid the production of content, two personas were developed covering the most likely range of people to need the training. i.e. from a person new to instruction with the minimum subject knowledge and experience through to a person with vast subject knowledge and both significant instruction and technical experience but both having limited IT experience. This helped to ensure that the design of the training was appropriate for all targeted students. See Figure 2 below.

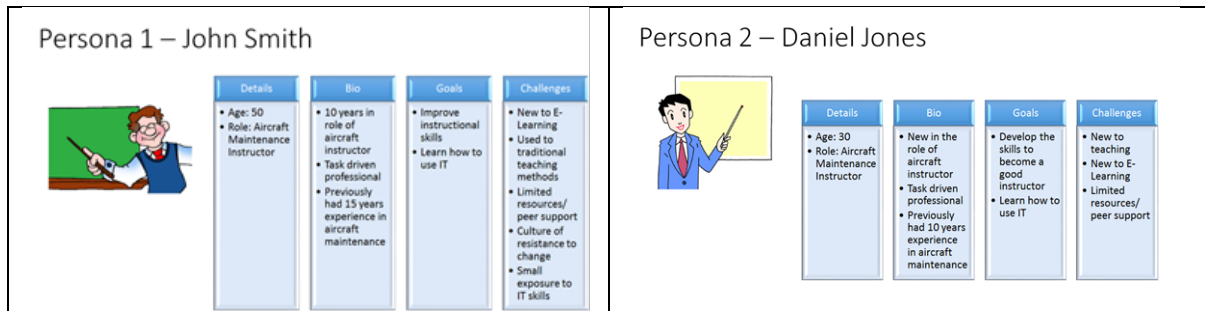


Figure 2 – Persona’s for new E-Learning instructors

Storyboards were then developed for each lesson and to plan the overall appearance, theme and structure. This approach allowed a quick and easy development of a framework of the course and a visualisation of the individual lessons. This approach would be even more critical in a group development so that everyone can track changes and the progress of the design. The lessons included text and graphic based content and video based narration to cater for students different learning styles as illustrated in Figure 3.

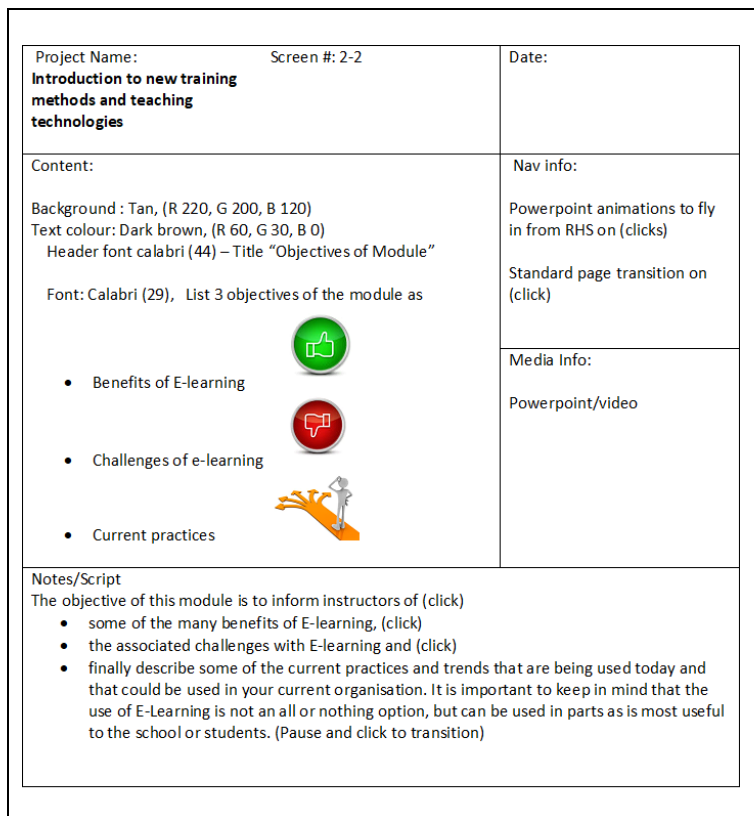


Figure 3 – Sample Storyboard for the benefits of E-Learning

Implementation: Project Development

The development phase of the ADDIE process addresses what software was chosen and how it was built. PowerPoint was selected to create the artefact content presentations, as it is widely available and useable on the network. During the development, it was upgraded to PowerPoint-Mix as this contained additional features, which allowed the inclusion of MCQ's in the presentation and the option to export to video and SCORM formats. After the Wannacry virus attack, a clampdown by the network administrator blocked the MCQ's and SCORM features, which deleted the MCQ's being used for formative assessments and prevented the SCORM export format. At this point production of content reverted to the original use of PowerPoint. A screen caster program Screencastomatic was used to generate a video from the power point animations while narrating the content.

For hosting the lessons in an online format, several options were reviewed. The use of an LMS was preferable to demonstrate its use as part of the course, as recommended by Smith (2005). Moodle was initially the preferred option as it was freely available and is in use or known in the target industry. Unfortunately to use it, you need to download and set up your own hosting of the application which was blocked on the company network. Fortunately, a cloud version became available during the development, which made this selection possible. Moodle allowed the inclusion of MCQ quizzes as an activity to elicit performance and allow feedback on the learning for each module. Forums were also included through the training program. These followed the first three stages of Salmon's (2004) five stage model. Starting with ensuring access and usability by the student and welcoming and encouragement from the tutor, moving on to introducing online socialization and communication between students and tutor, to information exchange. Specific forums targeting the final stages of the model including knowledge construction and development were not included in the training due to the short nature of the course but may develop during a forum and the tutor should be able to recognise and facilitate its development.

Summary Findings: Questionnaire and Interviews

In reviewing the responses from industry on their views as to what should be included in the training syllabus for new online instructors, the questionnaires were completed by 14 people from several organisations. This took longer than expected as a time limit in the questionnaire was not specified for responses. A lower than expected response rate from those targeted required additional respondents to be sought. There were no responses from any of the organisations accomplishing aircraft type training only, this was a significant limitation as it excludes an entire category of organisations. Follow up queries as to reasons for this were down to these organisations being much smaller and they either lacked the resources, the expertise or the interest in developing a blended/online training program, particularly when they were dealing with a low volume courses. Responses from the questionnaire indicated a spread of roughly 2:1 of instructors to training managers and again a 2:1 spread of colleges to industry training organisations. Over 90% of respondents had more than 3 years aviation instruction experience, all had previous exposure to some level of online/blended learning and all considered themselves average or above average in knowledge and usage of computers. Educational or instructional techniques training was split evenly between having a level 6 train the trainer (or equivalent) qualification and having a level 7 or higher qualification. With regard to the views on topics to be included in the syllabus, roughly 75% of those expressing an opinion, either strongly agreed or partially agreed with the topics proposed from the literature

review. This left a small group that ranged from two to four respondents that either strongly or partially disagreed with most of the topics. Also of note, were those not expressing an opinion, by selecting “*don’t know*” or leaving a question blank. This ranged between 6% and 40% for various questions with these heavily loaded towards the learning theory topics.

The main findings from the five follow up interviews, to gain a greater understanding on the responses from the questionnaire indicated that of those not expressing an opinion, this was because they were not aware or familiar with the learning theory or instructional design topic being queried. This correlated with those respondents which only had the Train the Trainer qualification. Those that responded that they partially agreed with topics, explained that they conditionally agreed with the topic provided it “*wasn’t excessively detailed and should be directly applicable to the role of the instructors*” or the “*topic is already covered with in-house training and we don’t want excessive repetition*”. Of those partially or strongly disagreeing with including the suggested topics, when added together they represented organisations accounting for a significant proportion of the basic training currently being accomplished. They also came from across the range of roles and qualifications, although other respondents from the same organisations held opposing opinions. These views were grounded on a reluctance to accept that new online and blended training methods would provide the same quality of learning for the students “*you can’t allow for all the variables, we have foreign students with a wide variation in their understanding of English*”, this view was based on their knowledge and experience of typical students on these courses and will be elaborated on in the second and third sections of the results/discussion section.

Results/Discussion

Several themes of note emerged from the research. Firstly, from the literature review much of the published articles found relating to online and blended learning would appear to be very university focused, where the objectives of the learning were a little more general or varied in scope and have an emphasis on addressing issues of instruction higher up Blooms taxonomy. This particularly applies, for example, in assignments where there is scope to choose a project, design, create an artefact and reflect on it, as evidence of the learning and this then forms part of the formative assessment. Today using computer software and learning applications can be a large part of this, as applying learning about computers is an acceptable objective in most courses. Within the aviation industry, this flexibility is not available as the assessment method is specifically defined as series of mandated MCQ exams. All of these are in a specified format that apply to a focused syllabus; these do not include the ability to use computers. In comparison, industry is not particularly interested in learning objectives that are not mandated or required and similarly students will not be interested in assignments that are not part of the assessment. This difference is illustrated more definitively in the practical training portion of the training already, where the practical assignments and assessments are not specified in the regulation and colleges tend to use a design and create task for these assessments. In comparison industry will generally have an industry specific task to be accomplished i.e. follow the designated manual instructions to complete a specified task. Bonk *et al.* (2006) elaborates on the future directions of blended learning, identifying a difference in the priorities of where education and industry felt their future course in blended learning were headed. Educational organisations are leaning towards reusable content objects and peer-to-peer collaboration tools. For industry the priorities were identifying knowledge management tools and online simulation tools. The difference in approach or outlook between these types of organisations will lead to non-standardisation of the training unless more guidance is given.

The second prominent theme came from the results of the questionnaires which indicated a reluctance of a proportion of the sampled industry to embrace the new methods being allowed by the change in regulation. Primarily they felt that the students learning would suffer for a variety of reasons. They cite various examples of when electronic devices were used in class. These included that the students were not paying attention and were communicating with other students, people external to the class or on social media during classes. *“We had to ban the use of electronic devices in the morning to reduce their distraction on students”* was the comment from one instructor. Based on this experience, they felt students would not be able to maintain sufficient motivation when remote from the classroom environment. Experiences with foreign students has also added complexity in instruction with regard to language skills and general supports. Both the physical and cultural relocation of the students to a blended learning system would result in greater isolation, reduced motivation and increased difficulties with learning. These opinions reflect the findings of Lim, Morris & Kupritz, (2014), who also found in addition to these factors, that students experience a reduced sense of belonging or community with other learners and very importantly for providers of training, a reduced satisfaction with the course instruction. This last aspect would be critical to the success of a commercial training organisation in recruiting and retaining future students. Secondary reasons for reluctance were based around training needs for instructors, *“instructors will need extensive exposure as both trainee and tutor”*, *“instructors will need training on LMS platforms and e-learning tools”* and implementation issues *“we have poor and intermittent internet access in rural areas”*.

When probed further, the reluctance to online and blended learning methods appeared to be at least partially founded on the misconception that it was a choice of all of one or all of the other and they were envisioning the worst-case situations. When presented with the option of being able to selectively choose and integrate items that they felt would help students in an incremental manner, were these changes could be assessed for being beneficial, then the resistance to the concept reduced. The NPA as written, can be interpreted that one or the other option applies but this is not explicitly stated and a more pragmatic approach as proposed by Ko & Rossen (2010), is to transfer currently approved existing courses, to an online environment in stages and trail them as you go.

The final major theme from the interviews was from the training managers, who indicated a preference for the training on instruction techniques for online and blended learning instructors to be face to face in a class environment. This should be done, at least initially as they felt there was a lot of new material for them to absorb and how it would apply to them regarding the regulation. This would allow the opportunity for more discussion with their peers and the instructor, around the topics and would permit them to target and maximise aspects that they would hope to get the most from out of the training. Once the content for this course became established, a shift to an online environment was acknowledged, as possible alternate method. This reflects a risk adverse approach common to personnel in the aviation industry in that they wished to establish a base line in an establish or traditional format first and then test it in the new format for acceptance. Such a workshop would be very beneficial to developing the training program, as it would identify practical concerns and issues from the students in a live environment and further areas for improvement. It is envisioned, that this will be done as a future cycle of the development of the training. Additional suggestions around setting up a *“learning community, peer support/advice”* around the topic would appear to have merit although issues around the proprietary nature of what companies were doing became an issue very quickly as did, who would resource supporting the community quashed the idea.

At this time industry are not using or developing blended learning programs, which limits the quality of the industry feedback as only limited numbers of respondents have experience with the development and introduction of blended learning programs of which none of the training programs were related to this field, but as this changes, it is planned to incorporate lessons learned from these organisations into the instructor training. The research into the introduction of an LMS system is currently underway in one organisation and even though it is planned to be used purely as a management and communication tool, to manage students and classes, as familiarity with its functions builds so too will the case to introduce blended learning opportunities.

Conclusion and Recommendations

This research project aimed to identify an effective curriculum for aircraft maintenance instructors new to online and blended learning. This was accomplished by conducting a review of the literature to date and by involving the training industry in the process, thereby harnessing their experience and knowledge in the field to improve the quality of the outcomes, and hopefully develop a greater acceptance of the results. This research has resulted in a broad agreement by industry on the topics to be included in the syllabus and very importantly, it has increased the awareness and understanding by industry of the changes being introduced by NPA 2014-22 and issues around how they might apply to them. It has also alerted industry to some of the potential opportunities that are now available.

There are a number of recommendations from this research, firstly that a joint workshop format for the initial training should be considered for organisations setting up a blended learning program, this differs from this online training, as there were insufficient resources available to produce it. This workshop should include all those involved in the training program, not just the instructors as required by the regulation, but also the designers, training managers, software developers and administrators. This approach is recommended by Salmon (2013), when elaborating on instructor training for the development of E-activities. The workshop format was also requested by several respondents and reflected an awareness of the lack of knowledge around the subject in the industry generally and particularly over the uncertainty around the how the regulation might be interpreted. Inclusion of the regulator in the workshop may be of mutual benefit in ensuring a shared understanding of the thinking behind the introduction and development of the blended learning in the organisation and how the regulation would apply to them, but due to the conflicting roles this may be counter-productive and would need to be on a voluntary basis.

The regulation itself, is drafted at a high level and is not very specific in the details. The logic behind this was to ensure that the maximum flexibility would apply, so that future technology and teaching methods, would not be excluded and to reduce the need for revisions to the regulation in the future. As the regulations are interpreted by multiple authorities within the EU, for the organisations within each authority's jurisdiction, the lack of clarity will inevitably lead to an uneven playing field for organisations. Additional details or guidance should be included in the regulation by the drafting agency, and/or suggested examples should be published, to improve clarity on the regulation.

The current instructor training standard for aviation maintenance training is a generic train the trainer course with no details on what this should include and it is up to the organisation to decide if it is sufficient for their needs. From the results of the questionnaires, it is apparent that there are some gaps in the knowledge of learning theories and instructional

design between instructors and/or training managers across the industry. A more detailed syllabus in the regulation for traditional instructors would ensure a more consistent standard of instructor training.

It was noted earlier in the paper, that during the research that there is a different perspective in interpreting learning objectives and how they are taught, between third level institutions and industrial/vocational training organisations. Further research into which approach is more beneficial would be advantageous to improving outcomes for students.

The current syllabus for people entering the aircraft maintenance industry was founded on the vocational needs of industry and international agreement in the 1950's. This has remained relatively constant in its general outline, and being at a high level, it has allowed for the technical content within the syllabus to be updated more frequently at a state level. These changes are still legislatively driven and are notoriously slow. For example, given that nitrogen generation systems (NGS) were developed, approved and being retrofitted to live aircraft over seven years ago, an amendment to the syllabus to include this sub-topic to be added to an already accepted main topic, is still in the draft stage. Further study into the future training needs of people entering the industry, as well as the gaps in the skills and knowledge of older already qualified technicians is needed, particularly for topics such as information, communication technologies (ICT) literacy skills that are not currently included. Lappas & Kourousis, (2016) asserts that there is increasingly an assumption that incoming students are “*digital natives*” (Prensky, 2001), which may not always be the case and aircraft systems are continually using more computer applications directly linked into the aircraft itself, leaving a widening gap in the knowledge and skills of the older generation of technicians and potentially a deficit in new ones.

This research is an on-going process that will continue to evolve as new technology becomes available and as the knowledge and experience of the introduction and running of blended learning courses in the industry increases. I would like to thank industry for their constructive support and participation in the research, it has aided the understanding of the industries perspective and hope it was of benefit to them.

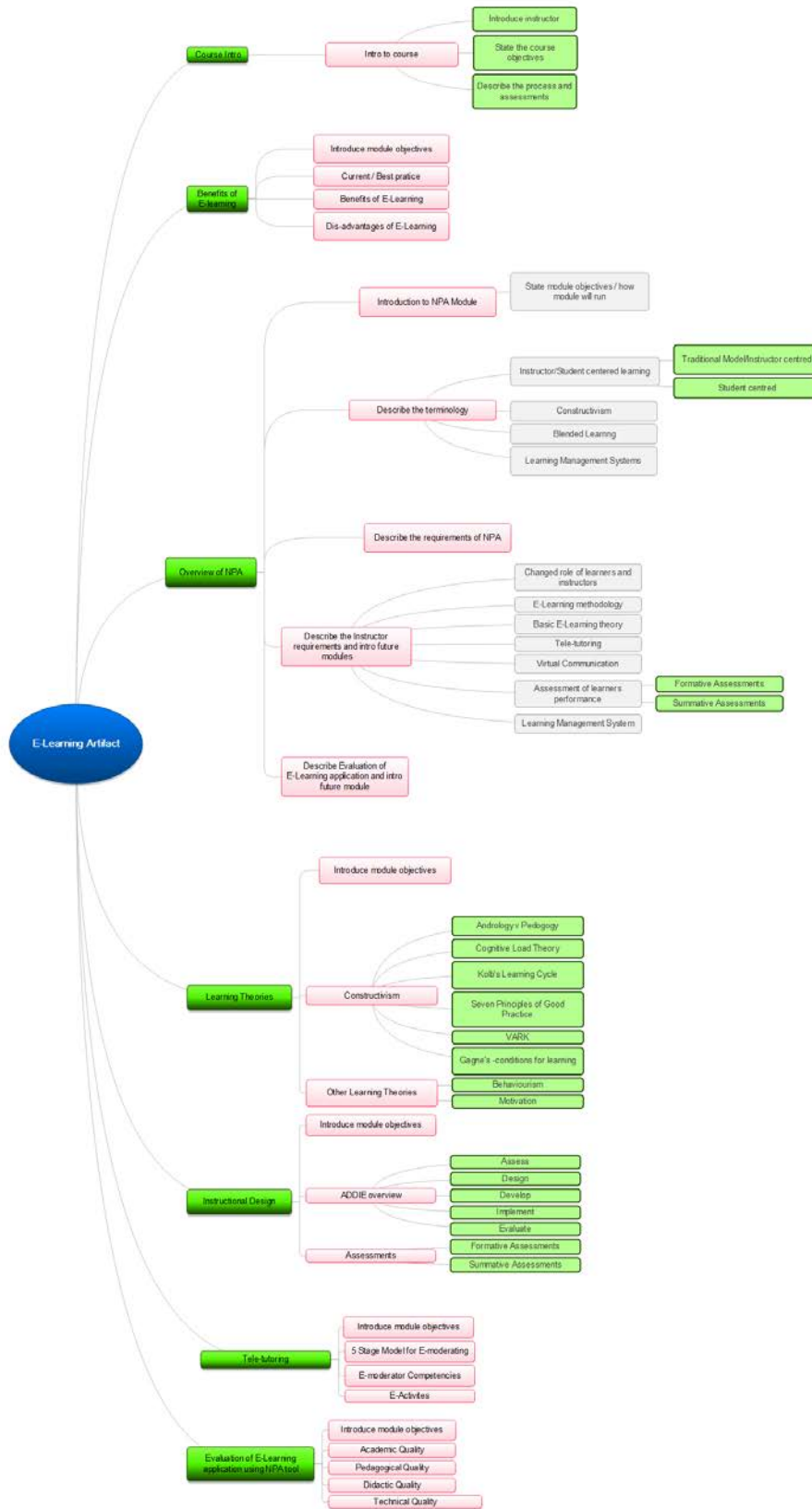
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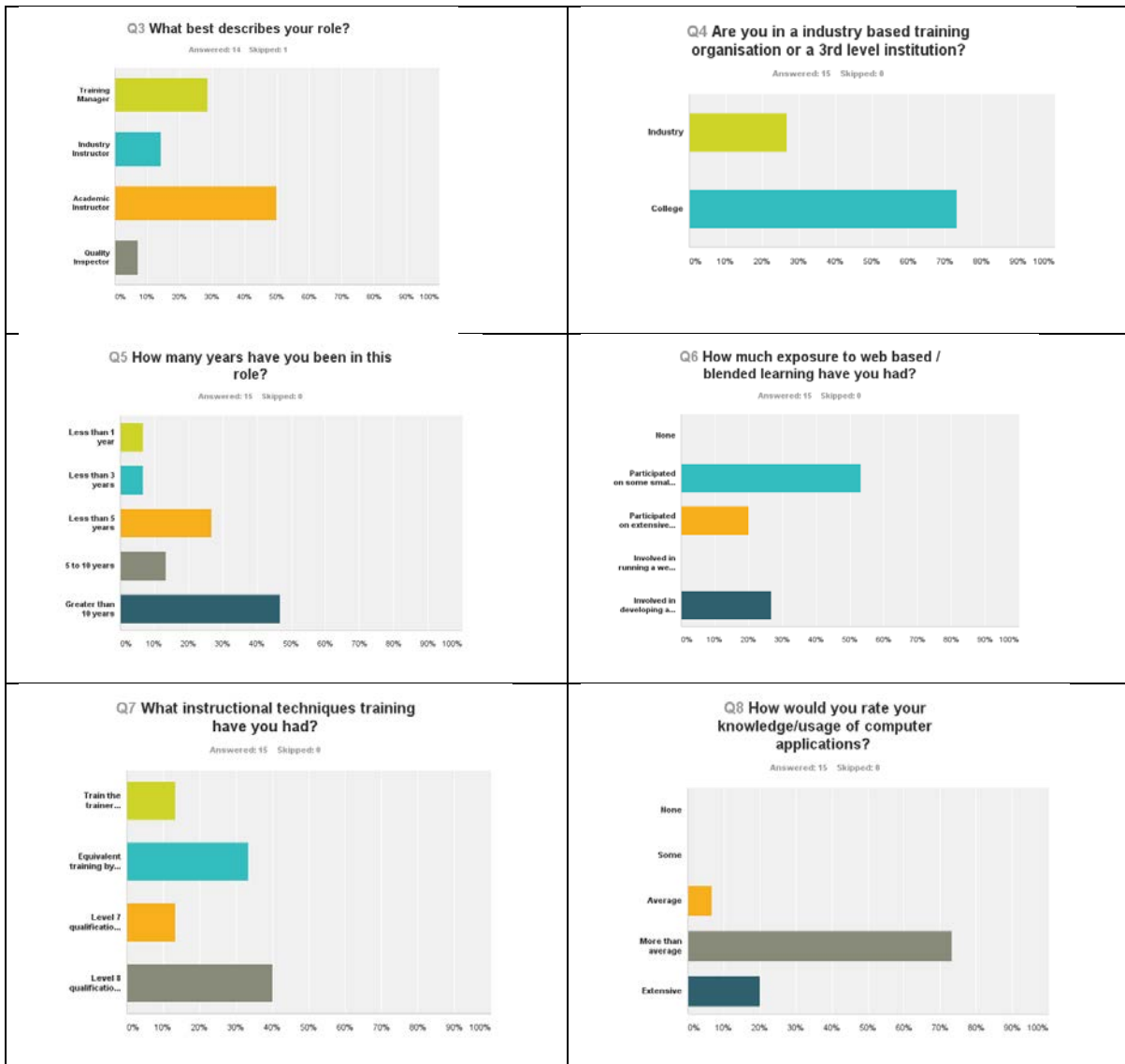
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Appendix A Overview of proposed syllabus



Appendix B Results from Survey

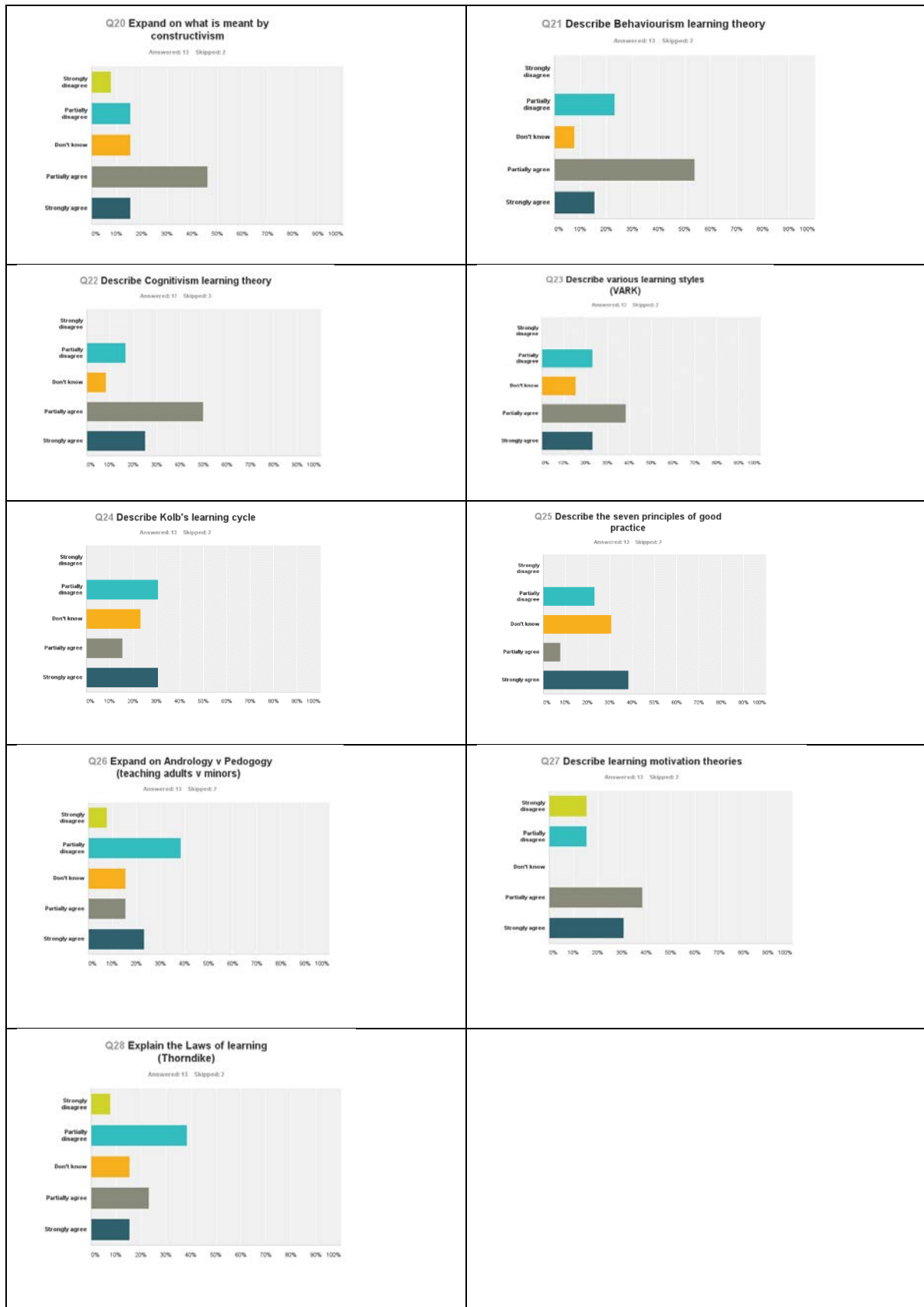
Profile of Respondents



General Topics to be included

<p>Q9 Should a general overview of the requirements of the NPA (Notice of Proposed Amendment) on new methods of instruction be included?</p> <p>Answered: 8 Skipped: 8</p>  <table border="1"> <thead> <tr> <th>Response</th> <th>Percentage</th> </tr> </thead> <tbody> <tr> <td>Strongly disagree</td> <td>0%</td> </tr> <tr> <td>Partially disagree</td> <td>12.5%</td> </tr> <tr> <td>Don't know</td> <td>0%</td> </tr> <tr> <td>Partially agree</td> <td>12.5%</td> </tr> <tr> <td>Strongly agree</td> <td>75%</td> </tr> </tbody> </table>	Response	Percentage	Strongly disagree	0%	Partially disagree	12.5%	Don't know	0%	Partially agree	12.5%	Strongly agree	75%	<p>Q10 Define and expand on Instructor centred and student centred methods</p> <p>Answered: 11 Skipped: 9</p>  <table border="1"> <thead> <tr> <th>Response</th> <th>Percentage</th> </tr> </thead> <tbody> <tr> <td>Strongly disagree</td> <td>18.2%</td> </tr> <tr> <td>Partially disagree</td> <td>9.1%</td> </tr> <tr> <td>Don't know</td> <td>0%</td> </tr> <tr> <td>Partially agree</td> <td>45.5%</td> </tr> <tr> <td>Strongly agree</td> <td>27.3%</td> </tr> </tbody> </table>	Response	Percentage	Strongly disagree	18.2%	Partially disagree	9.1%	Don't know	0%	Partially agree	45.5%	Strongly agree	27.3%
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<p>Q11 Define and expand on what is meant by blended training</p> <p>Answered: 15 Skipped: 9</p>  <table border="1"> <thead> <tr> <th>Response</th> <th>Percentage</th> </tr> </thead> <tbody> <tr> <td>Strongly disagree</td> <td>6.7%</td> </tr> <tr> <td>Partially disagree</td> <td>13.3%</td> </tr> <tr> <td>Don't know</td> <td>0%</td> </tr> <tr> <td>Partially agree</td> <td>20%</td> </tr> <tr> <td>Strongly agree</td> <td>50%</td> </tr> </tbody> </table>	Response	Percentage	Strongly disagree	6.7%	Partially disagree	13.3%	Don't know	0%	Partially agree	20%	Strongly agree	50%	<p>Q12 Describe what changes are needed to the TNA for a switch to a blended learning model</p> <p>Answered: 19 Skipped: 9</p>  <table border="1"> <thead> <tr> <th>Response</th> <th>Percentage</th> </tr> </thead> <tbody> <tr> <td>Strongly disagree</td> <td>5.3%</td> </tr> <tr> <td>Partially disagree</td> <td>10.5%</td> </tr> <tr> <td>Don't know</td> <td>5.3%</td> </tr> <tr> <td>Partially agree</td> <td>36.8%</td> </tr> <tr> <td>Strongly agree</td> <td>42.1%</td> </tr> </tbody> </table>	Response	Percentage	Strongly disagree	5.3%	Partially disagree	10.5%	Don't know	5.3%	Partially agree	36.8%	Strongly agree	42.1%
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<p>Q13 Include an overview of how to use the NPA evaluation tool</p> <p>Answered: 11 Skipped: 1</p>  <table border="1"> <thead> <tr> <th>Response</th> <th>Percentage</th> </tr> </thead> <tbody> <tr> <td>Strongly disagree</td> <td>9.1%</td> </tr> <tr> <td>Partially disagree</td> <td>9.1%</td> </tr> <tr> <td>Don't know</td> <td>0%</td> </tr> <tr> <td>Partially agree</td> <td>27.3%</td> </tr> <tr> <td>Strongly agree</td> <td>54.6%</td> </tr> </tbody> </table>	Response	Percentage	Strongly disagree	9.1%	Partially disagree	9.1%	Don't know	0%	Partially agree	27.3%	Strongly agree	54.6%	<p>Q15 Would the training benefit from including examples from current practice/best practice and trends in online/blended learning?</p> <p>Answered: 14 Skipped: 1</p>  <table border="1"> <thead> <tr> <th>Response</th> <th>Percentage</th> </tr> </thead> <tbody> <tr> <td>Strongly disagree</td> <td>7.1%</td> </tr> <tr> <td>Partially disagree</td> <td>14.3%</td> </tr> <tr> <td>Don't know</td> <td>0%</td> </tr> <tr> <td>Partially agree</td> <td>35.7%</td> </tr> <tr> <td>Strongly agree</td> <td>43.0%</td> </tr> </tbody> </table>	Response	Percentage	Strongly disagree	7.1%	Partially disagree	14.3%	Don't know	0%	Partially agree	35.7%	Strongly agree	43.0%
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<p>Q18 Describe the purpose and uses of a Learning Management System (LMS)</p> <p>Answered: 14 Skipped: 1</p>  <table border="1"> <thead> <tr> <th>Response</th> <th>Percentage</th> </tr> </thead> <tbody> <tr> <td>Strongly disagree</td> <td>7.1%</td> </tr> <tr> <td>Partially disagree</td> <td>14.3%</td> </tr> <tr> <td>Don't know</td> <td>0%</td> </tr> <tr> <td>Partially agree</td> <td>50%</td> </tr> <tr> <td>Strongly agree</td> <td>28.6%</td> </tr> </tbody> </table>	Response	Percentage	Strongly disagree	7.1%	Partially disagree	14.3%	Don't know	0%	Partially agree	50%	Strongly agree	28.6%													
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Learning Theory Topics to be included



Instructional Design Topics to be included

